SCENE

SCENE 2018 USER

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This is the June 2018 version of the SCENE 2018 User Manual. It applies to the SCENE 2018 software for FARO Laser Scanners and FARO Scanner Freestyle^{3D}.

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TABLE OF CONTENTS

Chapter 1: Introduction	
1.1 System Requirements	12
Chapter 2: Installation and Licensing	
2.1 Installing the Software	14
2.2 SCENE Licensing	
-	
2.3 License Manager	
2.4 Single-User Licenses	
2.4.1 Manual Activation with a Product Key	
2.4.2 Licensing with an USB Dongle	
2.5 Network Licenses (Floating Licenses)	
2.6 Updating Licenses to a New Version of SCENE	20
Chapter 3: Starting up with the Projects Overview	
3.1 Starting SCENE	22
3.1.1 Updates and News	
3.2 Known projects	
3.2.1 Opening scan projects	
3.3 Project Details	
3.4 Status tiles	
3.4.1 Status Tile "Processing"	
3.4.2 Status Tile "Registration"	25
3.4.3 Status Tile "Project Point Cloud"	26
Chapter 4: Navigation 4.1 Introduction	28
4.2 Workflow Bar	
4.3 Tasks and Task Steps	
4.4 Color Coding	
~	
4.5 Navigation Toolbar (3D View only)	
4.5.2 Camera Modes	
4.5.3 View All	
4.5.4 Predefined Views	
4.5.5 Center of Rotation.	37
4.5.6 Last Camera Position	
4.5.7 Align Camera on Point	
4.5.8 Supersampling	38
4.5.9 Gap Filling	38
4.5.10 Clear View	38
4.5.11 Toggle Clipping Boxes	39
4.5.12 Point Sizes	39
4.5.13 Adaptive	39
Chapter 5: Settings	
5.1 Settings Page	40
5.2 Settings Toolbar	
5.2.1 License Manager	40
5.2.2 Switch User Interface	40
5.2.3 Check for Updates	41
5.3 General Settings	42

5.3.5 Temporary Data Folder. 5.3.6 Reset General Settings. 5.3.7 User Interface. 5.3.8 Updates 5.3.9 FARO Customer Experience Improvement Program. 5.4 Import settings 5.4.1 Units 5.4.2 Reset Import settings 5.5 Processing Settings 5.5.1 General. 5.5.2 Filters 5.5.3 Find Targets. 5.5.4 Reset Process Scans Settings 5.6 Registration Settings 5.6.1 Automatic Registration 5.6.2 Manual Registration 5.6.3 Sensors. 5.6.4 Cloud to Cloud Registration Method. 5.6.5 Top View Based Registration Method 5.6.6 Target Based Registration Method 5.6.7 Top View Based Registration Method 5.6.8 Reset Registration Settings 5.7.1 General. 5.7.2 3D View 5.7.3 Reset Views Settings 5.7.4 Background Image for a 3D View: Environment Map. 5.8 Export settings 5.8.1 Units 5.9 SCENE WebShare Cloud settings. 5.9.1 Login Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3 Create Project 6.4.1 Project Transfer 6.4 Project Features when no Scan Project is Opened 6.3.2 Read-Only Projects. 6.3.3 Project Transfer 6.4 Project Features for an Opened Scan Project 6.4.1 Project History 6.5 Project Workspace. 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.3 Project Point Cloud 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces	5.3.1 Language	
5.3.4 Log File 5.3.5 Temporary Data Folder 5.3.6 Reset General Settings 5.3.7 User Interface 5.3.8 Updates 5.3.9 FARO Customer Experience Improvement Program 5.4 Import settings 5.4.1 Units 5.4.2 Reset Import settings 5.5.5 Processing Settings 5.5.5 Processing Settings 5.5.1 General 5.5.2 Filters 5.5.3 Find Targets 5.5.4 Reset Process Scans Settings 5.6 Registration Settings 5.6.1 Automatic Registration 5.6.2 Manual Registration 5.6.3 Sensors 5.6.4 Cloud to Cloud Registration Method 5.6.5 Top View Based Registration Method 5.6.6 Target Based Registration Method 5.6.7 Registration Report 5.6.8 Reset Registration Settings 5.7 Views settings 5.7 Views settings 5.7.1 General 5.7.2 3D View 5.7.3 Reset Views Settings 5.8 Export settings 5.8 Export settings 5.9 SCENE WebShare Cloud settings 5.9 SCENE WebShare Cloud settings 6.3 Project Features when no Scan Project is Opened 6.3 Create Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3 Create Project 6.3.1 Open Project 6.3.1 Open Project 6.4.1 Project History 6.4.2 Wipe Project History 6.5 Project Features for an Opened Scan Project 6.4.1 Project History 6.5 Project Features for an Opened Scan Project 6.4.1 Project History 6.5 Project Features for an Opened Scan Project 6.4.1 Project History 6.5 Project Features for an Opened Scan Project 6.4.1 Project History 6.5 Project Features for an Opened Scan Project 6.4.1 Project History 6.5 Project Features for an Opened Scan Project 6.4.1 Project History 6.5 Project Features for an Opened Scan Project 6.5.1 Scans 6.5.2 Scan Point Cloud 6.5.3 Project Point Cloud 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces		
5.3.5 Temporary Data Folder. 5.3.6 Reset General Settings. 5.3.7 User Interface. 5.3.8 Updates 5.3.9 FARO Customer Experience Improvement Program. 5.4 Import settings 5.4.1 Units 5.4.2 Reset Import settings 5.5 Processing Settings 5.5.1 General. 5.5.2 Filters 5.5.3 Find Targets. 5.5.4 Reset Process Scans Settings 5.6 Registration Settings 5.6.1 Automatic Registration 5.6.2 Manual Registration 5.6.3 Sensors. 5.6.4 Cloud to Cloud Registration Method. 5.6.5 Top View Based Registration Method 5.6.6 Target Based Registration Method 5.6.7 Top View Based Registration Method 5.6.8 Reset Registration Settings 5.7.1 General. 5.7.2 3D View 5.7.3 Reset Views Settings 5.7.4 Background Image for a 3D View: Environment Map. 5.8 Export settings 5.8.1 Units 5.9 SCENE WebShare Cloud settings. 5.9.1 Login Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3 Create Project 6.4.1 Project Transfer 6.4 Project Features when no Scan Project is Opened 6.3.2 Read-Only Projects. 6.3.3 Project Transfer 6.4 Project Features for an Opened Scan Project 6.4.1 Project History 6.5 Project Workspace. 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.3 Project Point Cloud 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces		
5.3.6 Reset General Settings. 5.3.7 User Interface. 5.3.8 Updates 5.3.9 FARO Customer Experience Improvement Program. 5.4 Import settings. 5.4.1 Units. 5.4.2 Reset Import settings. 5.5.5 Processing Settings. 5.5.1 General. 5.5.2 Filters. 5.5.3 Find Targets. 5.5.4 Reset Process Scans Settings. 5.6 Registration Settings. 5.6.1 Automatic Registration. 5.6.2 Manual Registration. 5.6.3 Sensors. 5.6.4 Cloud to Cloud Registration Method. 5.6.5 Top View Based Registration Method. 5.6.6 Target Based Registration Method. 5.6.7 Registration Report. 5.6.8 Reset Registration Settings. 5.7 Views settings. 5.7.1 General. 5.7.2 3D View 5.7.3 Reset Views Settings. 5.8.1 Units. 5.9 SCENE WebShare Cloud settings. 5.9.1 Login. Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened. 6.3 Create Project. 6.3.1 Open Project. 6.3.1 Open Project. 6.3.2 Read-Only Projects. 6.3.3 Project Transfer 6.4 Project Features for an Opened Scan Project 6.4.1 Project History. 6.5 Project Workspace. 6.5.1 Scans. 6.5.2 Scan Point Clouds 6.5.3 Project Point Cloud 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces. 6.7 Local Workspaces.		
5.3.7 User Interface 5.3.8 Updates 5.3.9 FARO Customer Experience Improvement Program 5.4 Import settings 5.4.1 Units 5.4.2 Reset Import settings 5.5.5 Processing Settings 5.5.5 Processing Settings 5.5.1 General 5.5.2 Filters 5.5.3 Find Targets 5.5.4 Reset Process Scans Settings 5.6 Registration Settings 5.6.1 Automatic Registration 5.6.2 Manual Registration 5.6.3 Sensors 5.6.4 Cloud to Cloud Registration Method 5.6.5 Top View Based Registration Method 5.6.6 Target Based Registration Method 5.6.6 Target Based Registration Method 5.6.7 Registration Report 5.8.8 Reset Registration Settings 5.7 Views settings 5.7.1 General 5.7.2 3D View 5.7.3 Reset Views Settings 5.7.4 Background Image for a 3D View: Environment Map 5.8 Export settings 5.8.1 Units 5.9 SCENE WebShare Cloud settings 5.9.1 Login Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3 Create Project 6.3.1 Open Project 6.4.1 Project History 6.5.2 Scan Point Clouds 6.5.3 Project Transfer 6.4 Project Features for an Opened Scan Project 6.4.1 Wipe Project History 6.5.9 Project Workspace 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.3 Project Point Clouds 6.5.3 Project Point Clouds 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces		
5.3.8 Updates 5.3.9 FARO Customer Experience Improvement Program 5.4 Import settings 5.4.1 Units 5.4.2 Reset Import settings 5.5. Processing Settings 5.5.1 General 5.5.2 Filters 5.5.3 Find Targets 5.5.4 Reset Process Scans Settings 5.6 Registration Settings 5.6.1 Automatic Registration 5.6.2 Manual Registration 5.6.3 Sensors 5.6.4 Cloud to Cloud Registration Method 5.6.5 Top View Based Registration Method 5.6.6 Target Based Registration Method 5.6.6 Registration Report 5.6.8 Reset Registration Settings 5.7 Views settings 5.7.1 General 5.7.2 3D View 5.7.3 Reset Views Settings 5.7.4 Background Image for a 3D View: Environment Map 5.8 Export settings 5.8.1 Units 5.9 SCENE WebShare Cloud settings 5.9.1 Login Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3.1 Open Project 6.3.1 Open Project 6.4.1 Project Fransfer 6.4 Project Features for an Opened Scan Project 6.4.1 Project History 6.5.2 Scan Point Clouds 6.5.3 Project Workspace 6.5.1 Scans 6.5.2 Scan Point Cloud 6.5.3 Project Point Cloud 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces	5.3.6 Reset General Settings	44
5.3.9 FARO Customer Experience Improvement Program 5.4 Import settings 5.4.1 Units 5.4.2 Reset Import settings 5.5 Processing Settings 5.5.5 Processing Settings 5.5.1 General 5.5.2 Fitters 5.5.3 Find Targets 5.5.4 Reset Process Scans Settings 5.6 Registration Settings 5.6.1 Automatic Registration 5.6.2 Manual Registration 5.6.3 Sensors 5.6.4 Cloud to Cloud Registration Method 5.6.5 Top View Based Registration Method 5.6.6 Target Based Registration Method 5.6.7 Target Based Registration Method 5.6.7 Target Based Registration Settings 5.7 Views settings 5.7 Views settings 5.7.1 General 5.7.2 3D View 5.7.3 Reset Views Settings 5.7.4 Background Image for a 3D View: Environment Map 5.8 Export settings 5.8.1 Units 5.9 SCENE WebShare Cloud settings 5.9.1 Login Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3 Create Project 6.3.1 Open Project. 6.3.2 Read-Only Projects. 6.3.3 Project Transfer 6.4 Project Features for an Opened Scan Project 6.4.1 Project History 6.4.2 Wipe Project History 6.5.2 Scan Point Clouds 6.5.3 Project Workspace 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.3 Project Point Cloud 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces		
5.4.1 Units 5.4.2 Reset Import settings 5.5.4 Processing Settings 5.5.1 General 5.5.2 Fitters 5.5.3 Find Targets 5.5.4 Reset Process Scans Settings 5.6 Registration Settings 5.6.1 Automatic Registration 5.6.2 Manual Registration 5.6.3 Sensors 5.6.4 Cloud to Cloud Registration Method 5.6.5 Top View Based Registration Method 5.6.6 Target Based Registration Method 5.6.7 Registration Report 5.6.8 Reset Registration Settings 5.7 Views settings 5.7.1 General 5.7.2 3D View 5.7.3 Reset Views Settings 5.7.4 Background Image for a 3D View: Environment Map 5.8 Export settings 5.8.1 Units 5.9 SCENE WebShare Cloud settings 5.9.1 Login Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3 Create Project 6.3.1 Open Project. 6.3.2 Read-Only Projects. 6.3.3 Project Transfer 6.4 Project Features for an Opened Scan Project 6.5 Project History 6.4.2 Wipe Project History 6.5.4 SCENE WebShare Cloud Data 6.5.7 Scene Workspaces 6.7 Local Workspaces		
5.4.1 Units 5.4.2 Reset Import settings 5.5 Processing Settings 5.5.1 General. 5.5.2 Filters 5.5.3 Find Targets 5.5.4 Reset Process Scans Settings 5.6 Registration Settings 5.6.1 Automatic Registration 5.6.2 Manual Registration 5.6.3 Sensors. 5.6.4 Cloud to Cloud Registration Method 5.6.5 Top View Based Registration Method 5.6.6 Target Based Registration Method 5.6.7 Registration Report. 5.6.8 Reset Registration Settings 5.7 Views settings 5.7.1 General. 5.7.2 3D View 5.7.3 Reset Views Settings 5.7.4 Background Image for a 3D View: Environment Map. 5.8 Export settings 5.8.1 Units 5.9 SCENE WebShare Cloud settings 5.9.1 Login Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3 Create Project 6.3.1 Open Project 6.4.1 Project Fransfer 6.4 Project Features for an Opened Scan Project 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.3 Project History 6.4.2 Wipe Project History 6.5.5 Project Workspace 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.3 Project Point Cloud 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces	·	44
5.4.2 Reset Import settings 5.5 Processing Settings 5.5.1 General 5.5.2 Filters 5.5.3 Find Targets 5.5.4 Reset Process Scans Settings 5.6 Registration Settings 5.6.1 Automatic Registration 5.6.2 Manual Registration 5.6.3 Sensors. 5.6.4 Cloud to Cloud Registration Method 5.6.5 Top View Based Registration Method 5.6.6 Target Based Registration Method 5.6.7 Registration Report 5.6.8 Reset Registration Settings 5.7 Views settings 5.7.1 General 5.7.2 3D View 5.7.3 Reset Views Settings 5.7.4 Background Image for a 3D View: Environment Map. 5.8 Export settings 5.8.1 Units 5.9 SCENE WebShare Cloud settings 5.9.1 Login Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3 Create Project 6.3.1 Open Project 6.3.1 Open Project 6.3.2 Read-Only Projects. 6.3.3 Project Transfer 6.4 Project Features for an Opened Scan Project 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.3 Project Workspace. 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.3 Project Point Cloud 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces		
5.5 Processing Settings 5.5.1 General 5.5.2 Filters 5.5.3 Find Targets 5.5.4 Reset Process Scans Settings 5.6 Registration Settings 5.6.1 Automatic Registration 5.6.2 Manual Registration 5.6.3 Sensors 5.6.4 Cloud to Cloud Registration Method 5.6.5 Top View Based Registration Method 5.6.6 Target Based Registration Method 5.6.7 Registration Report 5.6.8 Reset Registration Settings 5.7 Views settings 5.7.1 General 5.7.2 3D View 5.7.3 Reset Views Settings 5.7.4 Background Image for a 3D View: Environment Map 5.8 Export settings 5.9 SCENE WebShare Cloud settings 5.9.1 Login Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3 Create Project 6.4.1 Project Transfer 6.4 Project Features for an Opened Scan Project 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.3 Project Point Clouds 6.5.3 Project Point Cloud 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces		
5.5.1 General 5.5.2 Filters 5.5.3 Find Targets 5.5.3 Find Targets 5.5.4 Reset Process Scans Settings 5.6 Registration Settings 5.6.1 Automatic Registration 5.6.2 Manual Registration 5.6.3 Sensors. 5.6.4 Cloud to Cloud Registration Method 5.6.5 Top View Based Registration Method 5.6.6 Target Based Registration Method 5.6.7 Registration Report. 5.6.8 Reset Registration Settings 5.7 Views settings 5.7.1 General 5.7.2 3D View 5.7.3 Reset Views Settings 5.7.4 Background Image for a 3D View: Environment Map. 5.8 Export settings 5.8.1 Units 5.9 SCENE WebShare Cloud settings. 5.9.1 Login. Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3 Create Project 6.3.1 Open Project 6.3.2 Read-Only Projects. 6.3.3 Project Transfer 6.4 Project Features for an Opened Scan Project 6.4.1 Project History 6.4.2 Wipe Project History 6.5 Project Workspace 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.3 Project Point Cloud 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces	5.4.2 Reset Import settings	45
5.5.2 Filters 5.5.3 Find Targets 5.5.4 Reset Process Scans Settings 5.6 Registration Settings 5.6.1 Automatic Registration 5.6.2 Manual Registration 5.6.3 Sensors 5.6.4 Cloud to Cloud Registration Method 5.6.5 Top View Based Registration Method 5.6.6 Target Based Registration Method 5.6.7 Registration Report 5.6.8 Reset Registration Settings 5.7 Views settings 5.7 Views settings 5.7.1 General 5.7.2 3D View 5.7.3 Reset Views Settings 5.7.4 Background Image for a 3D View: Environment Map 5.8 Export settings 5.8.1 Units 5.9 SCENE WebShare Cloud settings 5.9.1 Login Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3.1 Open Project 6.3.1 Open Project 6.3.2 Read-Only Projects 6.3.3 Project Transfer 6.4 Project Features for an Opened Scan Project 6.4.1 Project History 6.4.2 Wipe Project History 6.5.5 Project Workspace 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.3 Project Point Clouds 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces	5.5 Processing Settings	46
5.5.3 Find Targets 5.5.4 Reset Process Scans Settings 5.6 Registration Settings 5.6.1 Automatic Registration 5.6.2 Manual Registration 5.6.3 Sensors. 5.6.4 Cloud to Cloud Registration Method 5.6.5 Top View Based Registration Method 5.6.6 Target Based Registration Method 5.6.7 Registration Report 5.6.8 Reset Registration Settings 5.7 Views settings 5.7 Views settings 5.7.1 General. 5.7.2 3D View 5.7.3 Reset Views Settings 5.7.4 Background Image for a 3D View: Environment Map. 5.8 Export settings 5.8.1 Units 5.9 SCENE WebShare Cloud settings. 5.9.1 Login. Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3 Create Project 6.3.1 Open Project. 6.3.2 Read-Only Projects. 6.3.3 Project Transfer 6.4 Project Features for an Opened Scan Project 6.4.1 Project History 6.4.2 Wipe Project History 6.5.5 Project Workspace. 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.3 Project Point Clouds 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces	5.5.1 General	47
5.5.4 Reset Process Scans Settings 5.6 Registration Settings 5.6.1 Automatic Registration 5.6.2 Manual Registration 5.6.3 Sensors. 5.6.4 Cloud to Cloud Registration Method 5.6.5 Top View Based Registration Method 5.6.6 Target Based Registration Method 5.6.7 Registration Report. 5.6.8 Reset Registration Settings 5.7 Views settings 5.7.1 General. 5.7.2 3D View 5.7.3 Reset Views Settings 5.7.4 Background Image for a 3D View: Environment Map. 5.8 Export settings. 5.8.1 Units. 5.9 SCENE WebShare Cloud settings. 5.9.1 Login. Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3 Create Project 6.3.1 Open Project. 6.3.2 Read-Only Projects. 6.3.3 Project Transfer 6.4 Project Features for an Opened Scan Project 6.4.1 Project History 6.4.2 Wipe Project History 6.5.5 Project Workspace. 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.3 Project Point Clouds 6.5.4 SCENE WebShares Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces	5.5.2 Filters	
5.6 Registration Settings 5.6.1 Automatic Registration 5.6.2 Manual Registration 5.6.3 Sensors. 5.6.4 Cloud to Cloud Registration Method 5.6.5 Top View Based Registration Method 5.6.6 Target Based Registration Method 5.6.7 Registration Report 5.6.8 Reset Registration Settings 5.7 Views settings 5.7 Views settings 5.7.1 General. 5.7.2 3D View 5.7.3 Reset Views Settings 5.7.4 Background Image for a 3D View: Environment Map. 5.8 Export settings 5.8.1 Units 5.9 SCENE WebShare Cloud settings. 5.9.1 Login. Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3.1 Open Project. 6.3.1 Open Project. 6.3.2 Read-Only Projects. 6.3.3 Project Transfer 6.4 Project Transfer 6.4 Project Features for an Opened Scan Project 6.4.1 Project History 6.5.2 Scan Point Clouds 6.5.3 Project Workspace 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.3 Project Point Cloud 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces		
5.6.1 Automatic Registration 5.6.2 Manual Registration 5.6.3 Sensors. 5.6.4 Cloud to Cloud Registration Method. 5.6.5 Top View Based Registration Method 5.6.6 Target Based Registration Method. 5.6.7 Registration Report. 5.6.8 Reset Registration Settings 5.7 Views settings 5.7.1 General. 5.7.2 3D View 5.7.3 Reset Views Settings 5.7.4 Background Image for a 3D View: Environment Map. 5.8 Export settings 5.8.1 Units 6.9 SCENE WebShare Cloud settings 5.9.1 Login. Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3 Create Project 6.3.1 Open Project 6.4.1 Project History 6.4.2 Wipe Project History 6.5.2 Scan Point Clouds 6.5.3 Project Workspace 6.5.1 Scans 6.5.2 Scan Point Cloud 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces	5.5.4 Reset Process Scans Settings	49
5.6.2 Manual Registration 5.6.3 Sensors 5.6.4 Cloud to Cloud Registration Method 5.6.5 Top View Based Registration Method 5.6.6 Target Based Registration Method 5.6.6 Target Based Registration Method 5.6.7 Registration Report 5.6.8 Reset Registration Settings 5.7 Views settlings 5.7.1 General 5.7.2 3D View 5.7.3 Reset Views Settings 5.7.4 Background Image for a 3D View: Environment Map. 5.8 Export settings 5.8.1 Units 6.5.9 SCENE WebShare Cloud settings 5.9.1 Login 6. Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3 Create Project 6.3.1 Open Project 6.3.2 Read-Only Projects 6.3.2 Read-Only Projects 6.3.3 Project Transfer 6.4 Project Features for an Opened Scan Project 6.4.1 Project History 6.4.2 Wipe Project History 6.5 Project Workspace 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.3 Project Point Cloud 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces 6.7 Local Workspaces	5.6 Registration Settings	49
5.6.3 Sensors. 5.6.4 Cloud to Cloud Registration Method. 5.6.5 Top View Based Registration Method. 5.6.6 Target Based Registration Method. 5.6.7 Registration Report. 5.6.8 Reset Registration Settings. 5.7 Views settings. 5.7.1 General. 5.7.2 3D View 5.7.3 Reset Views Settings. 5.7.4 Background Image for a 3D View: Environment Map. 5.8 Export settings. 5.8.1 Units. 5.9 SCENE WebShare Cloud settings. 5.9.1 Login. Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3 Create Project. 6.3.1 Open Projects. 6.3.2 Read-Only Projects. 6.3.3 Project Transfer 6.4 Project Features for an Opened Scan Project 6.4.1 Project History 6.4.2 Wipe Project History 6.5 Project Workspace. 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.3 Project Point Cloud 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces	5.6.1 Automatic Registration	50
5.6.4 Cloud to Cloud Registration Method 5.6.5 Top View Based Registration Method 5.6.6 Target Based Registration Method 5.6.7 Registration Report 5.6.8 Reset Registration Settings 5.7 Views settings 5.7 Usews settings 5.7.1 General 5.7.2 3D View 5.7.3 Reset Views Settings 5.7.4 Background Image for a 3D View: Environment Map 5.8 Export settings 5.8.1 Units 5.9 SCENE WebShare Cloud settings 5.9.1 Login Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3 Create Project 6.3.1 Open Project 6.3.1 Open Project 6.3.2 Read-Only Projects 6.3.3 Project Transfer 6.4 Project Features for an Opened Scan Project 6.4.1 Project History 6.4.2 Wipe Project History 6.5.5 Project Workspace 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.3 Project Point Cloud 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces	5.6.2 Manual Registration	50
5.6.5 Top View Based Registration Method 5.6.6 Target Based Registration Method 5.6.7 Registration Report. 5.6.8 Reset Registration Settings 5.7 Views settings 5.7.1 General. 5.7.2 3D View 5.7.3 Reset Views Settings 5.7.4 Background Image for a 3D View: Environment Map. 5.8 Export settings 5.8.1 Units 5.9 SCENE WebShare Cloud settings. 5.9.1 Login Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3 Create Project 6.3.1 Open Project 6.3.1 Open Project 6.3.2 Read-Only Projects. 6.3.3 Project Transfer 6.4 Project Features for an Opened Scan Project 6.4.1 Project History 6.4.2 Wipe Project History 6.5 Project Workspace. 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.3 Project Point Cloud 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces		
5.6.6 Target Based Registration Method 5.6.7 Registration Report 5.6.8 Reset Registration Settings 5.7 Views settings 5.7.1 General 5.7.2 3D View 5.7.2 Reset Views Settings 5.7.3 Reset Views Settings 5.7.4 Background Image for a 3D View: Environment Map 5.8 Export settings 5.8.1 Units 6.9 SCENE WebShare Cloud settings 5.9.1 Login 6.0 Chapter 6: Project 6.1 Introduction 6.3 Create Project 6.3 Create Project 6.3.1 Open Project 6.3.2 Read-Only Projects 6.3.2 Read-Only Projects 6.3.3 Project Transfer 6.4 Project Features for an Opened Scan Project 6.4.1 Project History 6.4.2 Wipe Project History 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.2 Scan Point Clouds 6.5.3 Project Point Clouds 6.5.3 Project Point Clouds 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces 6.7 Local Workspaces		
5.6.7 Registration Report. 5.6.8 Reset Registration Settings 5.7 Views settings 5.7.1 General 5.7.2 3D View 5.7.3 Reset Views Settings 5.7.4 Background Image for a 3D View: Environment Map. 6.5.8 Export settings 5.8.1 Units 6.5.8.1 Units 5.9 SCENE WebShare Cloud settings 6.9.1 Login Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3 Create Project 6.3.1 Open Project 6.3.2 Read-Only Projects 6.3.3 Project Transfer 6.4 Project Features for an Opened Scan Project 6.4.1 Project History 6.4.2 Wipe Project History 6.5 Project Workspace 6.5.1 Scans 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.3 Project Point Cloud 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces 6.7 Local Workspaces		
5.6.8 Reset Registration Settings 5.7 Views settings 5.7.1 General 6.5.2 3D View 5.7.3 Reset Views Settings 6.5.1 Views Environment Map 5.7.4 Background Image for a 3D View: Environment Map 6.5.8 Export settings 5.8 Export settings 6.5.9 SCENE WebShare Cloud settings 5.9.1 Login 6.5.9.1 Login Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3 Create Project 6.3.1 Open Project 6.3.2 Read-Only Projects 6.3.2 Read-Only Projects 6.3.3 Project Transfer 6.4 Project Features for an Opened Scan Project 6.4.1 Project History 6.5 Project Workspace 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.2 Scan Point Clouds 6.5.3 Project Point Clouds 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces 6.7 Local Workspaces		
5.7 Views settings 5.7.1 General. 5.7.2 3D View 5.7.3 Reset Views Settings 5.7.4 Background Image for a 3D View: Environment Map. 5.8 Export settings 5.8.1 Units 6.8 SCENE WebShare Cloud settings 5.9.1 Login 6.9.1 Login Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3 Create Project 6.3.1 Open Project 6.3.1 Open Project 6.3.2 Read-Only Projects 6.3.2 Read-Only Projects 6.4 Project Features for an Opened Scan Project 6.4.1 Project History 6.4.2 Wipe Project History 6.4.2 Wipe Project History 6.5 Project Workspace 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.2 Scan Point Clouds 6.5.3 Project Point Cloud 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces 6.7 Local Workspaces		
5.7.1 General. 5.7.2 3D View 5.7.3 Reset Views Settings 5.7.4 Background Image for a 3D View: Environment Map. 5.8 Export settings 6.5.8.1 Units 5.9 SCENE WebShare Cloud settings 6.5.9.1 Login Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3 Create Project 6.3.1 Open Project 6.3.2 Read-Only Projects 6.3.3 Project Transfer 6.4 Project Features for an Opened Scan Project 6.4.1 Project History 6.4.2 Wipe Project History 6.5 Project Workspace 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.2 Scan Point Clouds 6.5.3 Project Point Cloud 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces 6.7 Local Workspaces	5.6.8 Reset Registration Settings	52
5.7.2 3D View 5 5.7.3 Reset Views Settings 5 5.7.4 Background Image for a 3D View: Environment Map 6 5.8 Export settings 6 5.8.1 Units 6 5.9 SCENE WebShare Cloud settings 6 5.9.1 Login 6 Chapter 6: Project 6.1 Introduction 6 6.2 Project Features when no Scan Project is Opened 6 6.3 Create Project 6 6.3.1 Open Project 6 6.3.2 Read-Only Projects 6 6.3.3 Project Transfer 6 6.4 Project Features for an Opened Scan Project 6 6.4.1 Project History 6 6.5 Project Workspace 6 6.5.1 Scans 6 6.5.2 Scan Point Clouds 6 6.5.3 Project Point Cloud 6 6.5.4 SCENE WebShare Cloud Data 6 6.6 Creating New Workspaces 6 6.7 Local Workspaces 6	5.7 Views settings	53
5.7.3 Reset Views Settings 5.7.4 Background Image for a 3D View: Environment Map 5.8 Export settings 6.5.8.1 Units 5.9 SCENE WebShare Cloud settings 6.5.9.1 Login Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3 Create Project 6.3.1 Open Project 6.3.2 Read-Only Projects 6.3.3 Project Transfer 6.4 Project Features for an Opened Scan Project 6.4.1 Project History 6.4.2 Wipe Project History 6.5 Project Workspace 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.2 Scan Point Cloud 6.5.3 Project Point Cloud 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces 6.7 Local Workspaces	5.7.1 General	53
5.7.4 Background Image for a 3D View: Environment Map. 5.8 Export settings 5.8.1 Units 6.5.8.1 Units 5.9 SCENE WebShare Cloud settings 6.5.9.1 Login Chapter 6: Project 6.1 Introduction 6.2 Project Features when no Scan Project is Opened 6.3 Create Project 6.3.1 Open Project 6.3.2 Read-Only Projects 6.3.3 Project Transfer 6.4 Project Features for an Opened Scan Project 6.4.1 Project History 6.4.2 Wipe Project History 6.5 Project Workspace 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.3 Project Point Cloud 6.5.3 Project Point Cloud 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces 6.7 Local Workspaces	5.7.2 3D View	54
5.8 Export settings 6 5.8.1 Units 6 5.9 SCENE WebShare Cloud settings 6 5.9.1 Login 6 Chapter 6: Project 6.1 Introduction 6 6.2 Project Features when no Scan Project is Opened 6 6.3 Create Project 6 6.3.1 Open Project 6 6.3.2 Read-Only Projects 6 6.3.3 Project Transfer 6 6.4 Project Features for an Opened Scan Project 6 6.4.1 Project History 6 6.4.2 Wipe Project History 6 6.5 Project Workspace 6 6.5.1 Scans 6 6.5.2 Scan Point Clouds 6 6.5.3 Project Point Clouds 6 6.5.4 SCENE WebShare Cloud Data 6 6.6 Creating New Workspaces 6 6.7 Local Workspaces 6	5.7.3 Reset Views Settings	56
5.8.1 Units 6 5.9 SCENE WebShare Cloud settings 6 5.9.1 Login 6 Chapter 6: Project 6.1 Introduction 6 6.2 Project Features when no Scan Project is Opened 6 6.3 Create Project 6 6.3.1 Open Project 6 6.3.2 Read-Only Projects 6 6.3.3 Project Transfer 6 6.4 Project Features for an Opened Scan Project 6 6.4.1 Project History 6 6.4.2 Wipe Project History 6 6.5 Project Workspace 6 6.5.1 Scans 6 6.5.2 Scan Point Clouds 6 6.5.3 Project Point Cloud 6 6.5.4 SCENE WebShare Cloud Data 6 6.6 Creating New Workspaces 6 6.7 Local Workspaces 6	5.7.4 Background Image for a 3D View: Environment Map	56
5.9 SCENE WebShare Cloud settings 6 5.9.1 Login 6 Chapter 6: Project 6.1 Introduction 6 6.2 Project Features when no Scan Project is Opened 6 6.3 Create Project 6 6.3.1 Open Project 6 6.3.2 Read-Only Projects 6 6.3.3 Project Transfer 6 6.4 Project Features for an Opened Scan Project 6 6.4.1 Project History 6 6.4.2 Wipe Project History 6 6.5 Project Workspace 6 6.5.1 Scans 6 6.5.2 Scan Point Clouds 6 6.5.3 Project Point Cloud 6 6.5.4 SCENE WebShare Cloud Data 6 6.6 Creating New Workspaces 6 6.7 Local Workspaces 6	5.8 Export settings	60
5.9.1 Login 6 Chapter 6: Project 6.1 Introduction 6 6.2 Project Features when no Scan Project is Opened 6 6.3 Create Project 6 6.3.1 Open Project 6 6.3.2 Read-Only Projects 6 6.3.3 Project Transfer 6 6.4 Project Features for an Opened Scan Project 6 6.4.1 Project History 6 6.4.2 Wipe Project History 6 6.5 Project Workspace 6 6.5.1 Scans 6 6.5.2 Scan Point Clouds 6 6.5.3 Project Point Cloud 6 6.5.4 SCENE WebShare Cloud Data 6 6.6 Creating New Workspaces 6 6.7 Local Workspaces 6	5.8.1 Units	60
5.9.1 Login 6 Chapter 6: Project 6.1 Introduction 6 6.2 Project Features when no Scan Project is Opened 6 6.3 Create Project 6 6.3.1 Open Project 6 6.3.2 Read-Only Projects 6 6.3.3 Project Transfer 6 6.4 Project Features for an Opened Scan Project 6 6.4.1 Project History 6 6.4.2 Wipe Project History 6 6.5 Project Workspace 6 6.5.1 Scans 6 6.5.2 Scan Point Clouds 6 6.5.3 Project Point Cloud 6 6.5.4 SCENE WebShare Cloud Data 6 6.6 Creating New Workspaces 6 6.7 Local Workspaces 6	5.9 SCENE WebShare Cloud settings	61
6.1 Introduction 6 6.2 Project Features when no Scan Project is Opened 6 6.3 Create Project 6 6.3.1 Open Project 6 6.3.2 Read-Only Projects 6 6.3.3 Project Transfer 6 6.4 Project Features for an Opened Scan Project 6 6.4.1 Project History 6 6.4.2 Wipe Project History 6 6.5 Project Workspace 6 6.5.1 Scans 6 6.5.2 Scan Point Clouds 6 6.5.3 Project Point Cloud 6 6.5.4 SCENE WebShare Cloud Data 6 6.6 Creating New Workspaces 6 6.7 Local Workspaces 6		
6.1 Introduction 6 6.2 Project Features when no Scan Project is Opened 6 6.3 Create Project 6 6.3.1 Open Project 6 6.3.2 Read-Only Projects 6 6.3.3 Project Transfer 6 6.4 Project Features for an Opened Scan Project 6 6.4.1 Project History 6 6.4.2 Wipe Project History 6 6.5 Project Workspace 6 6.5.1 Scans 6 6.5.2 Scan Point Clouds 6 6.5.3 Project Point Cloud 6 6.5.4 SCENE WebShare Cloud Data 6 6.6 Creating New Workspaces 6 6.7 Local Workspaces 6		
6.1 Introduction 6 6.2 Project Features when no Scan Project is Opened 6 6.3 Create Project 6 6.3.1 Open Project 6 6.3.2 Read-Only Projects 6 6.3.3 Project Transfer 6 6.4 Project Features for an Opened Scan Project 6 6.4.1 Project History 6 6.4.2 Wipe Project History 6 6.5 Project Workspace 6 6.5.1 Scans 6 6.5.2 Scan Point Clouds 6 6.5.3 Project Point Cloud 6 6.5.4 SCENE WebShare Cloud Data 6 6.6 Creating New Workspaces 6 6.7 Local Workspaces 6	napter 6: Project	
6.2 Project Features when no Scan Project is Opened 6.3 Create Project 6.3.1 Open Project. 6.3.2 Read-Only Projects. 6.3.3 Project Transfer 6.4 Project Features for an Opened Scan Project 6.4.1 Project History 6.4.2 Wipe Project History 6.5 Project Workspace 6.5.1 Scans 6.5.2 Scan Point Clouds 6.5.3 Project Point Cloud 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces	•	62
6.3 Create Project 6 6.3.1 Open Project 6 6.3.2 Read-Only Projects 6 6.3.3 Project Transfer 6 6.4 Project Features for an Opened Scan Project 6 6.4.1 Project History 6 6.4.2 Wipe Project History 6 6.5 Project Workspace 6 6.5.1 Scans 6 6.5.2 Scan Point Clouds 6 6.5.3 Project Point Cloud 6 6.5.4 SCENE WebShare Cloud Data 6 6.6 Creating New Workspaces 6 6.7 Local Workspaces 6		
6.3.1 Open Project. 6 6.3.2 Read-Only Projects. 6 6.3.3 Project Transfer 6 6.4 Project Features for an Opened Scan Project 6 6.4.1 Project History 6 6.4.2 Wipe Project History 6 6.5 Project Workspace 6 6.5.1 Scans 6 6.5.2 Scan Point Clouds 6 6.5.3 Project Point Cloud 6 6.5.4 SCENE WebShare Cloud Data 6 6.6 Creating New Workspaces 6 6.7 Local Workspaces 6		
6.3.2 Read-Only Projects. 6 6.3.3 Project Transfer 6 6.4 Project Features for an Opened Scan Project 6 6.4.1 Project History 6 6.4.2 Wipe Project History 6 6.5 Project Workspace 6 6.5.1 Scans 6 6.5.2 Scan Point Clouds 6 6.5.3 Project Point Cloud 6 6.5.4 SCENE WebShare Cloud Data 6 6.6 Creating New Workspaces 6 6.7 Local Workspaces 6		
6.3.3 Project Transfer 6 6.4 Project Features for an Opened Scan Project 6 6.4.1 Project History 6 6.4.2 Wipe Project History 6 6.5 Project Workspace 6 6.5.1 Scans 6 6.5.2 Scan Point Clouds 6 6.5.3 Project Point Cloud 6 6.5.4 SCENE WebShare Cloud Data 6 6.6 Creating New Workspaces 6 6.7 Local Workspaces 6		
6.4 Project Features for an Opened Scan Project 6 6.4.1 Project History 6 6.4.2 Wipe Project History 6 6.5 Project Workspace 6 6.5.1 Scans 6 6.5.2 Scan Point Clouds 6 6.5.3 Project Point Cloud 6 6.5.4 SCENE WebShare Cloud Data 6 6.6 Creating New Workspaces 6 6.7 Local Workspaces 6		63
6.4.1 Project History 6 6.4.2 Wipe Project History 6 6.5 Project Workspace 6 6.5.1 Scans 6 6.5.2 Scan Point Clouds 6 6.5.3 Project Point Cloud 6 6.5.4 SCENE WebShare Cloud Data 6 6.6 Creating New Workspaces 6 6.7 Local Workspaces 6	•	64
6.4.2 Wipe Project History 6 6.5 Project Workspace 6 6.5.1 Scans 6 6.5.2 Scan Point Clouds 6 6.5.3 Project Point Cloud 6 6.5.4 SCENE WebShare Cloud Data 6 6.6 Creating New Workspaces 6 6.7 Local Workspaces 6		
6.5 Project Workspace 6 6.5.1 Scans 6 6.5.2 Scan Point Clouds 6 6.5.3 Project Point Cloud 6 6.5.4 SCENE WebShare Cloud Data 6 6.6 Creating New Workspaces 6 6.7 Local Workspaces 6		
6.5.1 Scans 6 6.5.2 Scan Point Clouds 6 6.5.3 Project Point Cloud 6 6.5.4 SCENE WebShare Cloud Data 6 6.6 Creating New Workspaces 6 6.7 Local Workspaces 6	6.4.2 Wipe Project History	66
6.5.2 Scan Point Clouds 6 6.5.3 Project Point Cloud 6 6.5.4 SCENE WebShare Cloud Data 6 6.6 Creating New Workspaces 6 6.7 Local Workspaces 6	S.5 Project Workspace	67
6.5.3 Project Point Cloud 6.5.4 SCENE WebShare Cloud Data 6.6 Creating New Workspaces 6.7 Local Workspaces 6.7		67
6.5.4 SCENE WebShare Cloud Data		67
6.6 Creating New Workspaces	6.5.3 Project Point Cloud	68
6.7 Local Workspaces		68
	•	68
	S.7 Local Workspaces	69
6.8 Workspace Structure		70
6.8.1 Naming conventions	6.8 Workspace Structure	70

Chapter 7: Import	
7.1 Introduction	72
7.2 Import by Drag & Drop	72
7.2.1 Importing a scan project	73
7.2.2 Importing a scan	73
1 0 0	73
	73
	74
,	74
·	74 76
·	76
	77
7.5 Import Images	
7.5.1 Import high resolution pictures as virtual scans	
7.6 Import Objects	
7.6.1 Importing VRML files	
	86
7.7 Import SCENE WebShare Cloud project modifications back to SCENE	87
Chapter 8: Processing	
8.1 Process	93
8.1.1 General	
8.1.2 Filters	
8.1.3 Find Targets	
8.1.4 Automatic Registration	
8.2 Results	
0.2 Nosuito	01
Chapter 9: Registration	
9.1 Background knowledge	98
9.2 Registration Dashboard	
9.2.1 Registration Status	
9.2.2 Registration Dashboard – Filter functions	
9.3 Clusters	00
9.3.1 Add Cluster	00
	00
	01
	01
•	02
·	02
	03
	04
	04
	06
	07
	07
· · · · · · · · · · · · · · · · · · ·	30
5	08
, , ,	11
3	11
0	12
	12

9.7.3 Place and Register	113
9.8 Registration Report	113
9.8.1 Target Statistics	
9.8.2 Scan Point Statistics	
9.8.3 Saving or Exporting the Registration Report	
9.9 Import Surveyed Points	118
Chapter 10: Explore	
10.1 View Project	120
10.2 Clusters	
10.3 3D View	
10.4 Quick View	125
10.5 Planar View	126
10.6 Explore Toolbar	127
10.6.1 Explore features in Quick View or Planar View (2D view)	128
10.6.2 Navigating with the mouse in 3D View	128
10.6.3 Navigating with the mouse in Quick View	
10.6.4 Navigating with the mouse in Planar View	
10.7 Overview Map	
10.8 Annotations (3D View, Quick View, Planar View)	131
10.9 Measuring (3D View, Quick View, Planar View)	133
10.9.1 Measure Points	134 135
10.10 Selecting Scan Points (3D View, Planar View, Quick View)	137
10.10.1 Selecting Scan Points in the Planar View or the Quick View	137
10.10.2 Selecting Scan Points in 3D View	139
10.10.3 Invert a selection of scan points	140
10.11 Selection Combinations	142
10.12 Save Screenshot (3D View)	142
10.12.1 Viewpoints (3D View)	
10.13 Mark Distance Range (Planar View)	
10.14 Clipping Boxes (3D View)	
10.14.1 Creating a Clipping Box	
10.14.2 Visualizing Scales and Distances	148 153
10.14.4 Hiding and Displaying Points by Means of Clipping Boxes	156
10.14.5 Deleting Points by Means of Clipping Boxes	158
10.14.6 Enabling / Disabling Clipping	158
10.14.7 Working with Multiple Clipping Boxes	159
10.14.8 Toggling Visibility of Clipping Boxes	163
10.14.9 Creating Multiple Clipping Boxes Along an Axis of an Existing Clippin 163	ig Box
10.14.10 Exporting Scan Points by Means of Clipping Boxes	168
10.15 Meshing (Planar View and 3D View)	169
10.15.1 What is a Mesh?	169
10.15.2 Creating a Mesh in Planar View	169
10.15.3 Creating a Mesh in the 3D View	171
10.15.4 Export	175
10.16 Virtual Scans (3D View)	175
10.17 Working with the Project Point Cloud.	177
10.17.1 Creating the Project Point Cloud	178 183
10.17.2 Updating the Project Point Cloud	184
10.18 Visibility Settings	184
10.10 Visibility Octalings	105

10.18.2 Layer	187
10.18.3 Extra	188
Chapter 11: Export	
•	189
11.1 Introduction	
11.2 Exporting the Scan Project	189
11.2.1 Export Scans	189
11.2.2 Export Project Point Cloud	190
11.2.3 Export Project	190 190
11.2.4 Export Overview Map	190
11.2.6 Export Objects	191
•	191
11.3 Exporting scan points.	
11.3.1 Scan points of an entire scan	191
11.4 Exporting scans	192
11.4.1 Exporting the scans of a cluster	192
11.4.2 Exporting the scans bundled as a new project	192
11.4.3 Exporting the images of the scans to .jpg format	192
11.5 Exporting scan point clouds	193
11.5.1 Export one scan point cloud	193
11.5.2 Export several scan point clouds	193
11.6 Exporting the project point cloud	193
11.7 Exporting a Cluster	193
11.7.1 Exporting the scans of a cluster	193
11.7.2 Exporting the scans bundled as a new project	193
11.7.3 Exporting the images of the scans to .jpg format	194
11.8 Format related settings	194
11.8.1 Export tab	195
11.8.2 Slices tab	196
11.8.3 Several slices	198
11.8.4 Tomograph	200
11.8.5 CPE Export	201
11.8.6 E57 Export	201
11.8.7 VRML	
11.8.8 DXF	
11.8.9 XYZ text	204
11.8.10 IGES	205
11.8.11 PTS Export	207
11.8.12 Export POD (PointoolsTM)	209
11.9 SCENE WebShare Cloud	210
11.9.1 Export SCENE WebShare Cloud Project	210
11.9.2 Uploading SCENE WebShare Cloud Project	217
11.9.3 Upload Project Point Cloud	218
Chapter 12: Virtual Reality	
·	004
	221
12.2 VR System requirements	221
12.3 SCENE project requirements	221
12.4 SCENE Virtual Reality features	221
12.5 Starting the Virtual Reality in SCENE	222
g,	
Chapter 13: Scanning	
•	200
13.1 Scanning	223
13.2 Scanner Control	223
13.3 On-Site Registration	225

13.3.1 On-Site Registration Setup. 13.4 On-Site Compensation. 13.4.1 Preparing the Compensation Station. 13.4.2 Connect Laser Scanner to Computer through Wireless LAN. 13.4.3 On-Site Compensation steps. 13.4.4 Setup. 13.4.5 Place target. 13.4.6 Horizontal Alignment. 13.4.7 Scan & Compensate.	228 228 229 229 230 231
13.4.8 Troubleshooting	
Chapter 14: FARO Laser Scanner Focus Scanner Administrati	
14.1 Items in the Structure View of the Scanner Administration	
14.3 Managing Snapshots	235 236 236 238
14.3.5 Transferring a New, Modified or Restored Snapshot to Your Scanne 14.3.6 Managing Scan Projects	238 239 240 240
Chapter 15: Apps	
15.1 Installing and managing apps 15.2 App Manager 15.3 Installing Apps 15.4 Updating Apps 15.5 Activating / Deactivating Apps 15.6 Uninstalling Apps	241242243243
Chapter 16: Advanced Functions	
16.1 Coordinates 16.2 Local Coordinates 16.3 Global Coordinates 16.3.1 Quick Change of Global Origin 16.4 Exemplary Driver Configuration for the Stereoscopic Mode 16.5 3DConnexion 3D Mouse Support 16.5.1 Predefined Commands 16.5.2 Adjusting the 3D Mouse Behavior Chapter 17: Reference Handbook	244 244 245 250 250 253 254 255
17.1 Hotkeys	256
17.2 Symbols the Structure Window 17.3 Context Menus 17.3.1 3D View 17.3.2 Clipping Box 17.3.3 Planar View and Quick View 17.3.4 Planar View or Quick View – Point Selection 17.3.5 Picture 17.3.6 Plane 17.3.7 Limited Plane	-

17.3.8 Plane Fit	264
17.3.9 Constrained Plane Fit	264
17.3.10 Sphere	264
17.3.11 Sphere Fit	265
17.3.12 Region	265
17.3.13 Point	266
17.3.14 Point Fit	266
17.3.15 Pipe	267
17.3.16 Pipe Fit	267
17.3.17 Line	267
17.3.18 Line Fit	268
17.3.19 Rectangle	268
17.3.20 Rectangle Fit	268
17.3.21 Scan	269
17.3.22 Scan Fit	272
17.3.23 Scans Folder / Cluster	272
17.3.24 Scan Manager	273
17.3.25 Virtual Scan (3D Picture)	273
17.3.26 3D Picture Fit (Fit of a Virtual Scan)	274
17.3.27 Workspace	274
17.3.28 Viewpoint	277
17.4 Properties	277
17.4.1 Scan Project Workspace	277
17.4.2 Scan Folder	278
17.4.3 Scan Manager	279
17.4.4 Scan	281
17.4.5 Scan Fit	284
17.4.6 Constraints Object	286
17.4.7 Constrained Plane Fit	287
17.4.8 Measurement	288
17.4.9 Picture	288
17.4.10 Pipe	288
17.4.11 Pipe Fit	289
17.4.12 Plane	289
17.4.13 Plane Fit	
17.4.14 Limited Plane Fit	291
17.4.15 Slab	
17.4.16 Slab Fit	293
17.4.17 Point	294
17.4.18 Point Fit	294
17.4.19 Sphere	295
17.4.20 Sphere Fit	295
17.4.21 Clipping Box	297
17.4.22 Documentation Object	297
17.4.23 Virtual Scan (3D Picture)	298
* * * * * * * * * * * * * * * * *	_00

Chapter 18: Error Messages

Chapter 19: Frequently Asked Questions

Chapter 20: Glossary

Technical Support A-305

Software License Agreement B-307

Chapter 1: Introduction

SCENE is a comprehensive 3D point cloud processing and managing software tool for the professional user. It is specially designed for viewing, administration, and working with extensive 3D scan data obtained from high resolution 3D laser scanners such as the FARO Focus X.

SCENE processes and manages scanned data highly efficiently and easily by offering a wide range of functions and tools, such as filtering, automatic object recognition, scan registration, as well as automatic scan colorization.

After SCENE has prepared the scan data, you can begin evaluation and further processing right away. For this, it offers functions from simple measuring to 3D visualization through to meshing and exporting your scan data into various point cloud and CAD formats.

With SCENE, you may also create and upload SCENE WebShare Cloud data from your scan projects. With SCENE WebShare Cloud, your scan projects can be published on the Internet and viewed with a standard Internet browser.

Customer Service

If you have any questions or need further instructions for any procedure, contact your **Customer Service** representative by phone, fax or email. You can also reach the Customer Service Applications and Training group through email at the following addresses:

- support@faro.com
- applications @faro.com
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Visit the **FARO Customer Service area** on the Web at *www.faro.com* to search our technical support database, which is available 24 hours a day, 7 days a week.

You may also find various **online tutorials** in the Internet at *tutorial.faroeurope.com*.

1.1 System Requirements

In order to use SCENE seamlessly, your computer should have the following specifications:

	Minimal Specifications	Recommended Specifications
Processor	64-bit (x64) with at least 2-gigahertz (GHz) (For example, Intel Core i7)	Quad-core x64Intel Core i7/Xeon, 8 physical cores

Graphics Card	 OpenGL 4.1, or higher At least 2GB Memory. For VR Rendering: NVIDIA 1060GTX or similar Oculus with Oculus Touch Controllers or HTC VIVE SteamVR 	 OpenGL 4.1, or higher At least 4 GB Memory Dedicated graphics card For Stereo Rendering: NVIDIA Quadro For VR Rendering: NVIDIA 1080GTX or similar Oculus with Oculus Touch Controllers or HTC VIVE SteamVR
Main Memory	At least 16GB	64GB
Hard Disk	256 GB Solid State Drive 512GB Solid State Drive + Regula HDD	
Display	1366 x 768 1920 x 1080	
Operating System	64-bit Windows 7 SP1 or higher	
Accessories	Mouse with 2 buttons and a scroll wheel Network connectivity is required for licensing	

Chapter 2: Installation and Licensing

2.1 Installing the Software



NOTE: You must belong to the group of administrators to install the software.

NOTICE



Uninstall any third-party software that interacts with SCENE and OpenGL software. This includes but is not limited to GPU performance and overclocking tools, gaming overlays, FPS counters and various streaming and recording tools. These tools are known to cause random SCENE crashes when working with 3D views.

The following third party software are not compatible with SCENE:

- Nahimic
- MSI Afterburner
- Lavasoft Web Companion
- Trimble Connected Community Explorer
- 1. Insert the installation USB stick supplied with the scanner.
- 2. Select the product and follow the installation instructions on the screen. An installation wizard will guide you during installation.

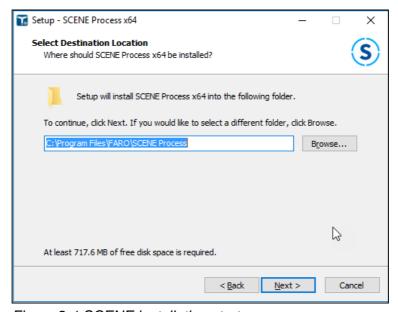


Figure 2-1 SCENE installation startup

- 3. Read and accept the license.
- 4. Decide if you would like to have the User's Manual installed with the software.
- 5. If desired, create a new default folder.

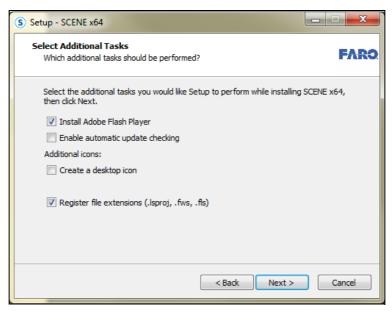


Figure 2-2 Select Additional Tasks

- Install Adobe FlashPlayer: You may clear the checkbox if you've already installed the latest version. If you're not sure about the installed version we recommend to install FlashPlayer.
- 7. Decide if you want to be informed about SCENE updates. You will then be notified if a newer SCENE version is available than you are using. A dialog appears that shows the used version, the new version and a link to download the .exe file for the new version. After downloading, you have install the software manually.
- 8. If the new version is a major release (first or second number has been incremented) you may need another license to use the new version. Select the "Don't ask me again" checkbox if you don't want to be informed again about this new version, for example, if you want to download later.
- 9. **Create a desktop icon**: Select, if you would like to have the SCENE button shown on your computer's desktop.
- 10.**Register file extensions (.lsproj,.fws, .fls)**: Decide if you want to open scan projects by clicking the file name in Windows Explorer.

2.2 SCENE Licensing

Once installed, you may fully test SCENE for 30 days without the need of a software license. After the trial period, you need a permanent license to continue using SCENE.

When purchasing SCENE you can select between two kinds of permanent licenses:

- Single-User Licenses
- Network Licenses (Floating Licenses)

Both types of licenses can be locked either to the computer where the software is installed (soft lock) or to a USB dongle (hard lock). An USB dongle is a device that you attach to the computer's USB port.

You can buy *Single-User Licenses* and *Network Licenses* (*Floating Licenses*) that are linked to a software product key. Or you can obtain a USB dongle that already carries one single-user license or one or more network licenses.

If you already have a license and a maintenance contract and you want to update to a new version of SCENE follow the steps described in chapter *Network Licenses (Floating Licenses)*.

2.3 License Manager

The License Manager provides an overview over all licenses available for the currently running SCENE version and helps you manage them. It offers the possibility to activate your product and to update licenses stored on your computer or on the plugged-in USB dongle.

The License Manager is available under **Settings** > **License Manager**.

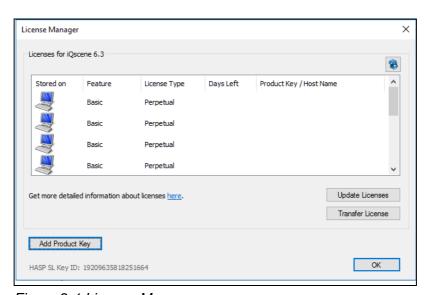


Figure 2-1 License Manager

The list in the dialog provides information about all the licenses available on your computer and in the network:

Stored On – Indicates where the license is stored on:

License is stored on your computer.

License is stored on a computer in the network (on a floating license server).

License is stored on the plugged-in dongle.

Feature – The licensed SCENE feature. Basic is the feature required to run SCENE.

License Type – Type of the license:

Trial – Limited trial license.

Perpetual – Full, unlimited and unrestricted license.

Other – Other types of licenses, for example full licenses that expire after a certain period of time.

Days Left – Days left until expiration (for trial licenses or time-restricted licenses).

Product Key /Host Name – If the license was activated with a product key, the product key will be shown. If the license is stored on a floating license server somewhere in the network, it will show its host name:



Indicates that the displayed content is a product key.



Indicates that the displayed content is the host name of a license server.

To get more information about the licenses, for example the licenses of other SCENE versions, follow the link in the dialog. This will open the Sentinel Admin Control Center.

To refresh the license list click the button. New licenses will be highlighted.

Update Licenses

To update existing licenses stored on your computer or the attached USB dongle to a new version of SCENE, click the **Update Licenses** button.

Transfer Licenses

To transfer a single-user license from one computer system to another, click the Transfer Licenses button. This opens a PDF document with details about how to transfer a SCENE, SCENE Process, or SCENE Applicense. The FaroRUS tool, that is required to perform the transfer, is also opened. Follow the process specified in the document to transfer the license.

To add a new license linked to a product key, click the Add Product Key button.

2.4 Single-User Licenses

The SCENE product key consists of not more than 18 characters, including numbers, letters and special characters. You may get a product key from:

- The back of the package
- Per mail if you bought from the FARO 3D App Center (3d-appcenter.faro.com)
- From FARO Customer Service.

Once received, you must validate the key and use it to activate the SCENE license. To do this, take the following steps:

- 1. Start SCENE.
- Open the License Manager which is available under Settings >
 License Manager (if the trial period has expired will automatically open this
 dialog at startup).

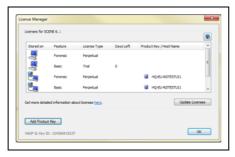


Figure 2-1 License Manager

3. Click the **Add Product Key** button to open the product activation dialog. The **Product Activation** dialog opens.

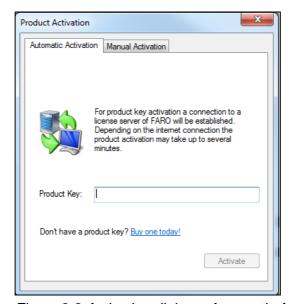


Figure 2-2 Activation dialog – Automatic Activation

- 4. Select the tab **Automatic Activation** to use an automatic activation method via Internet.
- 5. Enter your product key and click the **Activate** button.
- SCENE will contact FARO's license server to validate the entered key. Depending on the Internet connection, this process might take up some time.

After key has been successfully validated, the license linked to the product key is permanently locked to your computer and SCENE is activated. The new license will show up in the license manager.



NOTE: If your single-user license is locked to your computer and if you change your hardware, or if you want to use SCENE on a different computer, you will have to renew the license because it is bound to some hardware components of your computer. Contact customer service for assistance.

If the automatic activation fails, check your Internet connection or enter the product key again and retry. If activation still fails, you may activate SCENE manually.

2.4.3 Manual Activation with a Product Key

Use the manual activation method if the automatic activation as described above fails.

- 1. Start SCENE.
- 2. Open the License Manager under **Settings** > **License Manager** (if the trial period has expired, SCENE will automatically open this dialog at startup).
- 3. Click the Add Product Key button to open the product activation dialog.
- 4. Select tab Manual Activation:

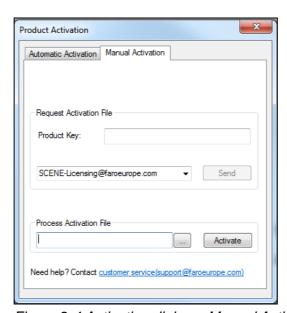


Figure 2-4 Activation dialog – Manual Activation

5. Enter your product key and click the **Send** button to create an activation request file (a file with the file extension .ar) which must be sent to FARO (this activation request file does not contain any private data):

- If an email client is properly installed on your system an email with the activation request file attached will automatically be generated. Just send this email to the provided address.
- If an email client is not installed on your system, you will be prompted to save the file to your hard disk. Attach this file to an email and send it to the provided email address.

After the email has been sent to FARO, you will receive an automatic email with an activation file (a file with the extension .v2c).

Save this file to your hard disk, add it to the **Manual Activation** dialog under **Process Activation File**, and then click **Activate**. Your product should now be activated and have a permanent license.

If you do not have an Internet connection, you may contact FARO's customer service team to receive an activation file.

2.4.5 Licensing with an USB Dongle

This licensing option is not bound to a single computer and adds mobility of the license between multiple computers. The license is recorded into an USB dongle which can be attached to an USB port on any computer running SCENE. After it is attached, SCENE has a valid license and can be used as normal; validation and activation over the Internet are not necessary.

2.5 Network Licenses (Floating Licenses)

Network licenses are hosted by a license server computer and will be shared to client computers over the network. If you start SCENE on any computer in your network it will search the network for available licenses. If one is found, it will use this license for the time it is executed. When closing SCENE, the license will be released again and will be available to other SCENE installations in the network.

Network licenses can either be locked to a dongle attached to the server's USB port or to the computer where the licensing software is installed.

2.6 Updating Licenses to a New Version of SCENE

Customers with maintenance contracts can automatically update existing licenses if SCENE was updated to a new version and a new license is required for that version.

To update existing licenses stored on your computer or USB dongle for a new version of SCENE, open the License Manager under **Settings** > **License Manager**:

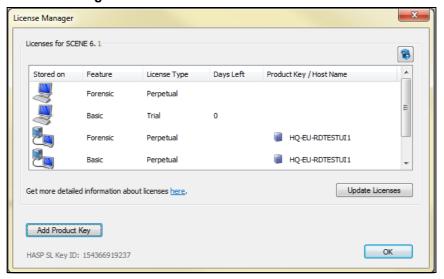


Figure 2-1 License Manager

Click the **Update Licenses** button. SCENE will contact FARO's license server and search for a valid maintenance contract. Depending on the Internet connection, this process might take some time.

After a valid contract is found, an updated license for the currently running SCENE version will be locked to your computer or dongle. The license for the new version of SCENE will show up in the License Manager.

Chapter 3: Starting up with the Projects Overview

3.1 Starting SCENE

SCENE always starts with the **Projects Overview** window. This chapter describes how it works and how you can change its view.

The Projects Overview presents all the scan projects which are saved in your project folder. When you start SCENE for the first time, this may mean that you will not see any projects.

3.1.1 Updates and News

When SCENE starts for the first time, the **Updates and News** window is displayed. This window provides you with the latest information from FARO about SCENE, including information about software updates, training, apps and so on. If you want to see the information again next time you start SCENE, click **CLOSE**. If you *don't* want to see the information again click **DISMISS** and then **CLOSE**. The information is always available from the Check for Updates button on the Settings page.

3.2 Known projects

SCENE will verify all known projects at startup. Only existing projects will be shown in the **Projects Overview**.

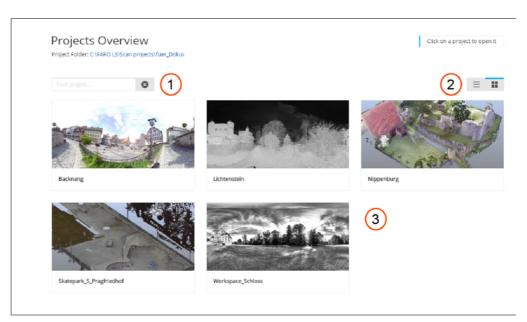


Figure 3-1 Projects Overview window

- 1. Search field. Start typing, and SCENE will automatically show scan projects which names fit to what you type.
- 2. Show the scan projects either as a list view, or as a tile view.

3. Scan projects shown with preview image. Hover with the mouse to see a short description of the scan project. This short description corresponds to what you see in the list view.

3.2.2 Opening scan projects

- In the tile view, click the project's preview image.
- In the list view, click the line of the scan project.
- Drag and drop a scan project file (ending: .lsproj) from a file system into the Project Preview.
- Drag and drop a scan file (ending: .fls) from a file system into the Project Preview. A new scan project will be created and opened.

3.3 Project Details

After the scan project is opened, the Project Details will be shown.

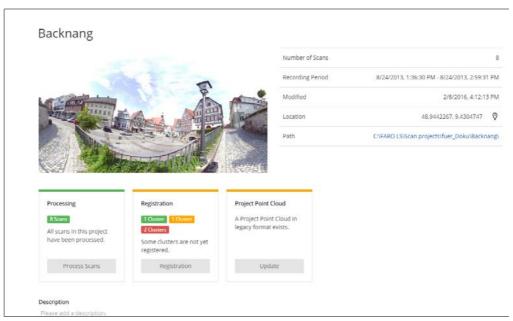


Figure 3-1 Project preview with two status tiles

Modifying preview picture

If the preview image is not the one you want to see at this place, you can replace it by another one. Only images in .jpg or .jpeg format are allowed.

- 1. Hover over the preview image. The **Change Image** button appears.
- 2. Click the Change Image button.
- 3. Browse to a folder, and select the image.
- 4. Click the **Open** button to replace the image.

Number of scans

The number of scans belonging to the scan project.

Recording period

Date and time when scanning was started, and date and time when scanning was finished. Times shown here are in local time.

Modified

Date and time when the scan project was modified for the last time.

Location

Add a position to your project to make the Google Maps View feature available.

The coordinates must be entered in decimal notation, first the latitude, then the longitude.

Here are some example coordinates:

Moscow:	55.758032	37.617188
Sydney:	-33.870416	151.204834
Rio de Janeiro:	-22.902743	-43.214722
Seattle:	47.606163	-122.332764

Google Maps

If positional information is provided for a project, the Google Maps View

button button becomes available in the project's preview. Clicking this button will open a Google Maps view of the project's location in your default web browser.

Path

The path of the folder in which the scan project is saved.

Description

You can enter a description of your scan project.

Read-only projects

Projects that can not be opened with write access are read-only. This happens for example if the project is opened by another SCENE instance. In this case, SCENE will show a message box while loading the project.

After the loading is finished, the project will be shown as read-only with a warning message at the top of the project dashboard. The **Save** button is disabled. As an additional hint for the user, the SCENE title bar contains a read-only hint.

3.4 Status tiles

Depending on your scan project, different status tiles may be shown. The order of the status tiles corresponds to the workflow steps in the Workflow bar.

Each status tile shows the status regarding one specific step of handling a scan project.

A status tile may typically consist of color coded badges, a description text, and an action button.

Depending on the status of the tile, the action button is disabled or enabled.



NOTE: The status tiles and their buttons are meant as information, and offer a short way to access a specific function. It is not mandatory to click the buttons, you can likewise click one of the toolbar buttons.

3.4.1 Status Tile "Processing"



Figure 3-2 Processing Tiles

The Processing status tile shows the current processing status of the scans inside the project.

The colored badges in the Processing Tile categorize the scans of the project into three categories:

Green: The Scan has been processed and has an up-to-date Scan Point Cloud.

Yellow: The Scan has been processed but does not have an up-to-date Scan Point Cloud.



NOTE: Scans that have been processed with SCENE 6.0 or lower must be processed again to have an up-to-date Scan Point Cloud, and to utilize the full functionality of SCENE 7.1.

Red: The Scan has not been processed yet.

Processing Status

The processing status of scans is displayed as follows:

- · The status color of the tile is gray if there are no scans in the project.
- Tile and badge are green if all scans are processed and have the updated Scan Point Clouds.
- The status color of the tile is yellow if the yellow badge is visible and the red badge is not visible. This means that all scans in the project were processed, but for some scans, Scan Point Clouds must be regenerated.
- The status color of the tile is red if the red badge is visible, when there is at least one scan that was not processed at all.

Click the **Process Scans** button to start processing.

The task will open. For more details, see *Processing Settings*

3.4.3 Status Tile "Registration"

The Registration status tile shows the current registration status of the scan project.

The tile will show different badges which show the number of clusters for each registration state.

An additional badge showing the mean point error is displayed if all clusters were successfully registered.

All information corresponds directly to the information shown in the registration dashboard and the registration report.

Each badge type has a tool tip with additional information.



NOTE: The workspace itself is not considered a cluster.

The tile can have three different states which correspond directly with the current state of the workspace in the Registration dashboard. These states are symbolized by colors:

Grey

- The currently open project does not contain any clusters or scans.
- The Registration button is disabled.

Orange

There are still clusters which need some user interaction in order to be successfully registered.

- · Red badge: the number of unregistered clusters.
- Orange badge: the number of incomplete clusters.
- Green badge: the number of finished clusters.
- ⇒ Click the **Registration** button to switch to the registration dashboard.

Green

All clusters are successfully registered.

- Green badge: the number of finished clusters.
- Red, orange, or green badge will show the overall mean point error. This number is also shown in header of the registration report with the same color coding, which depends on how high the error is.
- ⇒ Click the **Show Report** button to switch to the registration report.

3.4.4 Status Tile "Project Point Cloud"

The Project Point Cloud status tile shows the current processing status of Project Point Cloud (PPC).

Status colors

Tile and badge are gray if no Project Point Cloud exists for this project.

Click the Create button to create the Project Point Cloud.

The Point Cloud Creation dialog will open.



NOTE: If the registration is not yet complete, i.e., the registration tile is not green, a warning message is displayed which recommends finishing the registration before creating the Project Point Cloud.

Orange: A Project Point Cloud in a legacy format exists.

Click the **Update** button to update the Project Point Cloud.

First, the legacy Project Point cloud will be deleted, and the new Project Point Cloud is created afterwards.

Green: A Project Point Cloud in the current format exists.

A green badge will show the total number of scan points within the Project Point Cloud.

Click the **Explore** button to switch to the Explore category where the Project Point Cloud is shown in a 3D View.

Chapter 4: Navigation

4.1 Introduction

This chapter introduces to the toolbars and buttons which help you to navigate through a scan or point cloud.



NOTE: SCENE LT 7.2 provides all the features needed to finish typical scan projects. For some advanced features, however, you must switch to the classic style user interface by clicking **Switch UI** in the Settings toolbar.

Composition of the SCENE Window

After you have opened a scan project, the SCENE window appears. This window is made up of the following areas:

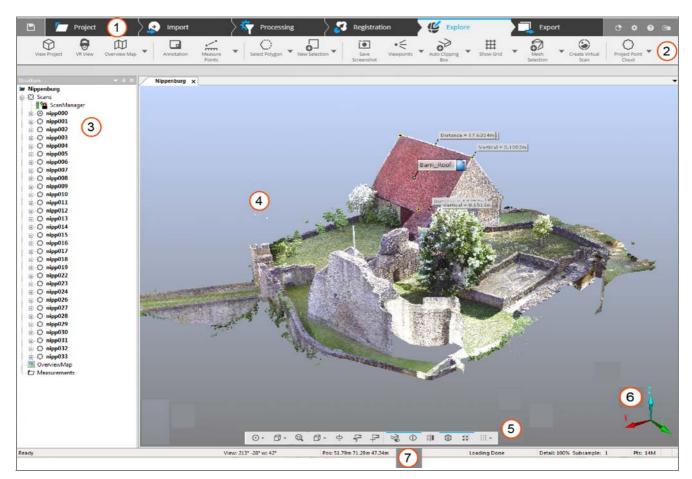


Figure 4-1 Composition of the SCENE window

1 Workflow Bar

The Workflow Bar guides you through a series of steps to process a scan project. All steps are structured in a similar way which will help to get familiar with all the functions.

② Toolbar

The Toolbar provides a quick and easy way to access features.

3 Structure Window

The Structure Window displays the structure of the workspace, including all folders and objects. If you click the name of those folders and objects with the right mouse key, a so-called context menu will open which offers specific functions.

By default, the Structure Window is folded away. If you want it to stay visible, click the **Structure** button, then click the thumbtack button.

Scan and object views

Shows the visual presentation of the scan data and other objects. Scans and objects can either be displayed in a **Quick View**, a detailed **Planar View**, or in **3D View**.

If you click the scan data and objects with the right mouse key, a context menu will open which offers specific functions.

⑤ Navigation toolbar (3D view only)

Offers a quick and easy way to a number of navigation modes. Offers several view, for example gap filling or point sizes.

© Coordinate axes

Shows the viewing direction by means of x, y, and z coordinate axes.

① Status bar

Displays command and scan point data details.

4.2 Workflow Bar

The Workflow bar and its buttons provide easy access to the usual steps with which a scan project is processed. Working through the steps from the left to the right should lead to a satisfactory result.



Figure 4-1 Workflow Bar

- ① Select the Save icon to save the currently open scan project.
- ② Select the *Project* category to find the features for your entire scan project.

There are two sets of tool bars, one that shows up when no scan project is opened, and one that shows up when a scan project is opened.

Select the *Import* category to import scans, projects, images, or SCENE WebShare Cloud data.

- 4 After importing, select the *Processing* category to determine how the raw scan data will filtered, colorized, and otherwise modified to make it more useful.
- ⑤ Select the *Registration* category to open the Registration features.
- Select the Explore category to add annotations, measurements, viewpoints, or clipping boxes.
- ①Select the *Export* category to export scan points, the point cloud, or the scan project. You can create data for SCENE WebShare Cloud, and upload this data afterwards.
- This icon opens the Apps feature.
- This icon opens the Settings for the categories.
- (10) Click the **Help** icon to open this document.
- ① Click the **Knowledge Base** icon to create and monitor support cases, access asset information, update contact information, submit product ideas, and more.

4.3 Tasks and Task Steps

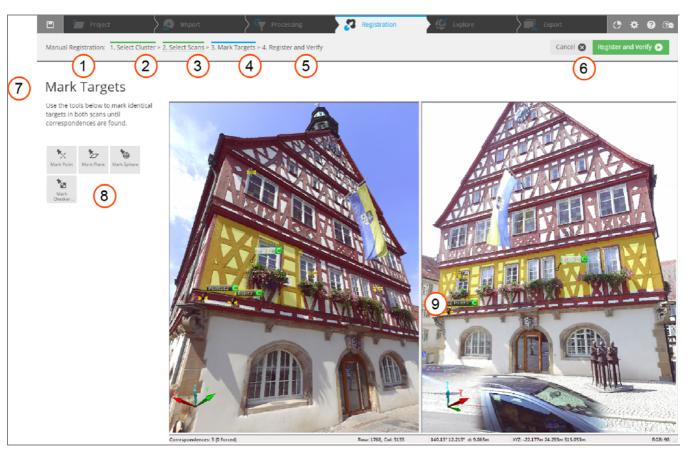


Figure 4-1 Task steps

- ① The task that is currently being executed, and the several steps of that task that are performed sequentially.
- ② Completed Step
- ③ Completed Step you can go back to. You can go back only one step at a time. Changes will not be reversed (for example, the result of a registration).
- 4 Active Step
- ⑤ Upcoming Step
- Navigation Buttons
 - · Cancel button exits the current task. It does not undo changes.
 - Continue button is only active (green) if all necessary prerequisites of the current step are fulfilled. It either goes to the next step, or finishes the task.
- ① Name of currently active task step.
- Optional description and tools of currently active task step.
- Work area, for example 3D Views and additional information ...

4.4 Color Coding

While you are working with SCENE, you will notice different colors, for example header lines, buttons, traffic light symbols, or messages. Those colors are meant to be an additional information.

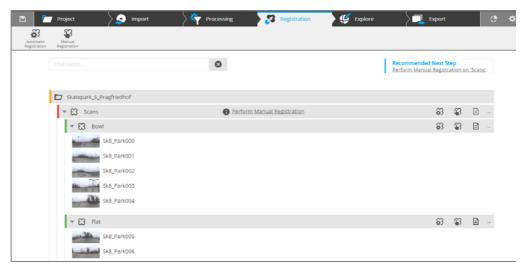


Figure 4-1 Color coding

Blue: stands for an information, or shows an active step.

Green: all is fine! For buttons: you can now click it to continue.

Yellow: something is not working properly, or there is legacy data. Check and fix.

Red: something went wrong, or some step was not processed yet. Check and fix.

4.5 Navigation Toolbar (3D View only)

A navigation toolbar is displayed only with the 3D scan view.



Figure 4-1 3D Navigation toolbar

The following options are available in the 3D navigation toolbar. For details, click the links:

- ₽ * View Modes
- Camera Modes
- Q View All
- Predefined Views
- Center of Rotation
- ₹ Last Camera Position
- Align Camera on Point
- Toggle Clipping Boxes
- Supersampling
- Gap Filling
- Clear View
- ** Adaptive
- **■** Point Sizes

4.5.2 View Modes



Figure 4-3 View Modes

Examine Mode \odot

Clicking the **Examine Mode** button \odot starts the object-based navigation, it seems as if the objects move while you stand still.

Smart Mode 🔊

The **Smart Mode** \bigcirc combines different navigation modes.

A ring is used to divide the view into different zones. When starting the actual navigation by clicking the mouse button, different navigation modes will be used depending on the zone.



Figure 4-4 SCENE with activated Smart Mode

The navigation ring disappears when the mouse is not moved anymore, or while you are clicking and moving the view. It appears again as soon as you hover with the mouse.

2 Zone navigation (default)

A thin ring visualizes the two zones. The cursor of the mouse gets updated depending on the position of the mouse cursor.



Figure 4-5 2 Zone navigation

- ① Fly Mode: activated if the mouse cursor is in the inner of the ring.
- ② Examine mode: Activated if the mouse cursor is in the outer area of the ring.

3 Zone navigation

A thick ring visualizes the three zones. The cursor of the mouse gets updated depending on the position of the mouse cursor.



NOTE: To set the 3 Zone navigation, you must switch to the SCENE 5 style user interface by clicking **Settings > Switch UI**. In the old UI, select **Tools > Options**, then click the **Navigation** tab.

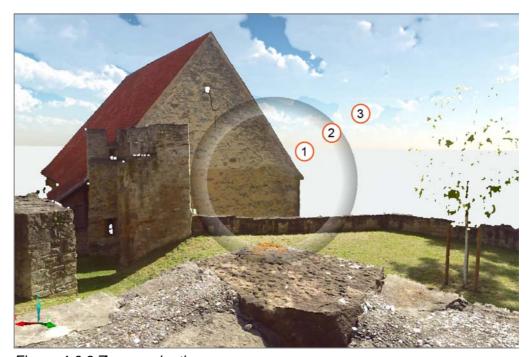


Figure 4-6 3 Zone navigation

- ① Fly Mode: Activated if the mouse cursor is in the inner of the ring.
- ② Roll Mode: Activated if the mouse cursor is on the ring.

③ Examine Mode: Activated if the mouse cursor is in the outer area of the ring.

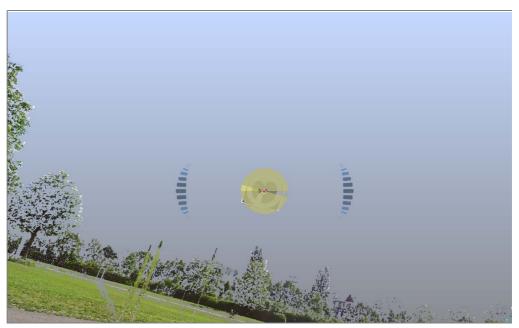


Figure 4-7 Scenery with Roll mode

To do this, click the ring and drag the mouse in any direction. A circle will appear in the middle of the view, indicating the rotation angle.

The **Fly Mode**

✓ of the observer-based navigation simulates flying through the 3D world.

- Clicking and dragging the 3D View with the mouse simulates a flight around the scanner's position.
- The cursor keys left, right, up, and down turn your head to the left, the right, forward, and backwards.
- The keys page-up and page-down move you up and down.
- In addition, you can press the shift key to accelerate these movements.

Pan Mode 🖔

There is no turning available in this navigation mode. Mouse movements are interpreted as observer movements.

Walk Mode **ℰ**

The **Walk Mode** of the observer-based navigation is similar to the fly mode but you are constrained by the XY plane, you travel along the XY plane. For example, the walk mode is useful to stay at the same height.

4.5.8 Camera Modes



Figure 4-9 View Modes

Perspective

Normally, the 3D View displays the scan points and objects with the correct field of view, in other words, objects of the same size appear smaller with increasing distance.

Orthographic

You can also change the view to an orthographic representation. Then, objects of the same size always appear the same size, regardless of how far away they are. This type of representation is common in a lot of CAD systems.

4.5.10 View All

(Not available in the Quick View)



Figure 4-11 View All

Changes the position of the observer in such a way, that a view on all the objects is achieved.

4.5.12 Predefined Views

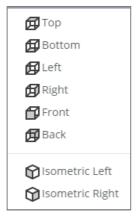


Figure 4-13 Predefined Views

Changes the position and viewing direction to view the complete SCENE from top, bottom, right, front, back, or in an isometric view.



NOTE: Double-click a scan point to fly to a location. SCENE will then zoom into the SCENE and close to the selected scan point. Cancel the movement by clicking and moving the view with the mouse, or with the respective keys.

4.5.14 Center of Rotation

The **center of rotation** (rotation point) is somewhere in the 3D world. It is set automatically by some functions, for example, when using the object-based navigation.

In the Fly mode, the center of rotation is set to the position of the observer.

To set it manually, click the **Set rotation point** button $\buildrel \diamondsuit$, then click the scan point or object.

4.5.15 Last Camera Position

The Last Camera Position button 🗗 moves camera to the last camera position.

4.5.16 Align Camera on Point

Click the Align Camera on Point button \Rightarrow , then pick a point in the 3D View to align the camera position to an estimated surface. The center of rotation will be set to the picked point.

4.5.17 Supersampling (

Switches supersampling on or off.

Supersampling renders the point cloud with a resolution higher than the resolution of your screen, and then shrinks the point cloud to fit the screen resolution.

This reduces anti-aliasing effects and gives the point cloud a smoother visual appearance. Fine and filigree structures look sharper, and stray points will appear less annoying. Set the resolution of the initially rendered point cloud compared to the screen resolution by selecting one of the options 2x2, 3x3, or 4x4.

For example, selecting 2x2 means that the point cloud will be rendered with a resolution that is 4 times the resolution of your screen.



NOTE: Objects like walls might appear transparent when using small point sizes in combination with supersampling.

High supersampling resolutions like 4x4 require large amounts of graphics card memory.

4.5.18 Gap Filling

Switches gap filling on or off.

If switched on, it will fill gaps between scan points that are physically close to one another. Gap filling can be defined as a predefined setting.

4.5.19 Clear View

Switches Clear View on or off. Clear View can be defined as a predefined setting.

4.5.20 Toggle Clipping Boxes ≥

If there are *Clipping Boxes (3D View)* placed in the 3D View, you can switch these on or off with the Toggle Clipping Boxes button &.

4.5.21 Point Sizes

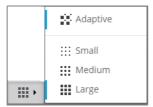


Figure 4-22 Point size settings

Toggles adaptive point size mode, and switches through three different point size settings.

4.5.23 Adaptive

Adaptive point size means, that if activated, the displayed size of each point adapts to its distance to the observer. The closer a point is to the observer, the larger it gets.

If adaptive point size is deactivated, points always are drawn with the same size in pixels. They get displayed with the same size on screen, no matter how distant from the observer they are located.

The three point size buttons scale the size of the points on the screen and can be used to influence the density of point visualization.

The 3D View is used just like the other views. In addition, in the 3D View you can position yourself at arbitrary positions in space and have a look at the scan points and CAD models. The mouse is used to define the turning movements you want to perform, and with the keyboard you define the actual movement in space.

Chapter 5: Settings

5.1 Settings Page

The **Settings page** provides options to specify or edit all SCENE settings in one place. All changes (except language changes) are immediately visible and applied after returning to a scan project.



NOTE: Settings are valid for all scan projects. As soon as you start working on a new scan project, it might be necessary to adjust some settings.



Figure 5-1 Settings button

- 1. Click the **Settings** icon 🌣 on the right side of the Workflow Bar.
- 2. Check the settings. If one of the settings is shown collapsed, click the header line to open it.
- 3. Modify the settings, if required.
- 4. Move to another setting. Your changes are immediately applied.

5.2 Settings Toolbar

The **Settings toolbar** offers some more functions:



Figure 5-1 Settings features

5.2.2 License Manager

The *License Manager* provides an overview over all licenses available for the currently running SCENE version and helps managing them.

5.2.3 Switch User Interface

To access some SCENE functions, you must switch to the SCENE Classic user interface.



Click the **Back** button to exit the **Settings** page, and to return to the Workflow Bar.

Reset All Settings button

Resets all SCENE settings to their predefined values.

A confirmation box similar to the reset of the individual categories will be shown.



NOTE: Reset All Settings does not only reset the settings visible and accessible in the new UI, but also all settings only accessible in the SCENE classic style user interface. Hidden and undocumented registry settings are also removed/set back to their predefined status.

5.2.4 Check for Updates

Click this button to open the **Updates and News** window. This window provides you the latest news from FARO about SCENE and SCENE Apps, demonstration videos, software updates, and more. This information is also displayed when you start SCENE, but you can see it any time by clicking this button.

5.3 General Settings

The **General Settings** page offers settings which are typically made only once and which are valid for all scan projects, for example country-specific settings, or the folder in which scan projects are to be saved.



Figure 5-1 Settings: General Settings

5.3.2 Language

Select the language of the user interface.



NOTE: The new language will be applied after a restart of SCENE.

5.3.3 Units

Select the units in which length and angle values are displayed.

The following options are available:

Length

Select one of the units of length:

- metric: Millimeter [mm], Centimeter [cm], Meter [m], or,
- Imperial: Inch [in], Feet [ft], Yard [yd], or,

US surveyor: Inch [in US], Feet [ft US], Yard [yd US].

The predefined setting is "Meter [m]".

Small sizes

Select one of the units for defining sizes. The options available are same as those for the **Length** option.

The predefined setting is "Millimeter [mm]".

The small sizes setting is used when presenting dimensions that are very small, such as the tensions the registration reports.

Angle

Select one of the units of angle: Degree [°], Radian [rad], or Gon [gon].

The predefined setting is "Degree [°]".

5.3.4 Project Folder

The project folder is in the predefined folder where scan projects will be saved. All projects listed in this folder will be displayed in the Project Selector. When you first open SCENE, the predefined project location will be a folder in C:\Users\<YourName>\Documents\FARO\Projects.

- 1. Click the **Browse** button ____ to open the file system browser. You can not enter a project folder path directly into the field.
- 2. Browse to the folder, or create a new folder.



NOTE: Only one folder can be defined as project location. If you need to have additional project locations, you can use symbolic links to refer to those locations.

The symbolic links must be placed your project folder and can point to an arbitrary folder (for example, on another drive).

5.3.5 Log File

In case of technical problems with SCENE, the FARO customer service may ask you for log files.

Enable logging if you experience problems during operating, and specify a folder in which the log files shall be saved to. When you first open SCENE, the predefined log file location will be a folder in

C:\Users\<YourName>\temp\SCENELogs.

- 1. Select the **Enable Logging** check-box.
- 2. Click the **Browse** button to open the file system browser. You can not enter a log file path directly into the field.
- 3. Browse to the folder, or create a new folder.

SCENE will then create log files which will be placed in the selected folder.

There will be one SCENE log file which contains overall information.

For operations like SCENE WebShare Cloud Export and Upload, separate log files are created.

5.3.6 Temporary Data Folder

This folder is used to buffer data during complex processes, for example the creation of point clouds. Therefore, sufficient disk space should be available.

When you first openSCENE, the predefined project location will be a folder in C:\Users\<your name>\AppData\Local\Temp\SCENETemp.

- 1. Click the **Browse** button ____ to open the file system browser. You can not enter a temporary data folder path directly into the field.
- 2. Browse to the folder, or create a new folder.

5.3.7 Reset General Settings

The Reset General Settings button will reset all the settings of this page.

- 1. Click the **Reset General Settings** button. A message box will be opened.
- 2. Confirm the reset by clicking the **OK** button.

The settings will be reset and the UI will automatically update to reflect the new settings.

5.3.8 User Interface

This section provides the option to activate or deactivate **Scanning** category or Tab in the user interface.

Check the Show Scanning Category option to activate Scanning.

5.3.9 Updates

SCENE version update checking can be enabled or disabled in the SCENE settings.

Check the **Enable Automatic Update Checking** option to activate update checking.

When enabled, the update checker checks directly at startup, if there is a new SCENE version available. Internet connection must be active on your system, for this option to function.

5.3.10 FARO Customer Experience Improvement Program

When you install SCENE, you are asked if you want to participate in the Customer Experience Improvement Program. If you click yes, anonymous usage statistics are sent to FARO. We collect the following information:

- The version number of the SCENE instance.
- The date and time that SCENE started and stopped. This allows us to detect crashes.
- The execution of some specific commands where we want to get more information about how they are used. This helps us to improve the software in the future and helps us understand what may have caused a crash.
- Tracing information that we have added to the software in order to help us investigate defects that have been reported, but which we cannot reproduce.

We use this information to help us understand how customers use SCENE so we can continue to make the software better. On the settings page, you can change your decision at any time.

5.4 Import settings

When importing scan data, it is often necessary to define the unit of length. In the **Import settings** page, you can set a default unit of length which is required for the import of some file format. Other determining parameters are to be set in the respective **Import** dialogs.



Figure 5-1 Settings: Import

5.4.2 Units

Default unit of length

Select one of the units of length:

- metric: Millimeter [mm], Centimeter [cm], Meter [m], or,
- · Imperial: Inch [in], Feet [ft], Yard [yd], or,
- US surveyor: inch [in US], Feet [ft US], Yard [yd US].

The default setting is "Meter [m]".

5.4.3 Reset Import settings

The **Reset Import Settings** button will reset all the settings of this page.

- 1. Click the **Reset Import Settings** button. A message box will be opened.
- 2. Confirm the reset by clicking the **OK** button.

The settings will be reset and the screen will automatically update to reflect the new settings.

5.5 Processing Settings

The Processing settings will be applied when a Process operation is started through the **Process Scans** button , or the **Process Scans** command in the context menu of a scan or cluster.

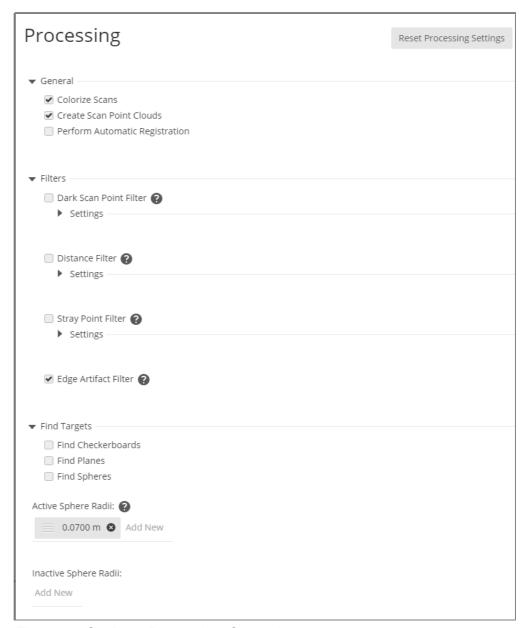


Figure 5-1 Settings: Processing, General

5.5.2 General



NOTE: The **Colorize Scans** and **Create Scan Point Clouds** settings are enabled per default. Changing these settings will change the default values that are used for processing scans.

Colorize Scan

If enabled, the scan will be colorized using the camera pictures.

Create Scan Point Clouds

If enabled, a scan point cloud for each scan will be created as last part of the processing.

Automatic Registration

Select that the project should be registered with an automatic registration after the processing of scans finished successfully.

The method used for the automatic registration is the method selected on the page.

5.5.3 Filters

In order to identify an inaccurate scan point, the filters compare the scan point with the scan points in the surrounding area. Some of them are filtering is performed based on information from the point. The surrounding area is oriented towards the scanner's recording technique, in other words, it is oriented towards the rows and columns, as they can be seen the **Planar View**.

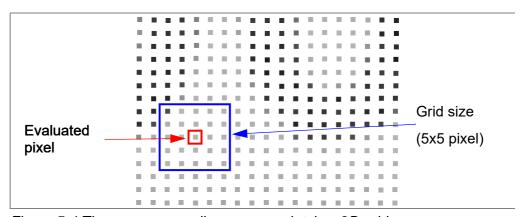


Figure 5-4 The area surrounding a scan point, in a 2D grid

In Figure 5-4 the surrounding area oriented towards the recording point is shown. The single scan point marked has the scan points within the surrounding square in its near vicinity. Using filters, you can set what should be regarded as the surrounding area. In this example, the value 5 was set, which means the edge length of the surrounding square is 5.

Dark Scan Point Filter

The Dark Scan Point Filter removes points based on a reflectance value. **Reflectance Threshold**: indicates the minimum reflectance value a scan point must have. The Reflectance Threshold range is: 0 to 2048.

This criterion is useful because with a dark scan point, only a very small amount of light entered the scanner and therefore the measurement will have an increase in noise.



NOTE: This filter is not applicable on colorized scan points.

Distance Filter

The Distance Filter simply removes all scan points which are outside of a certain distance range. All points with a distance less than the **Minimum Distance** will be deleted, as well as all points that have a larger distance than the **Maximum Distance**.

Stray Point Filter

The Stray Point Filter checks if the 2D grid cell of a scan point contains a sufficient percentage of points with a distance similar to the scan point itself.

Grid Size: the size of the surrounding area used for comparison. For each scan point of the scan or selection, the filter takes the valid scan points of this surrounding area and counts how many of them are at a distance to the scanner which is approximately the same as the distance of the scan point currently being viewed.

Distance Threshold: A scan point is counted if the difference in distance is smaller than the Distance Threshold.

Allocation Threshold: If at least the percentage of scan points indicated by the Allocation Threshold in the surrounding area is also within this distance threshold, the scan point remains in the scan. Otherwise it is removed.



NOTE: The Stray Point Filter is very well suited to correcting incorrect scan data. It also works well, if the **Allocation Threshold** is below 50%. However, the filter must not be applied on surfaces that were strongly inclined versus the scanner's laser. The filter is always applied to the whole scan. It is not possible to apply it only in selected areas.

Edge Artifact Filter

The Edge Artifact Filter is enabled by default. The filter is especially useful to remove artifacts at the edges of objects.

5.5.5 Find Targets

In the **Find Targets** section you indicate what types of targets, if any, that SCENE will try to find in the scans during processing. The target types are

checkerboards, markers, planes, and spheres. For information about which types of targets are best for your situation, how to position them, etc., see *Targets* on page 102.



NOTE: Finding targets is time consuming and should be enabled only when scans are registered with the Target Based registration.

Active Sphere Radii

Create a global list of sphere sizes. These sphere sizes will be used for target detection.

This list of user-defined sphere sizes will be shown in the settings page for future processing runs.

Inactive Sphere Radii

Specify additional sphere radii for sphere detection.

Drag & drop the sphere radii that are not required for the SCENE project, from the **Active Sphere Radii** to the **inactive Sphere Radii** list.

You can easily move items between the two lists and manage the sphere radii throughout the different scan projects.

5.5.6 Reset Process Scans Settings

The Reset Processing Settings button will reset all the settings of this page.

- 1. Click the Reset Processing Settings button. A message box will be opened.
- 2. Confirm the reset by clicking the **OK** button.

The settings will be reset and the user interface will automatically update to reflect the new settings.

5.6 Registration Settings

Adjustments made in the **Registration** settings page will affect the quality of the registration result.

Besides incorporating sensor data, SCENE supports two sophisticated registration methods that can also be used in succession.

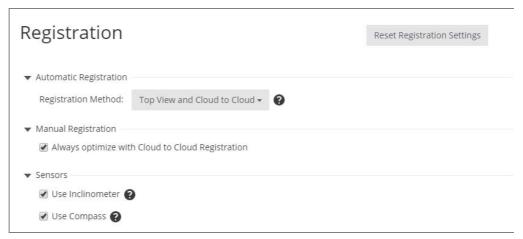


Figure 5-1 Automatic registration, Manual registration, and sensor settings

5.6.2 Automatic Registration

Registration method that will be used when performing the automatic registration task. Select among 3 options: Top View based registration, Cloud to Cloud registration, Top View first and Cloud to Cloud afterwards, or Target Based registration.

5.6.3 Manual Registration

Select, if you want to optimize each registered pair of scans with Cloud to Cloud registration or not. This optimization is always done before you are asked to select another pair of scans.

5.6.4 Sensors

The scanner's sensor data that will be used during registration.

- The inclinometer data will be used for Top View based and Cloud to Cloud Registration.
- The compass data will be used for Top View based registration.



NOTE: Sensor data can only be used when the sensors were enabled during scanning.

Inclinometer

Normally, inclinometer data is available, and this is used by default to level the scans during registration.

Leveling ensures that the z-axis of the registered scan corresponds to the z-axis defined by the inclinometer. By this technique one reference can be replaced during registration.

When registering with inclinometer data, this will be used as fully trusted information and all other registration objects will be used with lower priority.

Compass

If the scans were recorded with a FARO Focus Scanner equipped with a built-in compass, orientation information is available for the single scans. Enable this option to use this information as auxiliary information for the correspondence search. If the correspondence search cannot find any correspondences that are consistent with the compass data, this may be an indicator that the compass was influenced by environmental interference and the compass data will be ignored. If you disable this option, no compass data will be used for correspondence search at all.

5.6.5 Cloud to Cloud Registration Method

Subsampling

The result of the Cloud to Cloud registration can be adjusted through the subsampling rate. The value defines the size of the grid in which scan point homogenization is performed.

⇒ Set the slider to the value which should bring the desired result. As soon as you move the handle, the set value will be shown.

5.6.6 Top View Based Registration Method

Subsampling

The result of the Top View based registration can be adjusted through the subsampling rate. The value defines the size of the grid in which scan point homogenization is performed.

⇒ Set the slider to the value which should bring the desired result. As soon as you move the handle, the set value will be shown.

Reliability

The reliability value determines the amount of additional checks on a registration. It filters out results that could be contested. Higher values allow for more certainty, but could affect the time complexity of the algorithm.

⇒ Set the slider to the value which should bring the desired result. As soon as you move the button, the set value will be shown.

5.6.7 Target Based Registration Method

Find correspondences for scan positions

Select this check-box, if the position of a scan is known, for example by a surveyed reference point, or by a reference sphere representing the position of the scanner in other scans.

Force correspondences by target names

Select this check-box, if you want to force correspondences by target names.

The targets in each scan must be named according to their counterparts in the other scans.

This feature requires that targets were already detected by SCENE. In **Settings > Process**, select a target search, then run **Process**. After that, open

the cluster or the scans in **Explore**. You can then click the target's names the in Structure View and rename them.

Use Checkerboard Normals

Select, if you want to use normals of checkerboards for correspondence search.

Uncheck, if the direction of checkerboards has changed from one scan to another. For example, if you use checkerboard targets that can be tilted and turned for a precise orientation to the scanner.

Target Distribution Threshold slider

This slider sets the limit for registration. If targets are too near to one another, registration will be refused. In this case, lowering the limits gives you a result.

⇒ Set the slider to the value which should bring the desired result. As soon as you move the handle, the set value will be shown.

5.6.8 Registration Report

Thresholds for point error color coding

Values below the first threshold are shown in green color, and values above the second threshold are shown in red color. Values in between are shown in yellow color. The color codes are used in the Registration Report, the Project Dashboard, and the Scan Managers.

⇒ Set specific thresholds by clicking into the field and entering a new value.

Thresholds for overlap color coding

Values above the first threshold are shown in green color, and values below the second threshold are shown in red color. Values in between are shown in yellow color. The color codes are used in the registration report.

⇒ Set specific thresholds by clicking into the field and entering a new value.

5.6.9 Reset Registration Settings

Click the **Reset Registration Settings** button to reset all registration parameters to their predefined values.

5.7 Views settings

The **Views** settings page provide settings for the 3D View, Quick View, and Planar View.



Figure 5-1 Views settings

5.7.2 General

Explore

Check the **Automatically Open 3D View** option under Explore category. When you switch to explore category, a new 3D view is opened. You can uncheck this option if the 3D view takes a lot of time to load.

Measurement Properties

The **Measurement Properties** provides settings to set the displayed measurement distances for all views.

The following options are available:

- **Overall Distance**: This is the default setting. The overall distance measured between two points is displayed.
- **Horizontal Distance**: The horizontal measurement of the point-to-point distance is displayed.
- Vertical Distance: The vertical measurement of the point-to-point distance is displayed.

The selected distance measurements will be shown in 3D View, Quickview, and Planar View.

The chosen distance value will be displayed in all new measurement objects.

However, to change the displayed measurement distance for each individual measurement, use the **Measurement Object Properties** dialog.

5.7.3 3D View

The settings for the 3D View are separated into Display and Navigation settings. All these settings will be applied when a new 3D View is opened. These settings will not be applied to views which are already opened. Changing these settings will be used as new defaults for opening a 3D View.

Navigation

Default Mode

Select the navigation mode which shall be activated when you open a new 3D View. You can select among Fly, Examine or Smart mode as default navigation modes.

Invert Mouse Wheel

Changes the forward and backwards movement by the mouse wheel. The default behavior of the mouse wheel is: spinning it forward will move the view backwards in space and vice versa.

Default Speed

Change the speed of the left, right, forward and backwards movement triggered by pressing the cursor keys.

Accelerated Factor

This is the factor which is used to determine the accelerated speed. The accelerated speed is the factor multiplied with the default speed.

The accelerated speed is used by pressing the cursor keys in combination with the shift key.

The settings invert Mouse Wheel, Default speed and Accelerated Factor" will be applied to the opened view.

Display Settings

Effects

Supersampling – Supersampling renders the point cloud with a resolution higher than the resolution of your screen and then shrinks the point cloud to fit the screen resolution. This reduces anti-aliasing effects and gives the point cloud a smoother visual appearance. Fine and filigree structures look sharper

and stray points will appear less annoying. Set the resolution of the initially rendered point cloud compared to the screen resolution by selecting one of the options 2x2, 3x3, or 4x4. For example, choosing 2x2 means that the point cloud will be rendered with a resolution that is 4 times the resolution of your screen.



Figure 5-4 Supersampling turned off (left) and turned on (right)



NOTE: Objects like walls might appear transparent when using small point sizes in combination with supersampling.

High supersampling resolutions like 4x4 require large amounts of graphics card memory.

Gap Filling – The gap filler fills gaps between scan points that are physically close to each other.

Clear View – In the clear view mode, points in areas with low point density will be displayed more transparently and points in areas with a high point density will be displayed more brightly.

It adds transparency to the otherwise completely opaque point cloud rendering. This allows for viewing through walls or ceilings and may give a much better impression of the spatial structure of the underlying point cloud. Points in areas with low point density will be displayed more transparently and points in areas with a high point density will be displayed more brightly.



NOTE: Changing the effects will be applied if a new 3D View is opened. The effects which can be changed directly in the 3D View are only applied to the 3D View which is opened.

Gap filler or clear view can only be activated if supported by hardware.

Background

Select either a *Background Image for a 3D View: Environment Map*, or a gradient background color.

The gradient background color starts with the selected top color and transitions linearly to the selected bottom color.

- 1. Click the **Top Color** button to open the color selector dialog.
- 2. Select the color with which the background shall start at the top of the display.
- 3. Click the **Bottom Color** button to open the color selector dialog.
- 4. Select the color with which the background shall end at the bottom of the display.

5.7.5 Reset Views Settings

Click the **Reset Views Settings** button to reset all View settings parameters to their predefined values.

5.7.6 Background Image for a 3D View: Environment Map

SCENE offers solid or gradient color backgrounds in a 3D View. These are suitable for editing of point clouds, but when a realistic visualization is needed (like for capturing a video of an outdoor scene in the Video App), the result would look somewhat boring.

To make such scenes or videos look more realistic, you can add a so-called **Environment Map** as a background image.

The background image selected last will be used as a default setting for a new 3D View.



Figure 5-7 3D View with a solid gray background



Figure 5-8 Environment Map showing a cloudy sky

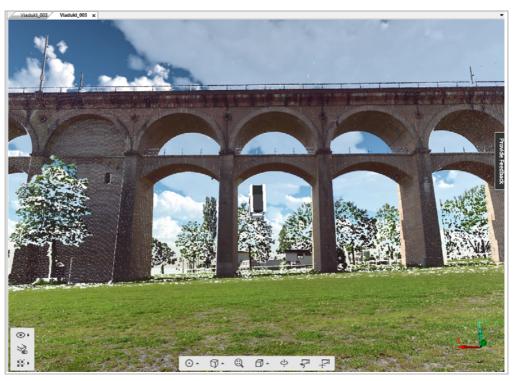


Figure 5-9 3D View with Environment Map

How to add an Environment Map

The usage of Environment Maps can be enabled in the Visibility Settings dialog of a 3D View.

1. Click the **Settings** button on the right side of the Workflow Bar, then select the **View** page.

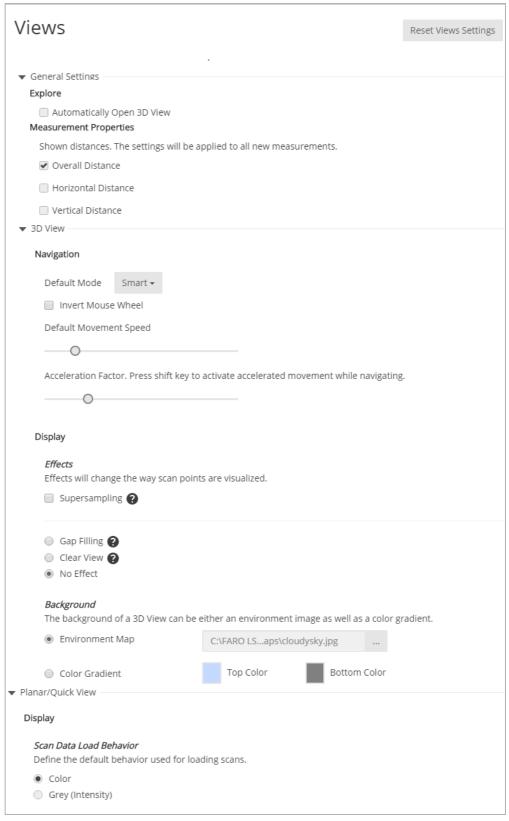


Figure 5-10 Selecting an Environment Map in Settings

- 2. To select a new Environment Map, click the **Browse** button ____. A dialog opens with the folder "Environment Maps".
- 3. Select your new background image and click **Open**. The file name is now shown in the View tab.

The selected Environment Map will be saved with the project. So, when another person on another machine opens the project, the Environment Map will again be shown as background image.

Limitations

At the moment, the Environment Map is only available for 3D Views with a perspective camera setting. For views with orthographic cameras, it is disabled.

Creating individual Environment Maps

If you need a special background image for your scan project, you can create it yourself.

It has to fit the following conditions:

- Aspect ratio 2:1, which means that it is twice as wide as it is high.
- The lower half of the image shall show "ground" and should not show too much structure.
- The image is later mapped to an imaginary spherical firmament.
- should look distorted because it is meant to texture a sphere. Professional graphics editors offer a feature called "Spherics" which may help in creating suitable images.
- · The left and the right end of the image must fit.

You can save the newly created Environment Map into the folder SCENE 7.2\EnvironmentMaps, but you can save it to any other folder as well.

Scan Data Load Behavior

Select the default scan load behavior to be used to load a scan for Planar or Quick View. By default, the scan is loaded in color mode.

5.8 Export settings

The **Export** settings page provides **Units** settings for exporting SCENE data.

5.8.1 Units

Set the default unit of length used to export data.

Select one of the units of length:

- Millimeter [mm], Centimeter [cm], Meter [m], or,
- Inch [in], Feet [ft], Yard [yd], or
- Inch [in US], Feet [ft US], Yard [yd US].

The default setting is "Meter [m]".



NOTE: Some export formats like PTX do not support user-defined **Unit** settings. They support only the metric system.



Figure 5-2 Export settings

5.9 SCENE WebShare Cloud settings

The SCENE WebShare Cloud settings page provides settings to login to SCENE WebShare Cloud.

5.9.1 Login

The login credentials will be used to automatically log in every time a connection to SCENE WebShare Cloud is required for **Import** or **Export** process.



Figure 5-2 SCENE WebShare Cloud Settings

Domain – Enter your organization's subdomain name on SCENE WebShare Cloud.

User Name (email) – Enter the user name to log in to SCENE WebShare Cloud.

Password – Enter the password with to log in to SCENE WebShare Cloud.

Login and Save Credentials – Click to save the login credentials to SCENE WebShare Cloud button. If the login is not successful, an error message is displayed and the credentials are not saved.

Chapter 6: Project

6.1 Introduction

The Project category provides the features for your entire scan project.

There are two sets of tool bars, one that shows up when no scan project is opened, and one that shows up when a scan project is opened.

6.2 Project Features when no Scan Project is Opened



Figure 6-1 Project toolbar when no scan project is opened

Create Project: Create a new scan project from scratch.

Open Project. Open an existing scan project. Clicking the little arrow opens a drop-down menu with the recently loaded scan projects.

Project Transfer. Transfer scan data from an SD Card, or from any other place.

6.3 Create Project

Create a new scan project. The new scan project and its project workspace are initially empty and you must fill them.

There are different ways to create new scan projects:

1. Click the Create Project button in the toolbar. The Create New Scan Project dialog appears:

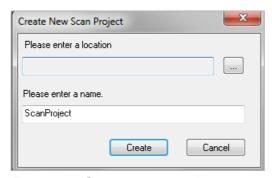


Figure 6-1 Create a new project

- 2. Enter a location, or click the **Browse** button ____ to open the file manager.
- 3. Enter a project name.

4. Click **Create**. All necessary files and structures will automatically be created at the selected location.



NOTE: When creating a new scan project from scratch, it will have an empty project workspace and you must fill it first with the appropriate scan files. SCENE offers several *Import* features to do that.

The scan project can be identified by the lsproj file which is accessible in the folder of the scan project. It is usually named like the scan project itself.



NOTE: You may also create a new project by transferring scan data from an SD Card, exporting an existing scan project, a cluster, or a single scan to a different location. For this, use the *Export* features.

6.3.2 Open Project

There are different ways to open new scan projects:

Recently loaded scan projects

- 1. Click the little arrow besides the **Open Project** button in the toolbar. A drop-down menu with the recently loaded scan projects opens.
- 2. Click one of the listed scan projects to open it.

Open existing project

- 1. Click the **Open Project** button in the toolbar. The **Open Existing Project** file manager is opened.
- 2. Enter a path, or browse to find the folder.



NOTE: The scan project can be identified by the .1sproj file which is accessible in the folder of the scan project. It is usually named like the scan project itself.

3. Click Open.

6.3.3 Read-Only Projects

Working with the project workspace

Working with the project workspace means working on the scan project directly; you can modify, create, add or delete any kind of data a scan project can have. Saving your changes will immediately modify the data of the centrally provided scan project. Scan projects maintain a history of changes of their data. Every save operation will create a new revision of the project.

Write-lock

A write-lock for all shared data of the scan project will assure that only one user is able to modify shared data at a time. All modifications made to the scan project will be visible to other users after are saved.

When users try to access the scan project while a write lock already exists, the scan project will only be opened in read-only mode.

- The SCENE title bar contains a new additional read-only warning string between the project name and the SCENE version.
- When trying to save a read-only project, the option to save a workspace is only available in the recent user interface.
- When trying to save a project opened in read-only mode, the message box informs that you must open the project with write access to be able to persist modifications.

6.3.4 Project Transfer

The Project Transfer task can be used to transfer scan projects (laser scanner and Freestyle^{3D} projects) from a source folder to a target folder.

A typical example for a project transfer is the SD card import. If an SD card is inserted, the **SD Card Transfer** task will open automatically, and the SD card will be used as predefined source folder.

Transfer scan projects from a storage medium

- 1. Select the source folder. If you wish to change the predefined folder, carry out the following steps:
 - Click the **Browse** button ____ to open the file system browser. You can not enter a project folder path directly into the field.
 - · Browse to the folder.
- 2. Select the target folder.
- 3. Select the **Process** check-box if the imported project shall be processed automatically after the import is finished.



NOTE: If you do not only wish to process the scan project but even to register its scans afterwards, check *Settings* > **Processing**.

4. Click the Start Transfer button to open the Configure Project Transfer dialog.

Transfer scan projects from SD card

If you insert an SD card and SCENE is already running, the **SD Card Transfer** dialog will be shown after some seconds.

If a scan project is already opened, this scan project has to be closed before the SD Card transfer can start. In this case, the **SD Card Transfer** dialog will show a warning.

- ⇒ Click the Yes button to start the SD Card Transfer task.
- 1. Select the scan projects to be transferred by unchecking the **Transfer** check-box of those which shall not be transferred.
- 2. Select the **Process** check-box if the imported project shall be processed automatically after the import is finished.
- 3. Select the target folder. If you wish to change the predefined folder, carry out the following steps:

- Click the **Browse** button ___ to open the file manager. You can not enter a project folder path directly into the field.
- · Browse to the folder.
- In the folder, select the scan project file, which is a file with the file ending .fws or .lsproj.

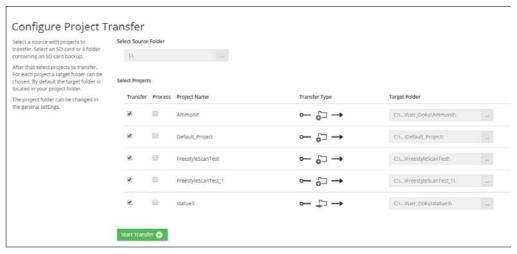


Figure 6-5 Project transfer dialog

For every project to be transferred, SCENE will search for a matching project name in the predefined project folder.

- 4. Click the **Start Transfer** button to start the transfer and finish the task.

After the transfer was performed, the task gets closed and a message is shown in which all projects are listed.

6.4 Project Features for an Opened Scan Project



Figure 6-1 Project toolbar for an opened scan project

Close Project: Closes the currently opened scan project. Before, you will be asked if you want to save the scan project. If you click **Yes**, you can enter a comment, and the author's name. You can also select if the project point cloud shall be updated before closing the scan project.

Project History: Shows all revisions of a scan project.

Wipe Project History: Deletes the project history, which means, that all revisions will be lost.

6.4.2 Project History

All revisions of a scan project are available in the Project History.

Click the **Project History** button to open the history of a scan project.

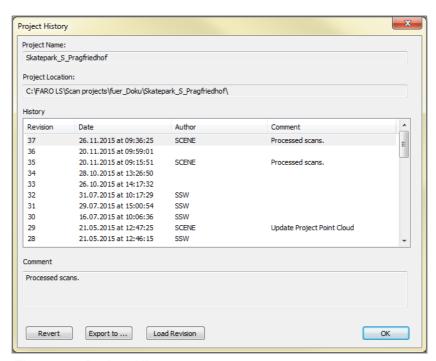


Figure 6-3 Project History

The project history shows all revisions of a scan project, together with a user name, and the information that had been entered when the scan project was saved.

6.4.4 Wipe Project History

As a project grows over time, numerous revisions may accumulate in the scan project history. Thus it may become necessary to reduce the number of revisions and the amount of stored data, for instance when an important

milestone has been reached and the individual steps are no longer needed. At this point you may delete all revisions, and save a new revision.

NOTICE



The scan project history is deleted.

All information about the history of a project will be lost. You will no longer be able to revert the project to a previous revision afterwards.

- 1. Click the **Wipe Project History** button. After confirming a warning message, the Share Changes dialog opens.
- 2. If required, modify the entry.
- 3. Click the **OK** button. SCENE will then start to create a new revision.



NOTE: If revision history is critical, you should use the *Export* features to export the scan project. Exporting the scan project will perform a cleanup and compact function but stores the results in a new scan project. The revisions of the original project will be kept.

6.5 Project Workspace

The project workspace contains all the objects required to process the scans, making the analysis comprehensible. This typically includes:

- Links to the scan files.
- Scan folders or clusters which define the structure of a scan project. They
 organize many scans into a manageable arrangement.
- Geometric objects identified in the scans as well as their fit objects.
- Reference to external coordinate systems.
- Documentation objects, which provide information about user defined points of interest in the scans or in the point cloud.
- Measurements
- CAD models for comparing scanned reality with the existing plans.

6.5.1 Scans

Scans are the scan files as they are recorded by the scanner with their millions of data records that include position, reflectance, and color for single scan points. Scans consist of scan points that were recorded from a single scanner location. They are organized in a row column order.

6.5.2 Scan Point Clouds

Scan point clouds are an alternative representation of the scans and must be created from the single scans. Scan point clouds are organized in a spatial

data structure that facilitates fast visualization of scan points and automated point loading based on point visibility. They may facilitate and accelerate the processing of the scan points.

6.5.3 Project Point Cloud

The result of a scan project in SCENE typically is a comprehensive project point cloud of the scanned object.

Unlike scans and scan point clouds, the project point cloud consists of the points of all the scans within your scan project and can be seen as a comprehensive point cloud of the complete scan project. It is typically created from all the single scans in your project after they have been preprocessed, colorized and registered.

Like the scan point clouds, the project point cloud is optimized for fast visualization of large amounts of scan points in the 3D View and is organized in a spatial data structure that facilitates fast visualization of the scan points. The project point cloud consists of the points of all the scans within you scan project and can thus be seen as a comprehensive point cloud of the complete scan project. For this reason, the amount of points in a project point cloud can be enormous. Unlike scan files, such large amounts of points cannot be loaded into physical memory at once. Therefore, the points of the project point cloud are automatically loaded and visualized on demand based on the camera position and point visibility. The automated point loading of the project point cloud is able to visualize hundreds of scans at once. This empowers you to actually see all scans of a scan project at once regardless of whether they fit into your computer's physical memory or not. Manual scan file loading is not necessary.

As the point cloud visualization technique is constantly loading scan points from the hard disk drive based on point visibility, the overall performance strongly depends on the speed of your hard disk drive. While project point clouds outperform all other visualization methods (including scan point clouds) on regular hard disk drives, we recommend using a solid state drive for maximum performance. Using a solid state drive will also speed up the process of creating the project point cloud.

The benefits of the project point cloud are:

- · Very fast visualization of large amounts of scans at once
- One optimized single spatial data structure for all scan points in a project
- Can be accessed from all local workspaces associated with the project.

6.5.4 SCENE WebShare Cloud Data

SCENE WebShare Cloud data is created from the scans and consists of panoramic scan images which can be put on the Internet, thus enabling you to share scan information of your scan project with others.

6.6 Creating New Workspaces

You can create a new workspace by

- drag & drop a scan file (with the extension .fls) from a file system browser into SCENE. SCENE will then open a new workspace which contains only this scan.
- drag & drop a raw scan folder from a file system browser into SCENE.
 SCENE will then open a new workspace which contains the scans of this folder.
- double-clicking on a scan file (with the file extension .fls). SCENE will then
 open a new workspace which contains only this scan.

A new workspace initially only exists in SCENE and not as a file in the file system, nor is it associated to a scan project. For this, you must explicitly save the workspace.



NOTE: When importing workspaces and scan projects, data will be imported from the current revision.

6.7 Local Workspaces

Local data

Local data is owned and maintained by users and is not visible to others until changes are shared with the scan project. Scan data becomes local data once it is modified and stays local until the changes are shared with the scan project.

Local workspaces

A local workspace is saved in the file system as a file with the extension .fws (scan files have the extension .fls). Each local workspace has an associated folder in which local changes to scan project data will be stored. This folder has the same name as the local workspace and is created in the sub-folder "Workspaces" of the folder of the local workspace file.

After creating a new local workspace, this folder will contain a predefined folder structure but otherwise will be empty. No project data is copied until changes have been made and saved.

By default the local workspace will access the shared data of the latest revision of the associated scan project.



NOTE: To create a local workspace, switch to the recent user interface by clicking the **Switch User interface** button in the **Settings** toolbar.

In the further course of this document the general term "workspace" is used, when the described functionality covers both, the local workspace as well as the project workspace; else it will be distinguished between both and the terms "local workspace" or "project workspace" will be used.

6.8 Workspace Structure

All objects in the workspace are arranged in a hierarchy so that they are easier to find. This is similar to the file system, where the files are placed in folders, which can also be nested hierarchically.

On the top level of the workspace hierarchy, you can find the following folders:

Documentation – contains the documentation objects.

References – contains survey data and any self made reference points.

Measurements – contains the measurement logs.

Models - contains CAD models.

Scans Folder

Contains scans.

This folder is usually named according to the name of your scan project and might have several scan subfolders depending on the structure of your scan project.

In the **Structure View**, you can see the hierarchy of the objects.

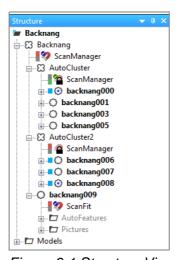


Figure 6-1 Structure View

Cluster folders

The **Scans** folder may contain folders which again contain scans. Such a folder is called **Cluster**. A cluster again may contain other cluster folders.

Scan

A scan is also essentially a folder which, apart from scan points, can also contain additional information, like objects (however, no further scans).

With the exception of the scans in a scan group, you can rearrange the objects within the hierarchy. To do this, select an object and using drag & drop, move it to the folder in which you require it to be located. You can do this in the **Structure View** and in the **Planar View**. If you use the left mouse button, the properties of the object will not change. Especially the local coordinates will not change. But because of the hierarchy of coordinates it may have changed

its *Global Coordinates*. If you use the right mouse button, an additional context menu opens with which you can decide what should happen with the object.

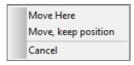


Figure 6-2 Structure View: Drag & drop object with right mouse button

Here you can select that the object should keep its global position.

Layers

Apart from this hierarchy, the objects are also assigned to layers. Layers are used to group objects independently of their hierarchy and to control the visibility of these object groups. For example, in your CAD model, you can place the interior walls of a building on a separate layer. If you then make this layer invisible, you very easily obtain an impression of the available floor space in the building.

6.8.3 Naming conventions

Workspace The workspace itself is named like the scan project. If it is a local workspace, it

is named 'Workspace'.

Objects You can give most objects their own names, which may only contain letters,

numbers, the point '.' and the underscore '_'.

Scans Scans cannot be renamed.

References The References folder should not be renamed because it is used for

registering the scans.

Screenshots The Screenshots folder can be renamed.

Chapter 7: Import

7.1 Introduction

This chapter gives an overview of the formats that are supported by SCENE to import scans, projects, objects, or images.



Figure 7-1 Import features

- Import Scans will import scans and point clouds. This includes FARO
 Laser scanner files (FLS), E57 files, PTZ files, PTX files, and unstructured
 point data in ASCII XYZ. With PTX and ASCII XYZ files, you must make
 sure that the scan points in the scan file are arranged so that they
 correspond to the row or column-oriented recording process of the scanner.
 You also must make sure that the scan was not registered.
- **Import Projects** will import SCENE Projects and Workspaces into existing projects. Note that this is different from simply opening a project.
- Import Objects will import VRML files and reference points.
- Import Images will import images as a layout plan, virtual scan, or simple image.
- Import SCENE WebShare Cloud will start the SCENE WebShare Cloud Import assistant.

7.2 Import by Drag & Drop

The easiest way to import scan projects, scans, images, or objects is by drag & drop a file into SCENE.





NOTE: Drag & drop is not only available in the **Import** window. You can also use it in all other steps in which the Structure View is available. Drag & drop a file to its place in the Workspace.

- 1. Additionally to SCENE, open a file system browser, for example, MS Explorer.
- 2. Click the **Import** button in the Workflow bar.
- 3. In your file system browser, select the file to be imported.
- Drag & drop the file to SCENE in the blue Drag & Drop field. The Drag & Drop field will change its size and its color (to green) as soon as the file is accepted.

Depending on the type of the file, the following would happen:

7.2.1 Importing a scan project

The scans and objects of the newly imported scan project will be added to the currently opened scan project.

7.2.2 Importing a scan

The newly imported scan can be found in the Structure View, in the cluster the mouse pointer was when dropping the file. You can move it to another cluster, again using drag & drop.



NOTE: Newer versions of the FARO Focus Laser Scanner allow the creation of scan groups, which are several scans created without moving the scanner.

One use for scan groups is to make a complete 360° scan, and then to make several higher-resolution partial scans of the targets that are visible in the first scan. This reduces the total time needed to scan the area, while still getting high-quality scans of the targets to ensure that registration is accurate.

7.2.3 Importing an image

After dropping the image file, the **Import Pictures** dialog will open.

The newly imported images can be found in the Workspace, in the **Pictures** folder.

7.2.4 Importing an object

After dropping the object file, a dialog will open in which you can adjust some settings. Those settings depend on the file format of the object.

The newly imported object can be found in the Workspace: objects in VRML format in the **Models** folder, objects in CSV format in the **References** folder.

7.3 Import Scans

The **Import Scans** feature allows to import scans and point clouds. This includes FARO Laser Scanner files (FLS), E57 files, PTZ files, PTX files, and unstructured point data in ASCII XYZ format.

- 1. Click the Import Scans button in the Import toolbar.
- 2. Browse to select the files which you want to import.
- 3. Click the **Open** button.

After closing the file manager, SCENE will start to import the selected files and shows the progress.

The newly imported scans can be found in the Workspace. You can move them to a cluster by drag & drop.



NOTE: When importing files with a space in the file name, this space will be automatically replaced by an underline.

Cancel Import

You can cancel this import process by clicking the Cancel button.

The **Cancel** button will not stop the import immediately, but after importing the current file. This is the reason why the **Cancel** button is not available if the import was started for only one file.

When the **Cancel** button was clicked, it will be grayed and the status message is updated.

7.3.1 General Scan Data Format .xyz

An xyz file can contain different information, like row and column for each scan point, RGB values, and intensity values.

There are two variants to import an xyz file:

- If the xyz file contains x and y coordinate information: the data is imported as a scan. The x coordinate, y coordinate, z coordinate and the reflection value are specified for each scan point.
- If the xyz file doesn't contain x and y coordinate information: the data is imported as point cloud. Two additional specifications are made for each scan point: the row and the column in the planar representation

When importing, it is assumed that the coordinates will be received in the selected import unit.

When importing a xyz file that contains both, RGB and intensity values, the RGB values are used.

7.3.2 Scan Data Format .ptx

PTX is an ASCII based interchange format for point cloud data, which is usually created with the scan software Leica Cyclone.

This format is especially suited for exchanging scan points and their corresponding coordinate transformation.

All values are given in ASCII and are metric. The first line states the number of columns, the second line the number of rows. In the next line, the translation part of the transformation is given (a 3D vector). After that, 3 lines with the rotation part follow (a 3x3 matrix). The next 4 lines contain the full transformation (a 4x4 matrix). Finally the scan points are written, one scan point per line: x, y, z, and a reflection value. In addition, 3 RGB values may follow. The reflection value is between 0 and 1.

When importing a PTX file, the following dialog opens:

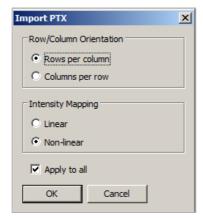


Figure 7-3 PTX import dialog

Row/Column Orientation

Rows per column – The input file contains the data column-wise, i.e., it starts with all the rows of the first column, then all rows of the second column, and so on. Good when importing FARO PTX files.

Columns per row – The input file contains the data row-wise, i.e., it starts with all columns of the first row, then the second row, and so on.

Intensity Mapping

Linear – A linear mapping of intensity values to gray values.

Non-linear – A non-linear mapping of intensity values to gray values. Good when importing for example Leica PTX files.

- If the PTX file contains RGB values, intensity mapping is not done. The RGB values are used instead.
- If the PTX file contains both, RGB and intensity values, the RGB values are used.



NOTE: If your input looks like garbage in the Planar View, but seems to be OK in the 3D View, try to import again with a different row/column orientation.

Apply to all

If the **Apply to all** check-box is selected and you click the **OK** button, it will apply the same settings for the following scans and not ask anymore.

If you uncheck Apply to all, the dialog will appear for the next scan again.

If you click the **Cancel** button, the import will abort for the current scan and all following scans. Scans that were already imported will remain.

7.3.4 Scan Data Format .ptz

PTZ is the binary data format of Leica HDS scan files, which are usually created with the scan software Leica Cyclone.

When importing a PTZ file, the following dialog opens:

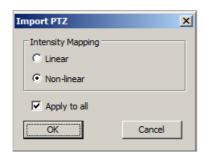


Figure 7-5 PTZ import dialog

Intensity Mapping

Linear – A linear mapping of intensity values to gray values.

Non-linear – A non-linear mapping intensity values to gray values. Good when importing for example Leica PTZ files.

If the PTZ file contains colors, intensity mapping is not done. The colors are used instead.

Apply to all

If the **Apply to all** check-box is selected and you click the **OK** button, it will apply the same settings for the following scans and not ask anymore.

If you uncheck **Apply to all**, the dialog will appear for the next scan again.

If you click the **Cancel** button, the import will abort for the current scan and all following scans. Scans that were already imported will remain.

7.3.6 Scan Data Format .e57

This scan data format is a vendor-neutral standard for storing point cloud data produced by 3D imaging systems. The "ASTM E57 3D file format" (officially ASTM E2807) is a format for three dimensional imaging data such as laser scans. The E57 file used as shorthand for "ASTM E57 3D file format" and is a combination of binary data and XML (extensible Markup Language).

An E57 file can store 3D point data, attributes associated with 3D point data such as RGB and/or intensity values.¹

SCENE supports the import of several features of the E57 file. When importing, the E57 file has to contain xyz or spherical coordinates as well as RGB and/or intensity values for each scan point. If the E57 file contains RGB and intensity values, the RGB values are used.

^{1.} The specification of the new format is available on http://www.astm.org/Standards/E2807.htm. SCENE uses the library libE57 V1.1.312 to write and read E57 files.

If the E57 file doesn't contain information about row/column ordering, the following dialog opens:

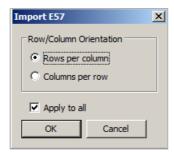


Figure 7-7 E57 import dialog

⇒ Select the correct ordering of the file, then click the **OK** button.

Row/Column Orientation

Rows per column – The input file contains the data column-wise, i.e., it starts with all the rows of the first column, then all rows of the second column, etc.

Columns per row –The input file contains the data row-wise, i.e., it starts with all columns of the first row, then the second row etc.

Currently, SCENE doesn't support import or export of associated 2D images.

Apply to all

If the **Apply to all** check-box is selected and you click the **OK** button, it will apply the same settings for the following scans and not ask anymore.

If you uncheck **Apply to all**, the dialog will appear for the next scan again.

If you click the **Cancel** button, the import will abort for the current scan and all following scans. Scans that were already imported will remain.

7.4 Import Projects

The **Import Projects** feature allows to import SCENE scan projects and Workspaces.



NOTE: The **Import Projects** feature will only work if a valid SCENE project or workspace is already open.

- 1. Click the **Import Projects** button **↓** in the **Import** toolbar. The file system browser will open.
- 2. Select the file format "Projects And Workspaces (*.lsproj, *.fws)".
- 3. Browse to select the files which you want to import.
- 4. Click the Open button.

The scans and objects of the newly imported scan project will be added to the currently opened scan project.

7.5 Import Images

The **Import Images** feature will import images as layout plan, virtual scan, or simple image.

There are three ways to use images in SCENE:

- Images can be added with their original resolution to the workspace and thus provide additional information about the scan environment.
- Images can be added with their original resolution to the workspace and thus provide additional information about the scan environment. These images are imported into the 3D world into virtual scans with their full resolution. Such images will be interpreted like a high resolution scan of a plane surface and can be placed on arbitrary positions in the 3D world.
- Images can be used to add color information to already existing scan points.
- 1. Click the **Images** button in the **Import** toolbar. The file system browser will open.
- 2. Select the file format "Image Files (*.bmp, *.jpg, *.png)".
- 3. Browse to select the files which you want to import.



NOTE: File names of imported images cannot be renamed. Ensure that the image file has the name you want before importing it into SCENE.

4. Click the **Open** button.

The following dialog appears:

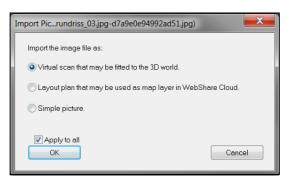


Figure 7-1 Import image dialog

5. Select for what you want the image to be used. If there are several images for one application, select **Apply to all**, or select the appropriate ones.

7.5.2 Import high resolution pictures as virtual scans

This method allows you to include high resolution pictures (for example, digital photos of important details in the scan environment) into the 3D world by importing them with their full resolution as *virtual scans*.

Such pictures will then be interpreted as a high-resolution scan of a plane surface and can be placed in an arbitrary position in the 3D world.

For this, import a picture into SCENE as virtual scan (see above).

If you choose to create a virtual scan, the picture will be placed in the scan folder of the Structure View and be marked with a special icon signifying that it is a picture with 3D information.

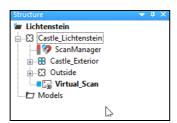


Figure 7-3 Virtual Scan in the Structure View

Initially, the virtual scan is scaled in such a way that the longest side of the picture is equal to 1 meter. The initial position in the 3D world is in the origin of the coordinate system.



Figure 7-4 Virtual scan in 3D View

The main application for virtual scans is to complement existing 3D scans with detailed information from high resolution photos of flat surfaces.

In this case, size and location of the virtual scan are fixed and can be determined by using the **Place on Surface** command under **Operations** > **Registration** in the virtual scan's context menu.

The command **Place on Surfaces** scales and places the virtual scan in the 3D world using a plane and corresponding points in the virtual scan and a scan in the 3D world. The command **Place in 3D** places the virtual scan upright in the 3D world.

The technique to place and scale virtual scans is similar to the one used to colorize existing scan points. This time, however, new points are created from the pixels of the picture and added at the proper position in the 3D world.

Place on Surface

The position of the virtual scan is defined by a plane that has to be created in one of the scans at the approximate position where the virtual scan should be placed. The exact position and size on this plane is then determined by selecting matching points in the virtual scan and in a real scan.

- 1. In the Structure window, right-click the virtual scan, then select **View** > **Planar View**. A new tab opens which shows the virtual scan.
- 2. In the Structure Window, right-click the scan in which the virtual scan shall be placed, then select **View** > **Planar View** or **Quick View**.
- 3. Use the **Mark Plane** function to mark the area where the virtual scan shall be placed.

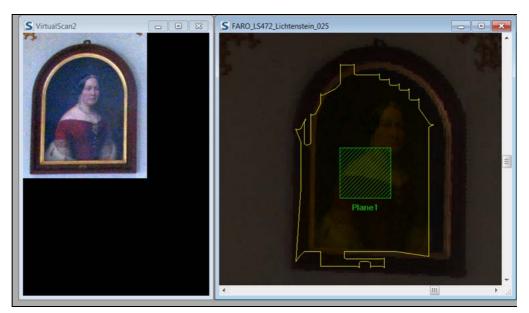


Figure 7-5 Mark Plane to place Virtual Scan

4. In the Structure window, right-click the virtual scan and select **Registration > Place on Surface**.

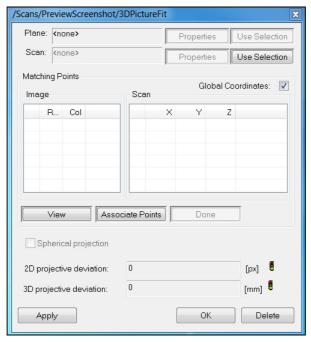


Figure 7-6 Place and scale dialog

- 5. In the Structure window, click the scan, then click **Use Selection** in the dialog.
- 6. In the Structure window, click the plane, then click **Use Selection** in the dialog.
- 7. Click **Associate Points**. The mouse pointer changes and is displayed cross-shaped.
- 8. Mark at least 4 suitable scan points in the virtual scan. Each scan point position is listed in the **Image** column in the dialog.

9. Mark the corresponding scan points in the scan. Take care to keep the same order. Each scan point position is listed in the **Scan** column in the dialog.

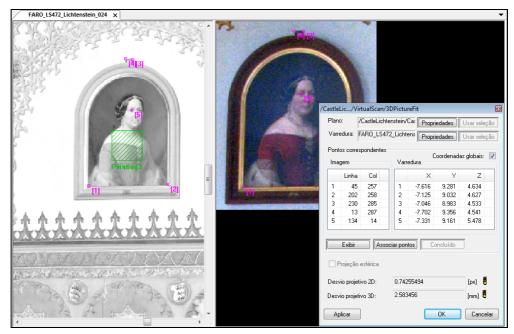


Figure 7-7 Associate points

10. When you are done selecting points, click **Done** to place and scale the virtual scan.



Figure 7-8 Placed and scaled virtual scan in 3D View

11. Open the scan folder or cluster in 3D View.

12.In the Structure window, right-click the virtual scan and select **Locate**. The virtual scan is now displayed at its new place.

Place in 3D

- 1. In the Structure window, right-click the virtual scan, then select **View** > **Planar View**. A new tab opens which shows the virtual scan.
- 2. In the Structure Window, right-click the scan in which the virtual scan shall be placed, then select **View** > **Planar View** or **Quick View**.
- 3. Use the **Mark Plane** function to mark the area where the virtual scan shall be placed.

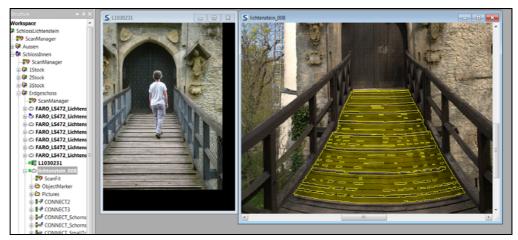


Figure 7-9 Arrange Virtual Scan and Scan

4. In the Structure window, right-click the virtual scan and select **Registration > Place in 3D**.

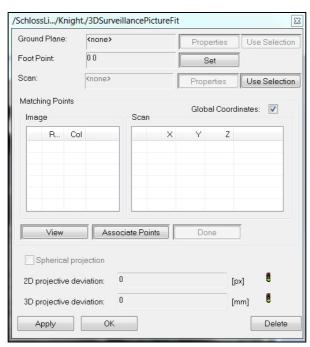


Figure 7-10 Place and scale dialog

5. In the Structure window, click the plane, then click **Use Selection** in the dialog.

- 6. In the Structure window, click the scan, then click **Use Selection** in the dialog.
- 7. Click **Associate Points**. The mouse pointer changes and is displayed cross-shaped.
- 8. Mark at least four suitable scan points in the virtual scan. Try to find scan points in all three dimensions. Each scan point position is listed in the **Image** column in the dialog.
- 9. Mark the corresponding scan points in the scan. Take care to keep the same order. Each scan point position is listed in the **Scan** column in the dialog.

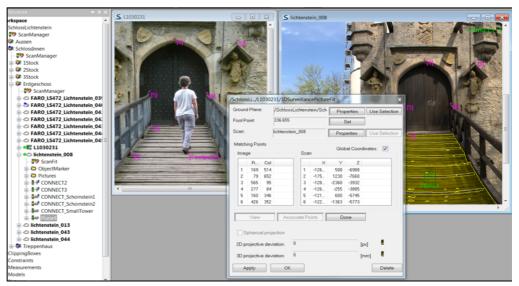


Figure 7-11 Associate points

- 10.In the dialog, click the **Set** button beneath **Foot Point**.
- 11.In the virtual scan, click a scan point that is suitable as placing point. This coordinates are now displayed as Foot Point.
- 12. When you are done with selecting points, click **Done** to place and scale the virtual scan.
- 1. Select the virtual scan.
- 2. Select **Measure points**
- 3. Measure an object.

Measure

Show positions in 3D View

Open the scan folder or cluster in 3D View.

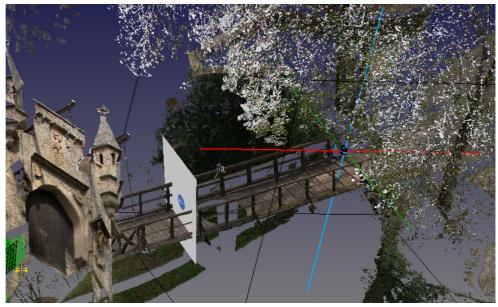


Figure 7-12 Laced virtual scan and camera position in 3D View

The virtual scan is now shown at its new place, not in original but plane-shaped. To find the camera position, search the 3D View for a suitable small camera symbol. If you click the camera symbol, the orientation of the camera is displayed.

7.6 Import Objects

The **Import Objects** feature allows to import VRML files and surveyed reference points.

7.6.1 Importing VRML files

To compare the scanned reality with the models from the CAD system, you can import the model into SCENE. For this, the model must be the multi-vendor-capable VRML (Virtual Reality Modeling Language) data format. A lot of CAD systems give you the option of exporting models this format. For this, read the instructions for your CAD system.

Although the VRML standard recommends a specific coordinate system and a specific unit of length, not all VRML files are modeled that way. The standard defines the unit of measure of the world coordinate system to be meters, and a coordinate system which the y axis points upwards.

Because many VRML files are modeled differently, you can select different.

When importing a VRML model, you can ask SCENE to combine any meshes the model into a single one.

SCENE does not support all objects or object properties that are available VRML. The following parameters are not transferred:

- · Light sources
- Textures with 8 or 16 bit per pixel (use 24 bit per pixel instead)

- · The in-line node
- 1. Click the **Import Objects** button \Rightarrow the **Import** toolbar. The file manager will open.
- 2. Select the file format
 - "All Object Files (*.wrl, *.wrl.gz, *.cor, *.csv)", or
 - "VRML 2.0 (*.wrl, *.wrl.gz)", or
- 3. Browse to select the files which you want to import.
- 4. Click the Open button.

7.6.2 Importing surveyed reference points

External Reference Objects

Usually external reference objects are measured with survey equipment like total stations. For spheres, the survey point lies the center point of the sphere. For circular flat papers, the survey point lies the middle of the light circle, which stands out clearly from the surrounding darker border. Finally, for checkerboards, the survey point lies the center point of the four quadrants.

Survey data can be imported .csv file format into SCENE. You can import the survey data to workspace level or into a specific folder or cluster. Survey data is displayed a Reference folder in the workspace.

In the selected location, a folder called References contains a separate object for each survey point with the name and coordinates from the survey file.

External references are mainly used for pairwise registration.

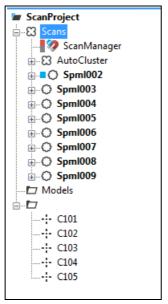


Figure 7-3 Clusters: Scans, indoor, Kitchen, Living Room and Outdoor

When registering scans within a cluster, external references are not mandatory. Nevertheless, existent external references will be used and will have a higher weighting in the registration algorithm than scan references.

If external references are available, the Reference folder of the cluster is used first. If not, the Reference folder of the next available higher leveled cluster is used.

For example, if you want to apply the **Place Scans** command to cluster "Kitchen" the example above, the external references the **References** folder of the kitchen folder will be used.



NOTE: When importing survey data, SCENE uses a right-handed coordinate system.

External references are only used with the target based registration



NOTE: In some applications, scans shall be registered without referring to higher-leveled references. In this case, create an empty Reference folder on the same level as the cluster with that scans, or create it somewhere between the cluster and the Reference folder which would be used.

Each row of the file contains one single reference point with the following specifications: name, x coordinate, y coordinate, z coordinate, and measurement quality. All four specifications must be given and must be separated by the same separator, which can be a blank space, a colon, a semicolon, or a tab. The coordinates are specified in the unit that has been defined in **Settings > General**.



NOTE: SCENE uses a right-handed coordinate system.

- 1. Click the **Import Objects** button \hookrightarrow in the **Import** toolbar. The file system browser will open.
- 2. Select the file format "Surveyed points (*.cor, *.csv)".
- 3. Browse to select the files which you want to import.
- 4. Click the **Open** button.

7.7 Import SCENE WebShare Cloud project modifications back to SCENE

If you have scan projects uploaded to SCENE WebShare Cloud, this scan projects might be modified by, for example, adding measurements or

annotations. You can import those modifications back to SCENE. Follow the steps below to do this:

- 1. Click the little arrow in the **Create SCENE WebShare Cloud Data** button in the scan project toolbar.
- 2. Click Import SCENE WebShare Cloud Data from the drop down menu.

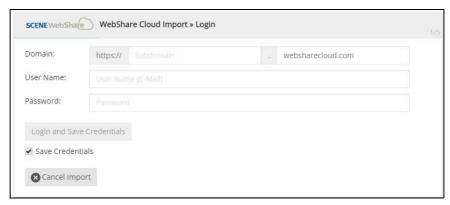


Figure 7-1 SCENE WebShare Cloud import dialog – Login

Domain – Enter your organization's subdomain on SCENE WebShare Cloud.

User Name (email) – Enter the user name with which you log in to SCENE WebShare Cloud.

Password – Enter the password with which you log in to SCENE WebShare Cloud.

Save Credentials – Click to save your login credentials so that you do not have to enter them again in the future.

Cancel Import – Click to stop importing, and return to the scan project.

Select project

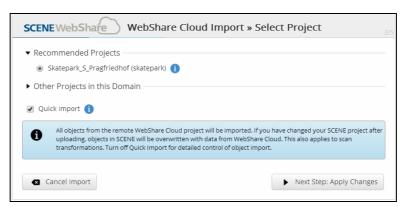


Figure 7-2 SCENE WebShare Cloud import dialog - Select project

Recommended Projects – the SCENE WebShare Cloud project which is most similar to the one opened in SCENE will be displayed.

Other Projects in this Domain – click the little arrow to see all the scan projects saved in this domain. If you want to import the contents of one of these projects, select it by clicking its check box.

Quick Import – the contents of the scan project are imported with default settings. Click the **Next Step: Apply Changes** button to import the scan project.

If you want to modify those settings, clear the Quick Import check box. Two additional dialogs are then shown in which you can specify the import process.

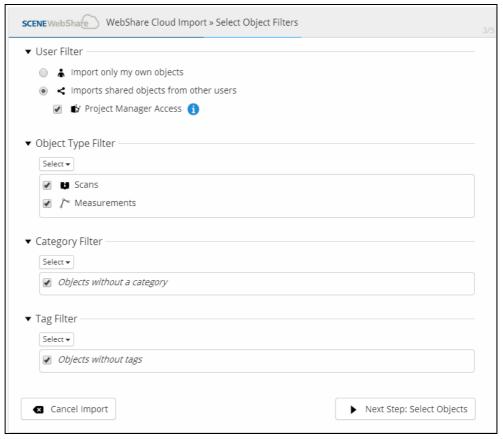


Figure 7-3 SCENE WebShare Cloud import dialog – Select Object Filters

Select Object Filters

User filter

Select, if you want to import the modifications you made yourself, or if you want to import the modifications of other users as well.

If your SCENE WebShare Cloud role is Project Manager, you will be able to import all the modifications, even those which were set to "private" by one of the other users.

Object type filter

Select, which type of objects shall be imported. Click the **Select** button to select all object types, or none of them. If you select "none", you must reselect at least one of the check boxes below.

Category filter

Objects without a category – select, if you want to import objects although they have no category.

Category name – select, if you want to import all objects which are linked to this category.

Tag filter

Objects without tags – select, if you want to import objects although they have no tags.

Tag names – select, if you want to import all objects which are tagged with this tag name.



Select Objects

Figure 7-4 SCENE WebShare Cloud import dialog – Select Objects

Select at least one of the objects in the list. If you need more information on an object, click the button. SCENE WebShare Cloud will then open **Show Properties** for this object.

Objects to be Updated

Click the objects which shall be updated. Click the **Select** button to select all objects of one type which shall be updated, or none of them. If you select "none", you must re-select at least one of the object check boxes in the list.

Objects to be Created

Click the objects which shall be created. Again, click the **Select** button to select all object types, or none of them. If you select "none", you must re-select at least one of the object check boxes in the list.

Click the **Apply Changes** button to start the import.

Final report



Figure 7-5 SCENE WebShare Cloud import dialog – Final report

The Final Report shows a list of what has been imported. If you need more information on an object, click the button. SCENE WebShare Cloud will then open **Show Properties** for this object.

Save Report – Click this button to receive a machine readable report. A dialog will open in which you can browse for a saving location.

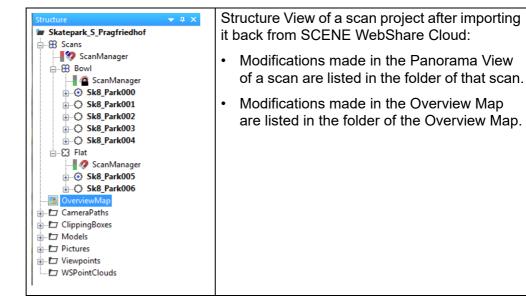
Close report – Click this button to close the report. This will not save the imported changes. To save the changes, use the regular SCENE saving function.

The Final Report also shows errors which may occur while importing, for example:

 The scan project in SCENE includes an object with the same name as one in the SCENE WebShare Cloud project, but it is not the same object. Such an object will be given a default name. A parent object is missing. It may happen that you uploaded a scan project
to SCENE WebShare Cloud, and, in the meantime, deleted one of the
scans in your scan project in SCENE. If you or someone else created
objects in that scan in SCENE WebShare Cloud, these objects cannot be
imported back anymore.

Check import in SCENE

You can now open one of the scans to see the imported objects. These objects are listed in the Structure View as well.



Chapter 8: Processing

The **Processing** toolbar offers a tool to process

- the entire scan project
- a cluster
- · a scan.

Some settings are restricted, depending on the selection:

- If at least one of the selected scans has already a scan point cloud, the creation of scan point clouds is enforced for all selected scans to ensure data consistency.
- If a scan was selected, the automatic registration is not available. The automatic registration option only makes sense for clusters and the complete project.



NOTE: There is a second possibility to start Processing during executing **Explore** features: in the Structure View, right-click the scan project, cluster, or scan, then click **Process Scan**.

8.1 Process

Processing will perform the following steps depending on the selected settings in the **Configure Processing** for each scan.

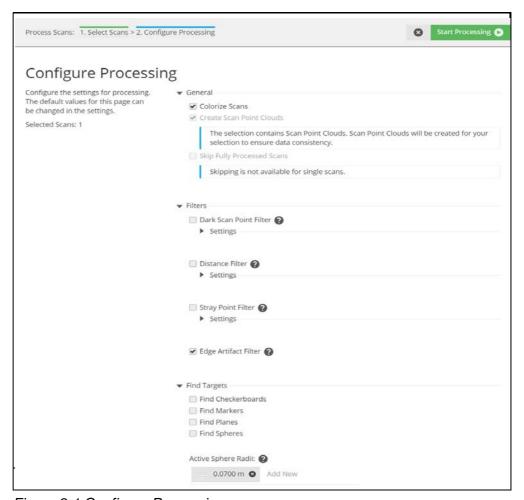


Figure 8-1 Configure Processing

8.1.2 General

Colorize Scans

If you have a scan taken by a laser scanner with the color option, this scan will also contain the digital pictures which the scanner took automatically during the scanning. These pictures will be applied to color the scan if the colorize option is selected.

Create scan point cloud

Scan point clouds will be generated if the related option is selected.

8.1.3 Filters

Dark Scan Point Filter

The Dark Scan Point Filter removes points based on a reflectance value. **Reflectance Threshold**: indicates the minimum reflectance value a scan point must have. The Reflectance Threshold range is: 0 to 2048.

This criterion is useful because with a dark scan point, only a very small amount of light entered the scanner and therefore the measurement will have an increase in noise.



NOTE: This filter is not applicable on colorized scan points.

Distance Filter

The Distance Filter simply removes all scan points which are outside of a certain distance range. All points with a distance less than the **Minimum Distance** will be deleted, as well as all points that have a larger distance than the **Maximum Distance**.

Stray Point Filter

The Stray Point Filter checks if the 2D grid cell of a scan point contains a sufficient percentage of points with a distance similar to the scan point itself.



NOTE: The Stray Point Filter is very well suited to correcting incorrect scan data. It also works well, if the **Allocation Threshold** is below 50%. However, the filter must not be applied on surfaces that were strongly inclined versus the scanner's laser. The filter is always applied to the whole scan. It is not possible to apply it only in selected areas.

Edge Artifact Filter

The Edge Artifact Filter is enabled by default. The filter is especially useful to remove artifacts at the edges of objects.

8.1.4 Find Targets

The **Find Targets** section allows to select targets like checkerboards, planes, and spheres. These will then be searched in each scan during processing.



NOTE: Finding targets is time consuming and must be enabled only when scans are registered with the Target Based registration.

Find Checkerboards

An often used type of paper targets is the checkerboard target. A checkerboard target fit determines the center point of the target's four quadrants. Select this option to find checkerboards and use them for scan registration.

Find Markers

Select this option to find Markers. Markers are printed targets with a unique ID.

Find Planes

Select this option to find planes and use them for scan registration.

Find Spheres

Three-dimensional, white spheres that come in various sizes. The advantage of spheres is that they can be placed at any angle to the scanner. Select this option to find spheres and use them for scan registration.



NOTE: Sphere search works with spheres meant for registration. Forensic spheres may not be found by this target search.

The global list of sphere sizes set in the **Settings > Processing** page are displayed in the active and inactive sphere radii list.

Active Sphere Radii

Click **Add New** and specify new sphere radii. These sphere sizes will be used for target detection.

This list of user-defined sphere sizes will be used for processing the scans in the current processing task run.

Inactive Sphere Radii

Click **Add New** and specify additional sphere radii for sphere detection.

Drag & drop the sphere radii that are not required for the current project, from the Active Sphere Radii to the inactive Sphere Radii list.

You can easily move items between the two lists and manage the sphere radii for processing the scans in the current project.

8.1.5 Automatic Registration

Perform Automatic Registration

Select this option to enable automatic registration after the processing. If the automatic registration is enabled, the following registration settings will appear.

Select among the 4 options in the drop-down list:

- Top View based registration
- Cloud to Cloud registration
- Top View and Cloud to Cloud (top view first and cloud-to-cloud afterwards)
- Target Based registration

According to the selected options in the drop-down list, further sub-options are displayed for setting. For example, if the Top View and Cloud to Cloud option

is selected, then the General, Top View and Cloud to Cloud sub options are displayed.



Figure 8-6 Automatic Registration Method: Top View and Cloud to Cloud

8.1.7 Start processing

- 1. Start Processing by clicking the **Process Scans** button.
- 2. Select a scan, a cluster, or the entire project. Then, click the **Configure Processing** button.
- 3. The **Configure Processing** dialog provides the same settings as the *Processing Settings* dialog, and also some options for automatic registration. However, here, the settings are only valid for this task.

8.2 Results

When processing is finished, a dialog is shown in which shows the results.

The dialog is color coded:

- green: all scans were successfully processed. Clicking the result line will show the list of scans.
- yellow: some scans were successfully processed, but there are scans
 which need special treatment. This dialog would consist of two parts: a list
 of scans which were processed successfully, and a list with scans which
 could not be processed. Clicking the result lines will show the list of scans.
- red: no scan could be processed.

Chapter 9: Registration

9.1 Background knowledge

What is Registration?

Scan points are recorded and saved in a coordinate system which is relative to the scanner. The point of origin for this scan coordinate system is the position where the laser meets the mirror. The coordinates of this point are x = 0, y = 0, z = 0. If you have two or more scans taken at different locations in a room, right after scanning each scan will only know its own scan coordinate systems. But of course in reality the origins of these scan coordinate systems are at different positions in the room, so it is necessary to determine the spatial relationship between them. This is called *registering the scan*, and the step from the scan coordinate system into the overall coordinate system is called *transformation*.

The scans of your scan project might have a rough initial placement derived from the sensors of the laser scanner (GPS, Altimeter, Inclinometer or Compass), but, in general, it is still necessary to perform a scan registration to get a more precise spatial relationship between the scans. This initial scan placement thereby facilitates scan registration.

9.2 Registration Dashboard

The Registration Dashboard will guide you through the registration process. You will always be informed of the status, and it will help you to perform the necessary steps to get the desired results.

The Registration Dashboard shows a hierarchical view of the registration relevant objects: clusters and scans.

For clusters, it includes their current registration status, and it allows registration relevant actions on the cluster.



Figure 9-1 Registration Dashboard

① **Automatic registration**: you will be asked to select the cluster, and an automatic registration will be executed afterwards.

- Manual registration: you will be asked to select the cluster, and a manual registration will be executed after you have marked some scan points which the scans in this cluster have in common.
- 3 Recommendation button: click to execute the recommended type of action.
- 4 Automatic registration: will register this cluster automatically.
- Manual registration: will register this cluster after you have marked some scan points which the scans in this cluster have in common.
- Registration Report: shows the Registration Report.
- ① **More** button: provides additional cluster handling functions.
- Wint: The hint is shown when you use the Recommendation button. It suggests what is the best to do next with the cluster.

To view a specific scan or cluster, collapse or un-collapse a cluster by clicking on it.

If you click the preview image, it will be shown enlarged.

9.2.2 Registration Status

Colors

For each cluster, the current registration status is shown with a colored line in front of the cluster's name. The registration status describes how well the subordinate clusters or scans are registered against each other.

The following colors are possible:

Green

A registration was performed and successful and you verified the result.

- Yellow
 - A registration was performed and successful, but you did not verify it yet.
 - A registration was successfully performed and verified by the user, but an optimization is recommended through the used registration method.
- Red
 - This cluster is not registered at all.
 - A registration was performed but failed.

Hints

The Registration Dashboard shows a hint, if available, for a cluster. The hint can help you with what is the best to do next with that cluster. The following hints are possible:

Perform Manual Registration

Perform a Manual Registration on this cluster.

• Perform Automatic Registration

Perform an Automatic Registration on this cluster.

· Optimize Registration

Optimize the registration result by performing a Cloud to Cloud Registration or target based registration if targets exist.

· Verify registration

A registration on a cluster was performed, but you have not verified the result yet.

9.2.3 Registration Dashboard – Filter functions

The elements shown in the **Registration Dashboard** can be filtered by name.

Filter by name

Use the text field shown to filter by names. As soon as you start typing a search string, the filter is automatically applied. Clear the search field by clicking the **Clear Entry** button.

9.3 Clusters

A cluster usually collects scans which somehow belong together, for example scans which were recorded on the same floor of a building, or scans which were taken in the same room. Scan groups, created during the scanning process, are also automatically put into a clusters when they are imported into SCENE.

The Registration Dashboard allows to modify clusters in a fast and comfortable manner.

9.3.1 Add Cluster

- 1. In the Registration Dashboard, click the **More** button ____, then click the **Add Cluster** button. A new cluster will be inserted in subordinate level below the one in which you clicked the button.
- 2. If required, name the new cluster, and click the ♥ button.

Drag and drop cluster

If you want the cluster at another place, drag and drop it to its new place. SCENE checks if it is allowed to drop the cluster at the new place.

9.3.2 Disband Cluster

In the Registration Dashboard, click the **More** button ____, then click the **Disband Cluster** button. The cluster and its scans will be added to the superordinate cluster. Note that clusters which are scan groups cannot be disbanded.

9.3.3 Delete Cluster

- 1. In the Registration Dashboard, click the **More** button ____, then click the **Delete Cluster** button. A warning message will be shown.
- 2. Click the **OK** button to delete the cluster and its content.

9.3.4 Mark Clusters as Finished

Sometimes clusters are already registered correctly, but SCENE keeps suggesting additional steps because SCENE assumes the cluster is not yet finished. This can happen, for example, when a project was registered with an older version of SCENE, or if you decline to optimize the registration.

In such cases the **Mark as Finished** feature can be used to force a clusters status to finished (green).

- ⇒ In the Registration Dashboard, click the **More** button . , then click the **Mark as Finished** button. The display of the option will be changed to look active.
- ⇒ Click again to disable the Marked as Finished status.



Figure 9-5 Finished cluster

If this feature is enabled for a cluster, the cluster will be shown as finished (green) and contains a hint that explains the status (to not confuse it with the finished status computed by SCENE).

When you click the hint, a popup is displayed. The button at the bottom can be used to restore the clusters registration status as it was computed by SCENE.



NOTE: The activation works recursively. That means if you enable **Mark as Finished** for a cluster, all subordinate clusters will be also marked. The same applies for removing the **Mark as Finished** status. All subordinated clusters will get their "real" registration status back.

The **Marked as finished** feature does not lock the cluster or prevents any other manipulation of the cluster. It is just a flag that tells SCENE that the cluster should be always displayed as finished. Any registration task can be started as usual on the cluster, but you will not be able to see the resulting registration status until you remove the Mark as Finished flag.

9.4 Targets

Targets are physical objects in the area to be scanned that SCENE can detect and use to register the scans. A target can be a naturally occurring plane such as a wall or desk, or you can use extra objects made specifically to function as targets. These artificial targets are spheres, checkerboards, and markers.

Planes, Spheres, Markers, or Checkerboards?

There are several things to consider when deciding which type of targets to use.

- Since planes probably exist in the environment you are scanning, you don't
 have to do anything extra to use them. But you can't be sure that your
 environment will have enough planes, and you can't document the location
 of the target by other means, i.e., via GPS coordinates.
- Spheres are highly accurate at any angle to the scanner and are often used in conjunction with GPS coordinates, but they are more expensive than printed targets, and can be bulky to transport.
- Both checkerboards and markers can be printed with your laser printer.
 They are easy to transport and replace, but they do not work if they are placed at an oblique angle to the scanner.
- Checkerboards, when scanned at right angles, can be detected at greater distances than other types of targets.
- Markers and planes can be automatically detected in scans made by both the Laser Scanner and the Freestyle Scanner, so you can use one set of targets for both types of scanner.

9.4.1 Spheres

Three-dimensional, white surveying spheres can be used as targets. A sphere is determined by its position and its radius, and its central point is used for the registration. Hence, you can add global position information to the sphere's property.



NOTE: Sphere search works best with surveying spheres that are meant for registration. Forensic spheres (used for determining trajectories) may not be found by this target search.

Spheres with preset radius

This type of sphere is particularly well-suited to fitting survey spheres, because their radius is known in advance. Use one of the following options to create spheres with a preset radius:

- During the Manual Registration, select the Mark Sphere button $^{\mathfrak{D}}$.
- Right-click a scan or a scan point selection, then click Find Objects. In the menu, select Spheres.

You can predefine one or more sphere radii under **Settings** > **Processing**.



Figure 9-2 Fitted survey sphere

9.4.3 Checkerboards

A frequently used type of paper target is the checkerboard target. A checkerboard target fit determines the center point of the target's four quadrants. This point is used for scan registration.

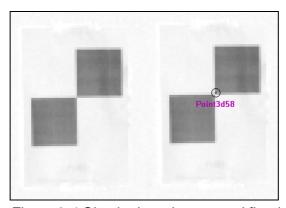


Figure 9-4 Checkerboard target and fitted checkerboard point

Creating checkerboard points

- During the Manual Registration, select the Mark Checker button 🛅.
- Right-click a scan or a scan point selection, then click **Find Objects**. In the menu, select **Checkerboards**.

9.4.5 Markers

Markers are a third type of target that can be used for registration. Markers are printed and used like checkerboards, but unlike checkerboards, markers are unique. This means that correspondences between scans are only possible for markers with the same ID. After installing SCENE, a PDF-file containing 200, A4-size pages each with one marker and one unique ID can be found at:

<Installation Path>\ RegistrationMarkers\RegistrationMarkersA4.pdf

You can print the markers at a reduced size in order to cover up less of the area that you are scanning but this will change the maximum distance at which the markers can be detected. The table below shows the distances at which

markers can be detected depending on scan resolution and marker size. Note that the markers must be placed orthogonally (at right angles) to the scanning direction to reach these limits.

Scan Resolution	Marker size 100% 15.5cm (6 in)	Marker size 75% 11.7cm (4.5 in)	Marker size 50% 8 cm (3 in)
1/8	3 m (9 ft, 10 in)	3 m (9 ft, 10 in)	2.5 m (8 ft, 2 in)
1/4	6.5 m (19 ft, 8 in)	5.2 m (17 ft)	4.2 m (14 ft, 9 in)
1/2	16 m (52 ft, 6 in)	8.3 m (27 ft, 2 in)	5.3 m (17 ft, 6 in)



NOTE: To print the markers at 100% on US letter size paper, select *Actual Size*, instead of Fit or Shrink. The A4 pages will be trimmed slightly but the markers and IDs are not affected.



Marker IDs *must* be unique within a project. Ensure that you do not include two markers with the same ID in the scan area.

9.5 Automatic Registration

The Automatic Registration looks for similar geometric constellations in the scans. The result can then be viewed and evaluated in the Correspondence View.

Automatic Registration uses inclinometer data, if activated in **Settings** > **Registration**.



NOTE: Check the Registration Settings for the type of Registration to be executed. You can select among 4 options:

- · Target based,
- · Top View based registration,
- Cloud to Cloud registration,

Top View first and Cloud to Cloud registration afterwards.

9.5.1 Select Cluster

There are three ways to start an Automatic Registration:

- Click the Automatic Registration button in the toolbar. You will then be asked to select a cluster.
- Click the Automatic Registration button in a cluster line. Select the settings to start registration.
- Click the recommendation to perform an Automatic Registration in a cluster line. Select the settings to start registration.

Automatic Registration from the header line

- 1. Click the Automatic Registration button 🛱 in the header line.
- 2. Select a cluster, then click the **Select Method** button on the upper right side. The **Select Method** dialog is shown.
- 3. In the drop-down menu on the left side, select the registration method. Available registration methods are: Top View Based, Cloud to Cloud, Target based, and a combination of Top View Based and Cloud to Cloud registration.
- 4. For Target based, a Verify Targets selection is available. Selecting this check-box will show a list with scans located under the cluster that should be registered. Each scan can be viewed either in a 3D View or a Quick View. For manipulation of targets mark tools are provided. Furthermore it is possible to delete individual targets by selecting them in the Quick View or in 3D View, and pressing the Del key.
- 5. On the right side, the available settings for this registration method are shown. This settings correspond with those in the *Registration Settings* page. If necessary, modify the settings. Your modifications will now be valid for the current registration. It will not change the settings made in the Registration Settings.
- 6. Click the **Register and Verify** button on the upper right side.

 The registration is executed. Depending on the number of scans in this cluster, this may take some time.
- 7. Verify the registration.



Figure 9-2 Automatic Registration task, first step: select a cluster

Automatic Registration from the cluster line

- 1. Click the Automatic Registration button 🕏 in the cluster's line.
- 2. Click the **Select Method** button on the upper right side. The **Select Method** dialog is shown.
- 3. In the drop-down menu on the left side, select the registration method. Available registration methods are: Top View Based, Cloud to Cloud, Target based, and a combination of Top View Based and Cloud to Cloud registration.
- 4. On the right side, the available settings for this registration method are shown. This settings correspond with those in the *Registration Settings* page. If necessary, modify the settings. Your modifications will now be valid for the current registration.
- 5. Verify the registration.

9.5.3 Register and Verify

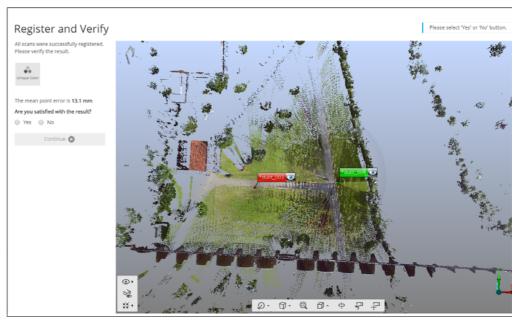


Figure 9-4 Registration task, verification: 3D View

A 3D View is displayed with which you can check if the registration was successful.

Use the

- Camera Mode buttons ☐ and View buttons ☐ in the task panel to change the observers view,
- View All button to get a view on all the objects,
- Unique Color button in the task panel to switch between scan colorization modes ("color per scan" or "original scan colors").

Registration was successful

In the verification step, you are asked if the registration was successful.

Yes: the cluster is marked as registered and you are returned to the dashboard.

No: marks the registration of the cluster as failed and continues to the dashboard which will suggest a manual registration for the cluster.

Registration failed but Auto Clusters are found

If the automatic registration failed but could create one or more Auto Clusters with some partial results, the verification step for partial results will be displayed.

- 1. Decide which of the Auto Clusters you want to keep. When the task step opens, a 3D View showing all generated Auto Clusters is opened first.
- Select a view to check the Auto Cluster. For this, use the 3D View or Registration Report button for each of the generated Auto Clusters. Additionally, there are also some tools shown in the task step that are useful for this verification step.

Every Auto Cluster that is not selected will be disbanded and its scans will be moved back to the parent cluster. The selected auto clusters will become normal clusters and are marked as registered.

The **Finished** button is colored green and clickable since this step is shown. Clicking this button finishes the task and returns you to the dashboard. The selected clusters from the verify step are shown yellow with the hint that the registration should be optimized.

9.5.5 Optimize Registration

Optimize Registration executes a Cloud to Cloud registration or target based Registration if targets are existing, with the settings you have made in the *Registration Settings*.



If there is an **Optimize Registration** step at all depends on the settings you have made in the *Registration Settings*. **Optimize Registration** is only available if you select **Top View based registration** for the Automatic Registration or Manual Registration. **NOTE:**

The result is not satisfying?

Select the **No** check-box and click the **Other Pair** button. You are returned to the **Select Scans** step, and you are asked to select the next scan pair.

9.6 Manual Registration

The Manual Registration can be executed for a cluster.

It offers the possibility to identify corresponding scan points of two scans by picking such scan points. As soon as there are sufficient corresponding scan points, SCENE will register the two scans. The result can then be viewed and evaluated in the Correspondence View.

Manual Registration uses inclinometer data, if set in the Registration Settings.

There are three ways to start a manual registration:

Manual Registration from recommendation

Click the recommendation to perform a Manual Registration in a cluster line.

Manual Registration from the header line

- 1. Click the Manual Registration button \$\iii\$ in the header line.
- 2. Select a cluster.

Manual Registration from the cluster line

Click the **Manual Registration** button $\ \ \ \ \ \ \ \ \ \$ in the cluster's line.

9.6.1 Select scans

When a cluster is selected, **Select Scans** is shown. In this step, scans or clusters that must be registered with each other, can be selected.

- 1. Click **Select Scans** on the upper right of the header line. Now, the display is divided into two columns, and each column shows previews of the scans in the selected cluster.
 - You can filter the lists by name. Enter the string in the Find name... field above each column.
 - It is also possible to sort the scans by Recording Time and Name. Click the text to open the selection, then select the type of sorting. Click the small field with the triangle to sort upwards or downwards.
 - For the right column, it is possible to sort by the Best Match. Best Match
 means that scans with a similar recording date as the selected scan on
 the left side are shown first. For every sort method except for the Best
 Match, it is possible to reverse the sort order by clicking on the triangle
 next to the drop down.

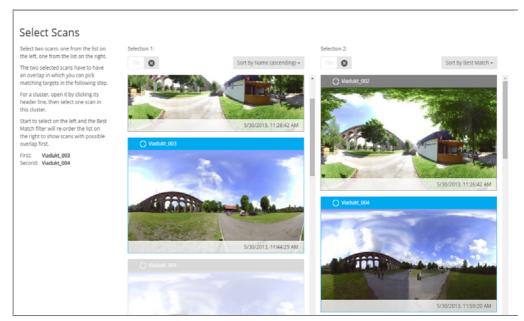


Figure 9-2 Manual Registration task, first step: select scans

- 2. Select a scan by clicking its preview. The header of scan preview is marked blue. The preview of the this scan in the other column will be grayed and is no longer accessible.
 - If by accident the wrong scan was clicked, simply click another one.
 - If a cluster contains a subordinate cluster, the scans in these cluster are displayed as a single flat group of scans. To register such a subordinate cluster, pick one representative scan. Selected subordinate clusters are also framed in color, they can be expanded or collapsed.
- 3. Change to the other column and select a second scan by clicking its preview. Again, the scan preview is marked with a blue triangle in its upper left corner. The preview of the same scan in the other column will be grayed and is no longer accessible.

9.6.3 Mark Targets

- 1. Click the **Mark Targets** button on the upper right side of the header. Now, the display changes to the **Split View**.
 - In the column on the left side, SCENE will show buttons, notes, and advices which guide you through the registration.
 - The two windows show each the two selected scans in a Quick View.



NOTE: Some types of scans will be shown in a 3D View, for example Freestyle^{3D} scans.



Figure 9-4 Manual Registration task, second step: select targets

- 2. Rotate, move, zoom the two scans until you have them in a useful position, i.e., they show the same part of the scenery.
- Check for natural targets like points or planes, or artificial targets like spheres, markers or checkerboards which could be useful and which are not marked yet.
 - Select the Mark Point button 🏃 to mark a point.
 - Select the Mark Plane button button to mark a plane.
 - Select the Mark Sphere button button to mark a sphere target.
 - Select the Mark Checker button ¹ to mark a checkerboard target.

Select the Mark Marker button to mark a Marker



NOTE: Points are typically hard to mark because it is difficult to determine where exactly they are in a 3D View. If you have the chance to mark planes, mark the planes.

Plane Normals

A plane is identified by the fact that it is level, i.e., there is precisely one direction that the plane stands perpendicular to (actually, there are two such directions; however, they are exactly opposite to one another). This direction is called the Normal of the plane.

Some types of scans will be shown in a 3D View, for example Freestyle^{3D} scans.

In this case, an additional **Invert Plane Normal** button is displayed on the image, This button can be selected to invert the Normal. This avoids that the scan is placed with a flipped orientation.

4. Mark the targets by hopping and clicking between the windows.

If SCENE detects that there are correspondences among the newly marked objects, or one of the newly marked target corresponds to an earlier marked target, it will mark them with a label.



NOTE: A label shows a name with a maximum of 9 characters. If the name has more characters, only the last 8 will be displayed and an asterisk (*) will replace the missing characters. As soon as you click a label, the name is shown completely.



Figure 9-5 Split View with detected correspondences

The label then has a small green field with a "C" which indicates that those correspondences were found automatically.

The frame around the label symbolizes the quality of the correspondence:

- · Green: good quality
- Yellow: compromised quality
- · Red: seriously compromised quality
- 5. Continue with marking correspondences until the button on the upper right side changes from Mark Targets to Register and Verify, and gets a green color. This means that there is a sufficient number of correspondences to perform the registration.

Delete specific targets or correspondences

It may happen that, at the end, your scans would show marked targets which were not needed for a correspondence, or you want to delete a correspondence because it is wrong.

⇒ Right-click the correspondence, then click **Delete 'name'**.

If two or more correspondences are very close to one another, a list will be shown. Select one of the correspondences by clicking on it, then click **Delete** 'name'.

9.6.6 Register and Verify

- 1. Click the **Register and Verify** button on the upper right side. The registration is executed.
- 2. Verify the registration.
- 3. Click either the **Finish** button, if there are no more scans in this cluster, or click the **Next Pair** button to register the next scan pair.

AutoCluster

In order to save registered pairs during registration, they are moved into a socalled AutoCluster. It is created below the previously selected cluster, which is the cluster in which scans pairs are to be registered. If SCENE needs more than one AutoCluster, these AutoClusters are numbered.

After all scans and clusters were registered, these automatically created clusters are removed.



NOTE: If you cancel a registration for some reason, you would see such an AutoCluster in the Registration Dashboard.

9.6.7 Optimize Registration

Optimize Registration always offers a Cloud to Cloud registration. To do this, click the **Start Optimization: Cloud to Cloud** button.

After a manual registration, the cluster contains scans with user-defined targets. A target-based registration can be performed using **Start Optimization: Target Based step** button.

9.7 Visual Registration

Visual Registration provides an option to place scans and clusters in the correspondence view by moving them with drag and drop. After a placing, an Automatic Registration can be started to refine the registration.

There are three ways to start a **Visual Registration**:

- Click the Visual Registration button in the Registration toolbar. You will then be asked to select a cluster.
- Click the Visual Registration button in a cluster line. Select the settings to start registration.



Figure 9-1 Visual Registration on a Cluster

 Click the recommendation to perform a Visual Registration in a cluster line. Select the settings to start registration.



Figure 9-2 Recommendation to perform a Visual Registration

9.7.3 Select Cluster

In the first step, select an cluster that must be used for registration.

9.7.4 Select Method

In the second step, select a method that must be used for registration:

- 1. Click the Select Method button on the upper right side. The Select Method dialog is shown.
- 2. Visual Registration provides only two methods:
 - Cloud To Cloud
 - · Target Based.

9.7.5 Place and Register

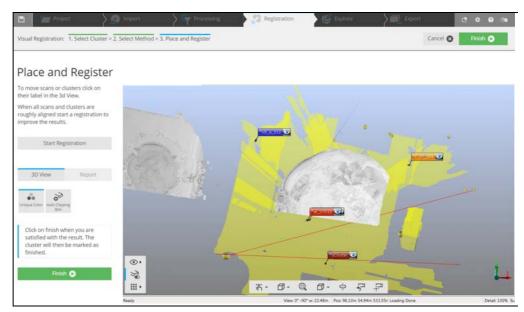


Figure 9-6 Visual Registration: Place and Register Scan

In the third step, place and register the scans:

- 1. A correspondence view is opened on the selected cluster. Move the scans and cluster in the view by selecting them with a mouse click. Drag and drop them on the shown manipulators.
- 2. Place all scans and clusters correctly in the correspondence view. Click the button **Start Registration**.
- 3. If the registration is successful, the result is displayed in the 3D View or through the Registration Report. If the registration is not successful, a dialog is shown to inform the user.



NOTE: To better be able to place the scans/clusters and verify the result, select **Unique Color** or **Scan Color** or create an **Auto Clipping Box**.

9.8 Registration Report

Once you have gone through all Registration steps, the Registration Report will give you an overview on the results.

Open Registration Report

In the Registration Dashboard, click the **Registration Report** button. This button is also displayed on the final page of the registration task.



NOTE: For the report, all values with a length unit (point error, subsampling settings, and others) will be shown in the smallest unit of the selected set (metric = mm, imperial = inch, imperial US = inch US).

9.8.1 Target Statistics

Target Statistics shows all reference pairs and target pairs used for the scan registration. Values close to zero indicate a good registration result. Here you can easily identify reference pairs which are causing problems in the registration.

All values are color coded with a bar on the left side, same as the table cells.

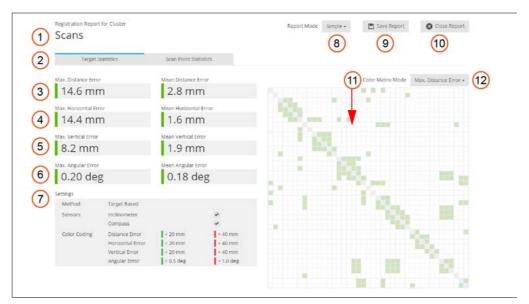


Figure 9-2 Target based registration report

- ① Name of the cluster

 The name of the registered cluster the report is opened on.
- ② Switch between Target Statistics and Scan Point Statistics.

The following statistics display the averaged Maximum and Mean error between all targets in this cluster.

- 3 Maximum Distance Error / Mean Distance Error
- 4 Maximum Horizontal Error / Mean Horizontal Error
- 5 Maximum Vertical Error / Mean Vertical Error
- Maximum Angular Error / Mean Angular Error

Shows the averaged maximum or minimum angular error between all plane targets in this cluster.

Angular errors can only be calculated for plane targets, which are planes, checkerboards, and slabs.

② Settings

Displays used settings and for placing the scans as well as a legend for the color coding of errors.

® Report Mode

The report has three modes:

Simple: Displays all statistics between the first-level scans of the cluster.

- Full: Displays all statistics between all scans inside the cluster (recursive).
- · Color Matrix Mode
- (9) If you require the Registration Report Table for usage outside SCENE, you can either save the report as PDF or copy the report directly into Excel[®]. Mark the table, or parts of it, and copy it to Excel[®]. Save the Registration Report as PDF
- © Click the Close button to close the Scan Report and to return to the Registration Dashboard.
- Matrix Gives a colored overview for the registration quality of the scans. Displays the error between a pair of scans or cluster. The type of error shown (e.g. Max Distance Error) can be changed in the Error Type Selection List[®].
- ② Error Type Selection List Open the drop down menu to select the type of error you want to see in the corresponding mode.

The view of the matrix depends on the content of the selected cluster. If this cluster contains subordinate clusters, the matrix displays the registration quality for those clusters. If the selected clusters contains scans, the matrix displays the registration quality for those scans.

If there is a square in yellow, red, or green color and you want to know which pair of scans or clusters they represent, use the mouse to hover over the square. The names of the two scans or clusters are displayed, with the error value.

Detailed Errors									
Scan/Cluster	Connections	Max. Dist. [mm] ♥	Mean Dist. [mm]	Max. Hor. [mm]	Mean Hor. [mm]	Max. Vert. [mm]	Mean Vert. [mm]	Max. Angle [deg]	Mean Angle [deg]
▼ GaylordPalms031	2	1526.3	510.9	1524.6	508.5	73.1	26.5	8.00	8.00
	Scan/Cluster	Max. Dist. [mm] ♥	Mean Dist. [mm]	Max. Hor. [mm]	Mean Hor. [mm]	Max. Vert. [mm]	Mean Vert. [mm]	Max. Angle [deg]	Mean Angle [deg]
	▶ GaylordPalms035	1526.3	1526.3	1524.6	1524.6	73.1	73.1	8.00	8.00
	▶ GaylordPalms029	3.2	3.2	0.7	0.4	3.2	3.2	-	
➤ GaylordPalms035	3	1526.3	529.0	1524.6	508.5	73.1	44.6	8.00	4.6
➤ GaylordPalms013	4	60.6	11.0	6.1	2.8	60.6	9.5	1.31	1.3
▼ GaylordPalms003	3	14.6	5.6	14.4	4.9	3.9	2.0		
	Scan/Cluster	Max. Dist. [mm] ♥	Mean Dist. [mm]	Max. Hor. [mm]	Mean Hor. [mm]	Max. Vert. [mm]	Mean Vert. [mm]	Max. Angle [deg]	Mean Angl [deg]
	▶ GaylordPalms005	14.6	9.1	14.4	8.9	2.5	1.9		
	▶ GaylordPalms004	4.9	3.7	4.1	2.8	3.9	2.0		
	► GaylordPalms002	2.8	2.8	0.9	0.9	2.6	2.6		
▶ GaylordPalms005	3	14.6	6.1	14.4	5.6	3.8	1.6		

Figure 9-3 Target based registration report, detailed errors

The **Detailed Errors** table shows errors between corresponding targets in a structured way:

- In the first level, the registered scans or clusters are listed. The maximum and mean errors for all the connections of the scans or clusters in the first level are displayed.
- In the second level, the scans or clusters with which the scan or cluster of the first level has targets in common, are listed. The maximum and mean errors for each connected scan pair are displayed.

• In the third level, individual targets and the errors in the registration of corresponding targets between the scans of the first and second level are listed. The point errors are displayed for each connected target pair.

Inclinometer Mismatches

The Inclinometer mismatches list is shown as part of the scan point statistics. This list displays the angular offsets between a scan's up direction after registration and the scan's up direction according to the scanner's inclinometer.

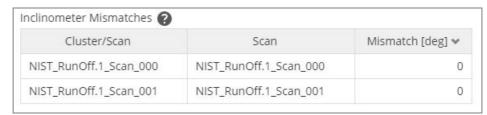


Figure 9-4 Target based registration report, inclinometer mismatch

For scans without an inclinometer, a dash '-' is shown instead of a value.

Scan names are specified as follows:

- Scan Name: For direct Scans of the main report cluster.
- · Cluster Name: For sub-clusters.
- Cluster Name_Scan Name: For scans in the sub-clusters of the report cluster.

9.8.5 Scan Point Statistics

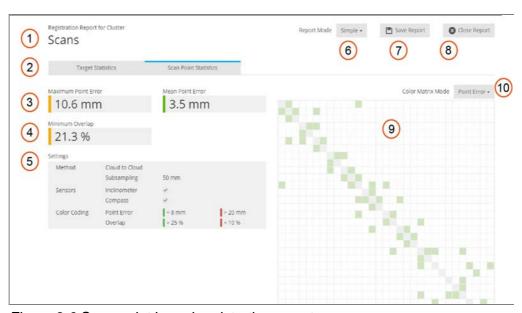


Figure 9-6 Scan point based registration report

- Name of the cluster
 The name of the registered cluster the report is opened on.
- ② Switch between *Target Statistics* and *Scan Point Statistics*.

Maximum Point Error Maximum point error of all shown scan pairs.

Mean Point Error Mean point error of all shown scan pairs.

Minimum Overlap Minimum percentage overlap of all shown scan pairs. All values are color coded with a bar on the left side, same as the table cells.

Settings
 Displays the settings used to register the selected cluster.

Report Mode The report has two

The report has two modes:

- Simple: Will show all statistics between the direct children of the cluster.
- Full: Will show all statistics between all scans inside the cluster (recursive).

The Report Mode is only visible when the report is opened from the Registration Dashboard. When opened in the registration verification, the simple mode is shown.

- ① If you require the Registration Report Table for usage outside SCENE, you can either save the report as PDF or copy the report directly into Excel[®]. Mark the table, or parts of it, and copy it to Excel[®]. as PDF
- ® Click the Close button to close the Scan Report and to return to the Registration Dashboard.
- Color Matrix Mode.
- Error Type Selection List.

Detailed Errors, Scan Point Statistics

Scan/Cluster	Connections		Max. Point Error [mm] ♥	Mean Point Error [mm]	Min. Overlap %	
▼ nipp032		2	10.6	7.2		52
	Scan/Cluster		Point Erro	Overlap %		
	nipp031				52	
	nipp030			3.8		69
▶ nipp031		2	10.6	8.7		52
▼ nipp026		1	6.7	6.7		56
	Scan/Cluster		Point Erro	Overlap %		
	nipp031			6.7		56
▶ nipp011		4	5.9	3.4		50
▶ nipp010		2	5.9	4.6		67
▶ nipp018		2	5.9	5.1		60
▶ nipp017		2	5.9	3.4		2
▶ nlpp024		3	4.9	3.3		51

Figure 9-7 Scan point based registration report table

The **Detailed Errors** table (in Simple Mode) shows detailed error values for every registered scan pair or cluster pair:

- Depending on the selected report mode, in the first hierarchy, all scans inside the cluster are shown. The errors that are displayed are applicable to all connections of the Scan or Cluster.
- The first hierarchy will show the name of the scan or cluster, the number of connections it has, the mean point error, maximum point error and minimum overlap.
- By clicking on the first hierarchy row, the connections show the individual scan or cluster Name, point error, and overlap.
- The three right columns are color coded with red, orange and green according to specific thresholds that can be adjusted using the registration settings.

The table can be sorted by clicking on the table header of every column.

9.8.8 Saving or Exporting the Registration Report

If you require the Registration Report Table for usage outside SCENE, you can either save the report as PDF or copy the report directly into Excel[®]. Mark the table, or parts of it, and copy it to Excel[®].



NOTE: When importing the table to Excel[®], the decimal separator has to correspond to the decimal separator used in SCENE. Otherwise, the numbers will be automatically converted into another format, e.g., a date.

Clicking the **Save Report** button opens a File Open dialog where a location and a file name can be chosen.

In the PDF report, the same data is displayed like in the SCENE report. Additionally some information about the project are listed like project name and recording period.

9.9 Import Surveyed Points

In the **Registration** Toolbar, you have an option to import surveyed points. We can use this option, when we need to include external references. For further information, see *Importing surveyed reference points*.



Figure 9-1 Registration Toolbar

Click the **Import Surveyed Points** button.

A File Open dialog box opens where you can choose the Surveyed Points file to be imported (in .cor or .csv format). An **Import References** dialog opens. You can select any of the following options and click **Import**:

- · Import on workspace level
- · Import on cluster level

• (Import) From Structure and map it to /Scans directory or pathname.

The imported survey points are used for Registration.

Chapter 10: Explore

10.1 View Project

 \Rightarrow Click the **View Project** button $^{\bigcirc}$. The scan project is shown in a 3D View. You can use a scan for many different purposes.

The Explore features allow to analyze a scan in different views.



NOTE: When a Project is opened, the scans are not automatically loaded. To load all scans, select **Load all Scans** option in the context menu of the Project. To unload all scans, select **Unload all Scans and Pictures** option in the context menu of the Project However, to unload the scans, de-select the **Loaded** option in the context menu of the Scan or Cluster. After a Scan is unloaded, it can be reloaded by selecting the **Loaded** option.

Types of views

There are various views to display and explore scans and point clouds:

Quick View

The standard scan view to examine single scans. The Quick View is available within a few seconds; in the meanwhile the scan data will be loaded in the background. You can manipulate the scan points as soon as background loading is finished. Until then, you are only able to view and navigate.

Planar View

Used to examine single scans. The scans must be loaded manually.



NOTE: When a Project is opened, the scans are not automatically loaded. To load all scans, select Load all Scans option in the context menu of the Project. To unload all scans, select Unload all Scans and Pictures option in the context menu of the Project However, to unload the scans, de-select the Loaded option in the context menu of the Scan or Cluster. After a Scan is unloaded, it can be reloaded by selecting the Loaded option.

3D View

The 3D View is not limited to display the scan points of a single scan or scan point cloud, it also offers the combined viewing of all the scans and objects in your project point cloud or workspace.

Structure View

The Structure View displays the structure of the workspace, including all folders and objects. If you click the name of those folders and objects with the right mouse key, a so-called context menu will open which offers specific functions.

By default, the Structure View is folded away. If you want it to stay visible, click the **Structure** button, then click the little pin needle button.

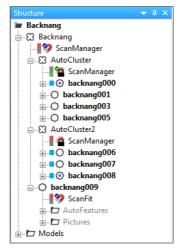


Figure 10-1 Structure View

VR View

SCENE 7.1 introduces the ability to step into your point cloud with virtual reality (VR). You can now experience your scans as if you were on location, take measurements, make screen captures, and read annotations

10.2 Clusters

To create a new cluster:

- In the Structure View, right-click the Workspace name, then click New > Cluster. A cluster will be created.
- 2. Give the cluster a name.
- 3. Create more clusters, for example "FirstFloor", "SecondFloor", "ThirdFloor".
- 4. If required, create subordinate clusters, for example, clusters that contain the scans for special rooms.
- 5. Arrange those clusters by dragging and dropping them into the respective superordinate cluster.
- 6. Drag and drop the scans into the clusters in which they belong to. You can also drag and drop subordinate clusters into a cluster folder.



NOTE: You can combine laser scanner scans and Freestyle scans in one scan project.

10.3 3D View

With the 3D View, you can achieve the most easily comprehensible view of the scan points and CAD models. The 3D View is normally set up with the field of

view corrected, so that you get an impression close to reality. Unlike the **Quick View** and the **Planar View**, scan points manipulation and analysis is limited in the 3D View.



NOTE: On systems with NVIDIA Quadro graphics processors, rendering performance in the 3D View might be slow or intermittent. In order to improve rendering performance, start the NVIDIA Control Panel application (available in the Windows Control Panel) and select the global preset 3D App – Game Development from the Global Settings tab.

The 3D View will show scan point clouds, or the project point cloud. Such a point cloud has to be generated by SCENE 6.1.

No point clouds available at all

If there are no such point clouds, these will be generated automatically. During generation, no scan points are displayed. This is not the case for Freestyle^{3D} scans during capturing, because those scans have a different format and will be converted later on during processing.

Point clouds from earlier and current SCENE versions available

If your scan project contains point clouds of new and old format (including scans for which no point cloud has been created), the following will happen:

- Automatic conversion of legacy point clouds in the background.
- · A warning message is displayed.

It is not possible to edit the legacy point clouds until they are converted.

Point clouds of earlier SCENE versions available

If your scan project contains point clouds of an old format, editing of the point clouds is possible.

You will be informed that these point clouds should be updated.

3D View of a single scan

⇒ Right-click the scan's name in the Structure Window, then click **3D View** in the context menu.



Figure 10-1 3D View of a single scan

3D View of a cluster

You can also open the 3D View for all the scans within a cluster.

⇒ Right-click the cluster's name in the Structure Window, then click **3D View** in the context menu.

In the 3D View, the points of scans have priority over the points of scan point clouds, which means that the points of loaded scans will be displayed instead of the points of the related scan point clouds.

3D View of the project point cloud

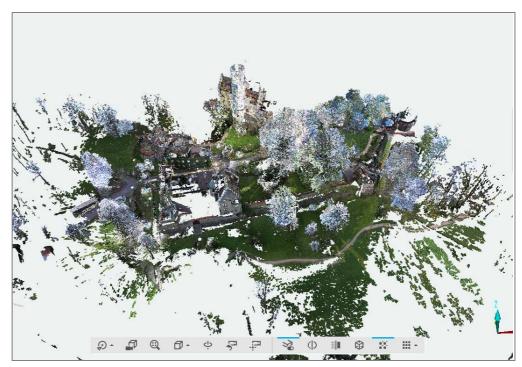


Figure 10-2 3D View of a project point cloud

1. Click the **3D View** button [3D] in the toolbar.

Or:

1. Right-click the superordinate cluster in the Structure Window. Typically, it is simply called "scans". Then, click **3D View** in the context menu.



NOTE: If no project point cloud is available, this button or command will open the 3D View of all scans in the workspace. Displaying the scans of a workspace behaves like displaying the 3D View of a cluster.

Normally, the 3D View displays the scan points and objects with the correct field of view, in other words, objects of the same size appear smaller with increasing distance (**Perspective View**). You can also change the view to an **Orthographic View**. Then, objects of the same size always appear the same size, regardless of how far away they are. This type of representation is common in a lot of CAD systems. You can switch between these two representations in the *Navigation Toolbar (3D View only)*.

10.4 Quick View



Figure 10-1 Quick View

The **Quick View** is the standard view and displays the content of a single scan.

To start the Quick View,

- double-click the scan's name in the Structure Window.
- right-click the scan's name in the Structure Window, then click View > Quick in the context menu.

After the Quick View has been opened and is displayed, the scan point data will be loaded in the background. However, until then you can view the scan and navigate but you cannot access and thus not manipulate the scan points. As soon as the scan data has been fully loaded, all the scan point manipulation functionality is available.

The following restrictions apply in the Quick View:

- You always see the scanned area from the scanner position, which means you cannot leave this position. However, you can of course change your line of sight and scale.
- The field of view cannot exceed 180°.

You can adjust the line of sight by holding the left mouse button down and moving the scan points in the direction required. In Quick View, the Examine Mode is the standard viewing mode.

10.5 Planar View



Figure 10-1 Planar view

Like the **Quick View**, the **Planar View** displays the content of a single scan only.

To start the Planar View

 right-click the scan's name in the Structure View, then click View > Planar in the context menu.

At first glance, the Planar View may appear very strange because the scanned area seems to be distorted. Straps and supports do not run in a straight line but are curved. For the Planar View, SCENE uses the same technique as it is used for depicting the earth's surface on a map where the area around the poles appears to be magnified, and the flight route between two distant cities is not straight but bent.

The consequence of the distortion is that it only succeeds approximately in displaying other objects congruent with the scan points. If a scanned reference sphere already appears in the view more like an ellipsoid than a sphere, do not be surprised that the added reference object does not cover the reference sphere completely. For this reason no CAD models are displayed in the Planar View; use the 3D View for this instead.

The Planar View is useful because of the fact that with some scanners, it is the most natural display format of the scan points. A lot of scanners process the horizontal and vertical angles step by step; it is therefore practical to display the scan points in a column and row oriented manner accordingly.

The view starts at the left margin with the first column the scanner recorded. In the local coordinate system of the scanner, this column normally has the horizontal angle of 0° . The subsequent columns then come to the right, with an increasing horizontal angle until 360° is reached with a circumferential scan. In the top row, the scan points with the greatest vertical angle reached are displayed, for example, the zenith with $+90^{\circ}$, which is directly over the scanner. From top to bottom, the vertical angle decreases, reaching 0° at the

horizontal line and then becoming a negative value. The smallest possible vertical angle is -90° .

As in the Quick View, you always view the scanned area from the scanner position – you cannot leave this position. However, you can of course change your line of sight and scale.

As in all views, you can set the scale using the scroll wheel of your mouse. There are also further buttons in the toolbar for the Planar View which you can use to change the scale.

10.6 Explore Toolbar



Figure 10-1 Explore Toolbar for Quick or Planar View



Figure 10-2 Explore Toolbar for a 3D View

The functions you see in the **Explore** toolbar depend on the kind of view. For example, the **Create Virtual Scan** button will not be shown when a scan is opened a Planar View.

The Explore features allow to analyze a scan in different views. The **Explore** toolbar has the following options:

- · View Project
- VR View
- Overview Map
- Annotation
- Measure Points
- Select Polygon
- New Selection
- · Save Screenshot
- · Mark Distance Range
- Project Point Cloud
- Only in Quick View or Planar View:
 - Color Mode
 - · Mark Points
- · Only 3D view:
 - Viewpoints
 - Auto Clipping Box
 - Show Grid

- Mesh Selection
- · Create Virtual Scan

Several buttons include more than one function and are marked with a little arrow beneath the icon. To see those functions, simply click the button and a dropdown menu will open. Some of these functions might be grayed because they do not work with a certain view. As soon as you select a function out of a dropdown menu, its icon will be shown in the toolbar.

10.6.3 Explore features in Quick View or Planar View (2D view)

Color mode

This button provides an option to easily switch between color and gray (intensity) mode views of a scan. Click **Color Mode** to reload the scan in the color mode or gray (intensity) mode.

If there is more than one view opened on that scan, all views are updated and the scan data is visualized in the new color mode.

If the color mode is selected and the scan contains only color or gray mode views, then a warning: "Toggle color mode is not possible as color or gray (intensity) data is not available" is displayed.

Mark Point

The **Mark Point** menu provides different options to mark points, planes spheres, checkerboards or markers.

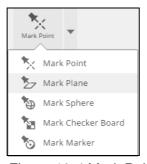


Figure 10-4 Mark Point

10.6.5 Navigating with the mouse in 3D View

Left mouse button Click the left mouse button, then drag the mouse to move the image area.

Double-click with the left mouse button

When you double-click a scan point the 3D view, the camera flies towards that scan point. Each time you double-click again on the same scan point, the camera flies even closer to that scan point.

To stop this **Fly to point** feature, move the view with the mouse or with the respective keys.

Middle mouse button (mouse wheel) Mouse wheel: Zoom in or out.

Click the middle mouse button or the mouse wheel to shift the image.

Right mouse button

Clicking with the right mouse button on a view or an object will open the socalled context menu. The context menu offers specific functions valid for this view or object. From the context menu, you can also open the Properties dialog.

10.6.6 Navigating with the mouse in Quick View

Left mouse button Click the left mouse button, then drag the mouse to move the image area.

Middle mouse button (mouse wheel) Mouse wheel: Zoom or out.

Click the middle mouse button or the mouse wheel to shift the image.

Right mouse button Clicking with the right mouse button on a view or an object will open the so-

called context menu. The context menu offers specific functions valid for this view or object. From the context menu, you can also open the Properties

dialog.

10.6.7 Navigating with the mouse in Planar View

Left mouse button Click the left mouse button, then drag the mouse to move the image area.

Middle mouse button (mouse wheel) Zoom or out.

Right mouse button Clicking with the right mouse button on a view or an object will open the so-

called context menu. The context menu offers specific functions valid for this view or object. From the context menu, you can also open the Properties

dialog.

10.7 Overview Map

The overview map provides a top view overview to the whole scan project. The map is by default, a gray scale image. It is recommended to create the map after the registration and cleanup of scan points is completed.



Figure 10-1 Overview Map

The icon with the dropdown button provides a menu with the following options:

This option is only enabled when an overview map exists. It will open a new view with the map.

1

NOTE: An overview map can also be opened on a single scan or a cluster. Right-click the desired object to open the context menu and select

View > Overview Map. This overview map displays only the scan or the scans that are part of the cluster.

Select this option to create a new overview map for a scan project

If you change the transformation of scans or clusters, or if scan points are deleted after the map has been created, the map becomes invalid. Update the map in such instances.

Select this option to delete the overview map.



NOTE: Even though an overview map is deleted, it may be available in older revisions of your project. Perform the **Wipe Project History** operation to free the space allocated for the overview map files in old revisions, if required.

Open

Create

Update

Delete

The toolbar contains a button to toggle the scan location visibility as well as buttons to zoom/zoom out.

The lower left corner contains also a scale bar that shows the metric and imperial scale. The default scale is meter or feet.

Each scan is marked with an icon. Hover on a scan marker icon to view the name of the scan. Click the icon, to open a popup. The popup contains the name of the scan and buttons to open quick and 3D views of the scan.

10.8 Annotations (3D View, Quick View, Planar View)

To attach a documentation object to a certain scan point,

- 1. Open a view of a scan, a cluster, or a scan project.
- 2. Select the documentation tool from the toolbar, then click the point of interest the view.
- 3. The new annotation and its **Documentation Properties** dialog are displayed.

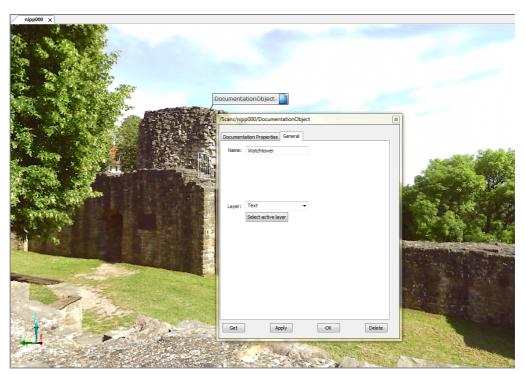


Figure 10-1 Documentation object in 3D View

Documentation **Properties**

Detailed information can be entered in the **Documentation Properties** dialog:

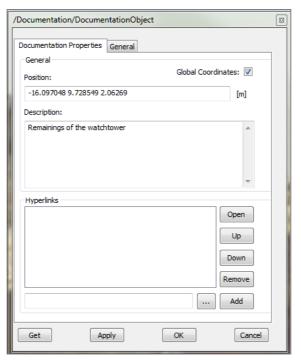


Figure 10-2 Documentation Properties Dialog

Position – determines the position of the documentation object in the workspace.

Description – detailed information about the documentation object.

Hyperlinks – hyperlinks to files or web sites.

- Add a new hyperlink by entering its address into the lower text field, then press Add.
- Change the order of the hyperlinks with Up / Down.
- Delete them with Remove.
- Open them by double-clicking on the list item or by selecting the Open button.

General tab

You can enter the name of the documentation object in the **General** tab. Since a documentation object usually consists of a text string, its **Layer** should be defined as **Text**.

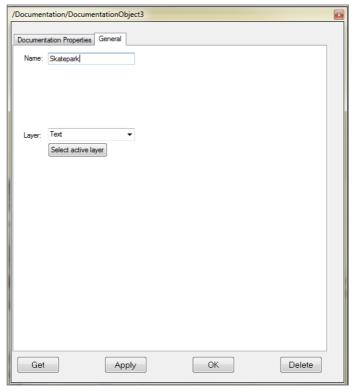


Figure 10-3 General dialog

10.9 Measuring (3D View, Quick View, Planar View)

With renovations, you are often confronted with the question of whether there is still enough space in the building for the intended machinery. Since you can only rely on the CAD model of the building to a certain extent, you will probably have to examine and take measurements of the critical places on site. Using scanned reality, you can easily address queries at your computer, such as: What is the clearance height of this gate? How great is the distance between these supports?

There are two different approaches for measuring distances:

- · between scan points,
- · between objects such as spheres or planes.

10.9.1 Measure Points



Figure 10-2 Point-to-point measurement

Select measure points

- 1. Click the **Measure Points** button in the tool bar.
- 2. Select valid scan points in the respective view with the **left mouse button**.
- 3. Select the last measure point and finalize the measurement by a **double- click** with the left mouse button.
- 4. To leave the measurement process, click the **right mouse button** or press the **Esc key**.

Several keyboard commands are available in the Quick View and the 3D View:

- Return key: Finalize the measurement without adding a last measure point.
- Backspace key: Remove the last measure point.
- Home key: Add a last measure point at the start position and finalize the measurement.

A new point-to-point measurement gets added as a child to the current scan when measuring in the Planar View or Quick View and to the **Measurements** folder of the workspace when measuring in the 3D View.

A point-to-point measurement made in the 3D View is only visible in the 3D View. It is not linked to any individual scan. If the involved scans are later

altered or transformed, the measurement stays in the same place. In this case you could delete the measurement and create a new one.



NOTE: Point-to-point measurements may be susceptible to single noisy scan points.

In the **Quick View** and the **3D View**, a yellow dashed line is drawn between the measure points. Labels show the overall distance and the length of each measure segment. In the **Planar View**, only the overall distance is shown.

Invalid measure points of point-to-point measurements are indicated by a red outline. While it is not possible to select invalid scan points as measure points in SCENE, this may happen in SCENE WebShare Cloud when the sky or an area with heavily filtered scan points is selected. Therefore, invalid measure points may exist in workspaces downloaded from SCENE WebShare Cloud. An invalid measure segment is indicated by a red dashed line.

Two additional lines show the vertical and horizontal distance between the first and last measure point.

10.9.3 Measure Objects

Probably you frequently have to measure distances to level surfaces, for example to the wall, the floor or the ceiling. In this case you should fit a plane through the wall and measure from the plane to the point you are interested in. When using a plane, the measurement is automatically taken perpendicular to this plane.



NOTE: Object measurements are also available in the Structure View.

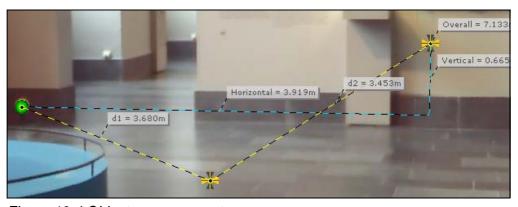


Figure 10-4 Object measurement

You can measure between objects of the following types:

Point objects

 Sphere (A sphere is a point object because its central point is used for measurement),

- Checkerboard,
- · Point Object, Corner Point,
- Scan. This means, the scanner icon which stands for a scanner position.

Figural objects

- Plane, including Expanded Plane, Rectangle, Slab.
- · Pipe.

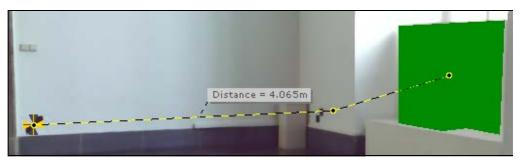


Figure 10-5 Checkerboard point - plane measurement

- 1. Click the **Measure Objects** button ♀ in the toolbar to start a measurement between objects.
- 2. To select objects for your measurement, select them with the **left mouse button**. You can also select objects in the Structure View this way.
- It may happen that objects superpose. In this case, a small dialog opens which lists these objects. Double-click the one you want to use, and continue measuring.
- 4. You can measure the distance between more than two objects if you hold down the **Shift** key when clicking on the next object. However, an object measurement can only contain one figural object.

A new object measurement gets added to the **Measurements** folder of the workspace.

If the position or location of the objects used for the measurement change, for example, by a new fit or by updating the registration, the measurement is automatically updated.

Measure Object

The representation of a measurement is called a measure object. To open the **Properties** dialog of a measure object, double-click it the Structure View, on its label or near a measure line.

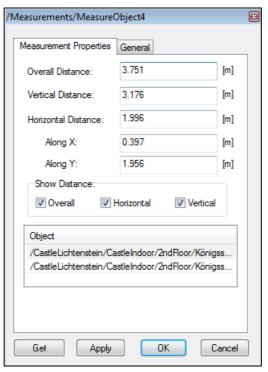


Figure 10-6 Properties of measurement object

The property dialog provides distance information and a list of the involved objects of an object measurement.

You can hide the lines for the vertical and horizontal distances and the label for the overall distance by selecting the **Show Distance** checkboxes.

10.10 Selecting Scan Points (3D View, Planar View, Quick View)

Depending on the view, it is possible to select scan points and then apply commands to this group of points.

10.10.1 Selecting Scan Points in the Planar View or the Quick View

In the **Planar View** and in the **Quick View**, it is possible to select scan points and then apply a variety of commands to this group of points. For example, you may apply an object fit on this group, or search for objects in the selected points and apply automatic object fits.

- · apply filters on the selected scan points,
- · apply a white-balance,
- · colorize them using scanner based pictures,
- delete them,
- export them into a CAD system,
- or create a new scan from the selected scan points.

Selected scan points are colored yellow. There can only be one selection simultaneously in all views, in other words, if you make a selection in one view, the selection disappears from the view worked on before.



NOTE: If you wish to select an area that you cannot see with the set line of sight, you can also switch into navigation mode during the selection process. Simply press the control (Ctrl) key.

Available selection tools Quick View and Planar View

Select Polygon button



Click the down arrow, next to the Select Polygon button in the **Explore** toolbar to get a drop down list with all the Selection tool options for Scan Points.

- 1. Click the left mouse button to define the starting point of the selection.
- 2. Release the mouse button, move the mouse to the next point and click to fix the point. A straight connection is drawn automatically between these two points.

Or:

You can also hold the mouse button down – then all the scan points that you move over with the mouse are selected.

3. Lock the selection by double-clicking with the left mouse button.

When completing the selection, the line will be closed; in other words, the last fixed point is connected to the starting point. The selection comprises all the scan points that are enclosed within the outline.

Select Rectangle button

- 1. Select a rectangular area by first defining a corner of the rectangle by click the left mouse button and hold it down to define the first corner of the rectangle.
- 2. Drag the mouse to define the opposite corner of the rectangle. You can then release the mouse button.

Select Circle button O

- 1. Click the left mouse button to define the starting point of the selection. A circle with the radius just set is displayed.
- 2. Change the radius by turning the scroll wheel on the mouse.
- 3. Click with the left mouse button again to place the selection in the chosen location and to end the selection process.

Select Ellipse button

- 1. Click the left mouse button to define the starting point of the selection. An ellipse with the starting point of the major axis just set is displayed.
- 2. Change length of the minor axis (i.e., the "width") by turning the scroll wheel on the mouse.
- 3. Click with the left mouse button again to place the selection in the chosen location and to end the selection process.

Select Line button

A linear selection has a thickness of one point.

- 1. Click the left mouse button to define the starting point of the line.
- 2. Release the mouse button, move the mouse to the next point of the line and click to fix the point. A straight connection is drawn automatically between these two points.

Or:

You can also hold the mouse button down – then all the scan points that you move over with the mouse are selected.

3. Lock the selection by double-clicking with the left mouse button.

Planar View only: Select Poly edge button

Select an arbitrarily shaped area of scan points, with the polygon following the visible edge in the scan points.

- 1. Click the left mouse button to define the starting point of the selection.
- 2. Release the mouse button and move the mouse to the next point. If you reach an edge, i.e., an area in which there is a noticeable difference in the reflection value, the selection will automatically follow this edge. If there is no such edge, a straight connection is drawn.
- 3. Click to fix the point.
- 4. If you are not confident with the polygon, you can undo the last part of the polygon by backtracking it in the opposite direction. You can always backtrack to the last fixed point.
- 5. With a click of the right mouse button, you switch edge detection on or off, and you can cancel the selection.

10.10.2 Selecting Scan Points in 3D View

Compared to the Quick View and the Planar View, you may

- delete a scan point selection,
- · invert a scan point selection,

- export them into a CAD system (only available for 3D selections made on the basis of points from scan point clouds and the project point cloud,
- · create objects,
- or create an object fit.

Available selection tools in 3D View

Select Polygon button

The polygon selection applies to point clouds.

- 1. Click the left mouse button to define the starting point of the selection.
- 2. Release the mouse button, move the mouse to the next point and click to fix the point. A straight connection is drawn automatically between these two points.

Or:

You can also hold the mouse button down – then all the scan points that you move over with the mouse are selected.

3. Lock the selection by double-clicking with the left mouse button.

When completing the selection, the line will be closed; in other words, the last fixed point is connected to the starting point. The selection comprises all the scan points that are enclosed within the outline.

Select Brush button 🔪

The brush selection can be used similar to brush tools known from 2D image processing programs. It works with scan – or project point clouds only.

The brush works in three dimensional spaces, meaning that you can use the mouse to literally paint points which are going to be selected.

The brush has the shape of a sphere. A transparent red circle will highlight the area where the selection sphere is currently located.

- 1. Click the left mouse button to define the starting point of the selection, hold the button down in order to paint the points.
- 2. Moving the cursor around while having the brush selector tool activated will highlight the scan points that are currently within the selection sphere.
- 3. Use the mouse wheel to modify the radius of the sphere.
- 4. Hold the shift key to modify the sphere radius more quickly.

10.10.3 Invert a selection of scan points

There may be applications in which the marking of scan points is difficult or time-consuming, and it would be much easier if you could mark those scan points you do NOT need.

- 1. Open a 3D view on a point cloud.
- 2. Click the Select Polygon \bigcirc or the Select Brush \searrow selection tool.

3. Create a selection in the 3D View.



Figure 10-4 Scan points of a house, marked with the Polygon selection

Right-click the selection, then click Selection > invert Selection.
 Your selection will be cleared and all other scan points will be selected.

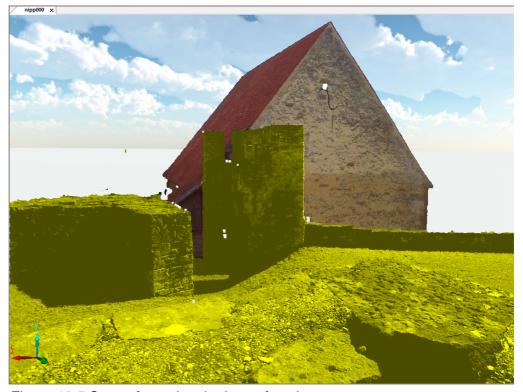


Figure 10-5 Scan after using the invert function

10.11 Selection Combinations

There are different types of selection combinations which determine what effect the next selection to be executed has on the selection that already exists.

- 1. If there is no selection: select scan points with one of the scan point selection tools.
- 2. Select the required combination type from the toolbar:

 - Add selection button Combination mode whereby the next selection is added to the existing selection.
 - Subtract selection button ☐ Combination mode, whereby the next selection is removed from the existing selection.
 - Intersect selection button Combination mode whereby the difference of the two selections is retained.

10.12 Save Screenshot (3D View)

You can save the view currently being displayed, for example, to share the view, or to use it as a preview for your scan project.

- 1. Open a 3D View of a scan.
- 2. Move the 3D View until it shows the view you want to see in the screenshot.
- 3. Click the Save Screenshot button in the toolbar.

An information box opens, saying: "The screenshot will be saved in the structure view in the folder named Screenshots". (The name will be different if you renamed the folder. If the screenshots folder doesn't exist, it will be created.)

The screenshot's name is generated automatically as, *Screenshot*. subsequent screenshots have a number appended. When the screenshot is created, a child object called a *Viewpoint* is also created. For more information, see *Viewpoints* (3D View) on page 143.

The screenshot image will show exactly what you have seen in the 3D View, including annotations or measurements, scan point selections, etc.

If you want to export the screenshot to a file, right-click the screenshot and select **Import/Export > Export Picture**.

10.12.1 Viewpoints (3D View)

Save the current camera position and line of sight as a viewpoint, so that you can return to it later. In the drop-down menu of the **Viewpoints** button, you can activate the previous or next viewpoint.

Create Viewpoint

- 1. Move the camera to a position that you would like to keep for later use.
- 2. Click the **Viewpoints** button ≤ . The drop-down menu opens.
- 3. Click **Create**. A little dialog opens in which you can enter a name for that viewpoint.
- 4. Click **OK** to save the viewpoint.



NOTE: You can also create a viewpoint with the short keys **Ctrl + F2.**

Viewpoints are added to a folder called **Viewpoints** in the Structure View. Viewpoints are part of the Workspace and will be saved when saving the Workspace or scan project.

In the Structure View, you can organize the viewpoints into folders. Create new folders, and drag and drop the Viewpoints into them.

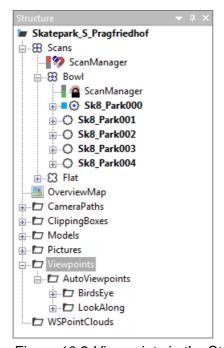


Figure 10-2 Viewpoints in the Structure View

Go to a viewpoint

⇒ In the Structure View, right-click the Viewpoint, then select **Activate** in its context menu.

Activate viewpoints

- 1. Click into the 3D View.
- 2. Click the **Viewpoints** button ≤ . The drop-down menu opens.

3. Click either **Activate Previous**, or **Activate Next**. The view will move to that position.



NOTE: All viewpoints can also be successively activated in the order of their creation by using the hotkey **F2** or in reverse order by using **Shift+F2**.

10.13 Mark Distance Range (Planar View)

The scan points in the Planar View are normally displayed so that the reflection value of a scan point determines the brightness of the pixel. You can also display the scan points so that the pixel assumes a different color depending on the distance of the scan point from the scanner. You can also then choose to either have all scan points in a range assume the same color or have the color reflect the actual distance.

This type of visualization is appropriate, for example, when analyzing a scan, if it must not fall below a certain level of precision. Generally, the quality of a scanner's distance measurement is not constant across the entire range but decreases as the distance increases. You can then highlight in color the range in which the distance measurement is no longer satisfactory.

You can switch the highlighting on or off using the **Mark Range on/off** button in the toolbar.

The colors are displayed corresponding to your entries:

- Scan points that lie close to the lower limit is colored red.
- Scan points that lie in between are colored yellow to green.
- · Scan points that lie close to the upper limit is colored blue.

Scan points lying outside this range are not colored.

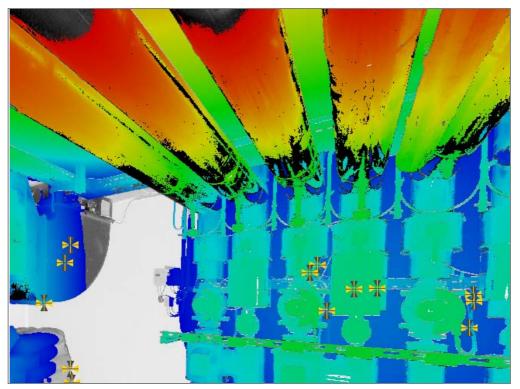


Figure 10-1 Scan points colored depending on distance

10.14 Clipping Boxes (3D View)

Clipping boxes provide an easy access to areas of interest of a 3D point cloud. They allow slicing the point cloud and clipping away specific areas which enables you to display or hide certain points of the 3D point cloud.

There are two types of Clipping Boxes:

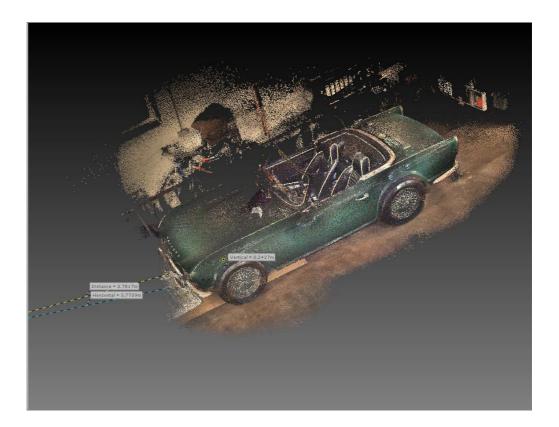
- Clipping boxes with the points outside of the box hidden. Only the points inside the box are displayed.
- Clipping boxes with the points outside the box displayed, points inside the box are hidden.

Clipping boxes may also be used to select scan points in the 3D View in order to perform certain operations on these points.



NOTE: Clipping boxes can be applied to the points of point clouds, not to the points of scans. In such a case, create point clouds by executing the **Process** feature.

If your scan project contains more than one scan, register those scans first, then use the Clipping Boxes for the entire scan project.



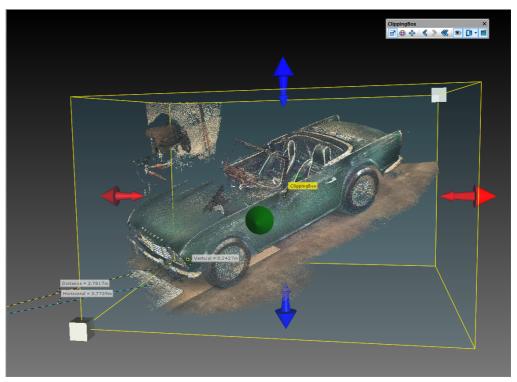


Figure 10-1 3D View without (upper picture) and with Clipping Box (lower picture)

10.14.2 Creating a Clipping Box

Open a 3D View and navigate to the area of interest.

There are various ways to create a Clipping Box:

Click Auto Clipping Box to get the following options:



Auto Clipping Box

A Clipping Box will be created close to the center of the current 3D View. The created Clipping Box will be scaled so that it covers roughly two thirds of the screen.

One Click Clipping Box

- Select this option from the drop down menu of the Auto Clipping Box button
 ⇒.
- 2. Select a point in the view in order to determine the surface. The Clipping Box will then be created with one of its faces being coplanar to the defined

surface, and with the selected point in the center. The created Clipping Box will be scaled so that it covers roughly two thirds of the screen.

Three Clicks Clipping Box

- 1. Select this option from the drop down menu of the **Auto Clipping Box** button ⇒ in the toolbar.
- 2. Select three points in the view in order to determine the surface. The Clipping Box will then be created with one of its faces being coplanar to the surface defined by the three picked points. The Clipping Box will be scaled in such a way as it exactly encloses the picked points.

Aligned to a limited or unlimited plane object

- Select New > Aligned Clipping Box in the context menu of a plane object to align a Clipping Box to the object:
 - Unlimited plane: The new Clipping Box will be created as a unit cube centered on the reference point of the plane. Its faces will be parallel to the selected plane.
 - Limited plane: The new Clipping Box will tightly enclose the boundary polygon of the limited plane.

The created Clipping Boxes are saved to the workspace for later use and will be added to a folder **ClippingBoxes** in the **Structure View**. Those folders are added as follows:

- New Clipping Boxes are local, which means, they will be placed below the object the 3D View is opened on.
- If the overall project 3D View gets opened, created Clipping Boxes will be global.
- In scan projects imported from earlier SCENE versions, Clipping Boxes will stay global.

Operations started from a 3D View which operates with Clipping Boxes will use only the Clipping Boxes visible in that 3D View.

After created, you can reposition and resize the Clipping Box.



NOTE:

- Once created, the rotation point of the view will be set to the center of the Clipping Box.
- Creating Clipping Boxes does not delete any points from the point cloud. The points outside or within the Clipping Box are simply hidden and may be displayed again at any time.

10.14.3 Visualizing Scales and Distances

SCENE allows to visualize dimensions and distances in the 3D View by displaying a customizable two dimensional grid.

This tool is only available in the 3D View.

The grid is a set of visible lines that serve as a visual distance reference and can be seen as a two dimensional ruler. The grid can be positioned anywhere

in the SCENE and gives a good impression of distances and scales in the point cloud.

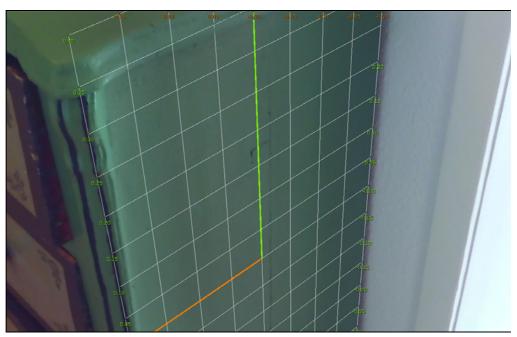


Figure 10-4 Regular grid in 3D View

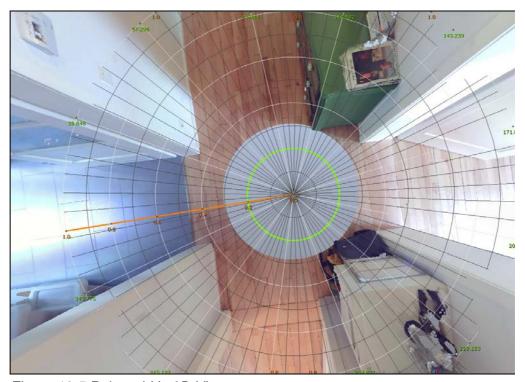


Figure 10-5 Polar grid in 3D View

Displaying and customizing the grid

- 1. Click the **Grid** button in the **Explore** toolbar to activate the grid function. By default, the grid is located in the coordinate origin and lies in the XY plane.
- 2. Customize the grid. Use the drop down menu of the grid button in the 3D toolbar to make your adjustments.



Figure 10-6 Drop down menu of the grid

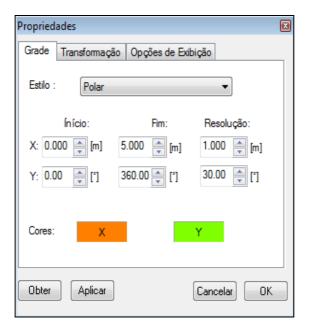
Grid Properties

Open the **Grid Properties** dialog from the **Show Grid** drop-down menu. The dialog has different options to set the grid properties.

The grid can be displayed in two different styles:

• The **regular grid** divides the space in axially parallel and evenly spaced rectangular areas. Both scales in X and Y direction show the distance in relation to the grid's origin.(Figure 10-5)

• The **polar grid** consists of concentric rings and radial dividers. The concentric rings show the distance to the grid's origin. With the radial dividers one can estimate the angles between two points of interest.



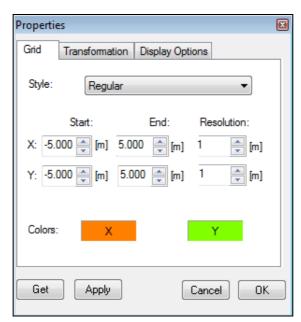


Figure 10-7 Grid properties

Style – choose between the regular and the polar grid.

Define the dimensions of the displayed grid in both directions by entering a **start** and an **end** value. Define the **resolution** of the grid by changing the distance between the displayed grid lines for both directions.

Colors – Change the color of the lines for the two directions.

Increase Resolution

Increase the resolution of the grid by decreasing the distance between the displayed lines by a factor of 2.

Decrease Resolution

Decrease the resolution of the grid by increasing the distance of the displayed lines by a factor of 2.

Attach to Scan Point

Change the position of the grid's origin. Pick a point in the SCENE and the grid's origin will be moved to that point.

Activates a tool to align the grid to a surface.

Attach with One Click

Align the grid by picking one click, if the plane has an even surface.

Attach with Three Clicks

Align the grid by picking three points, if the plane is uneven, or if you need a high accuracy. Picking three points for planes makes sense for outdoor scans, or for a scans of an old building in which floors or ceilings often are more or less curved.

Display Options

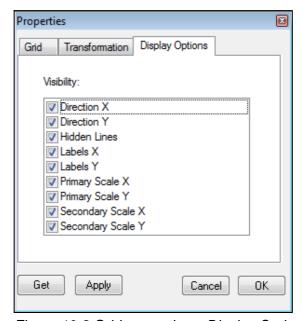


Figure 10-8 Grid properties – Display Options

On tab **Display Options** you may toggle the visibility of certain visible grid elements:

Direction X – x-axis (colored line)

Direction Y – y-axis (colored line)

Labels X – labeling of lines parallel to the x-axis

Labels Y – labeling of lines parallel to the y-axis

Primary Scale X – labeled lines of the grid in x direction

Primary Scale Y – labeled lines of the grid in y direction

Secondary Scale X – non-labeled lines visible at certain zoom levels in x direction

Secondary Scale Y – non-labeled lines visible at certain zoom levels in y direction.

10.14.9 Manipulating a Clipping Box

Clipping Box Toolbar

You can change the transformation of a Clipping Box by rotating, moving, or changing its size.

For this, click the Clipping Box in the 3D View, or click its name in the **Structure View**. A floating tool bar will appear which provides the manipulation functionality.



Figure 10-10 Clipping Box toolbar

Scale button

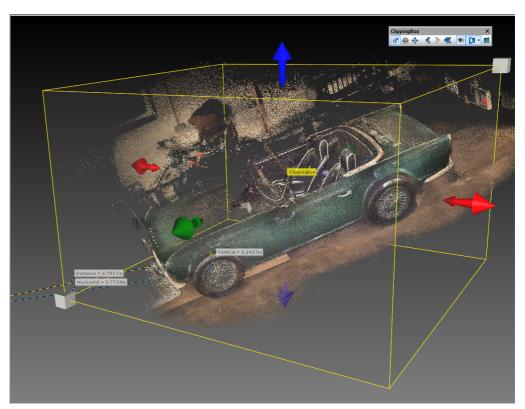


Figure 10-11 Resizing a Clipping Box

- 1. Select the **Scale** button from the Clipping Box toolbar to **resize** the Clipping Box. Handles will appear on the Clipping Box allowing you to resize it.
- 2. Drag one of the red, blue or green handlers to resize the Clipping Box. The corresponding face of the box will move.
- 3. Drag the gray cubes at the corners to resize the Clipping Box proportionally.

When dragging one of the handlers, the length of the movement will be indicated in the view as shown in the picture below.

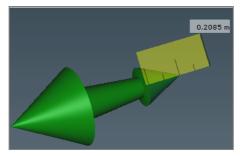


Figure 10-12 Length of movement

Rotate button

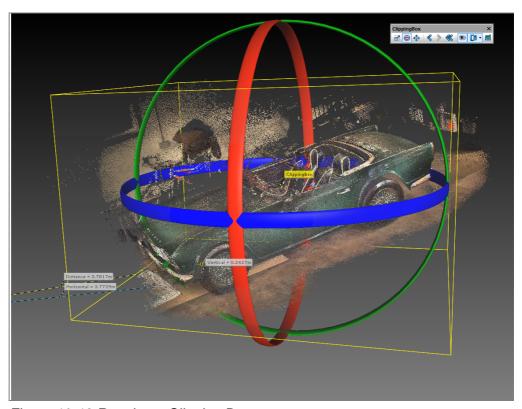


Figure 10-13 Rotating a Clipping Box

- 1. Select the **Rotate** button from the Clipping Box toolbar to **rotate** the Clipping Box. Handles will appear on the Clipping Box allowing you to rotate it around different axes.
- 2. Drag one of the red, blue or green handlers and rotate the Clipping Box along the corresponding axis.

Move button 🍨

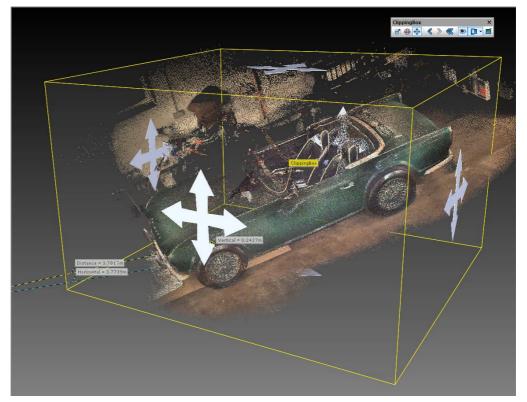


Figure 10-14 Moving a Clipping Box

- 1. Select the **Move** button from the Clipping Box toolbar to **move** the Clipping Box. Handles will appear on the Clipping Box allowing you to change the position of the box.
- 2. Drag one of the handlers (white arrows) and move the Clipping Box within two dimensions. The dimensions depend on the used handler. You may also use the keys 2, 4, 6 or 8 on the number pad instead.



NOTE: Change the size of the handlers with the num pad "+" key (increase size) and "-" key (decrease size).

You may undo (and reapply) your transformation changes with the following buttons of the Clipping Box toolbar:

Undo the last transformation change with <a>S.



Restore the initial transformation of the Clipping Box with ...



10.14.15 Hiding and Displaying Points by Means of Clipping Boxes

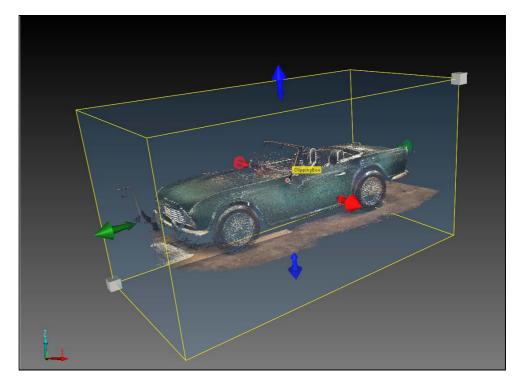
Hide button 📮 🕆

You may select which points are displayed or not with the **Hide** button of the Clipping Box toolbar.

Hide exterior: Hide the points outsides the selected Clipping Box (this is the default setting).

Hide interior: Hide the points insides the selected Clipping Box.

This does not have an effect on the visible objects in the 3D View.



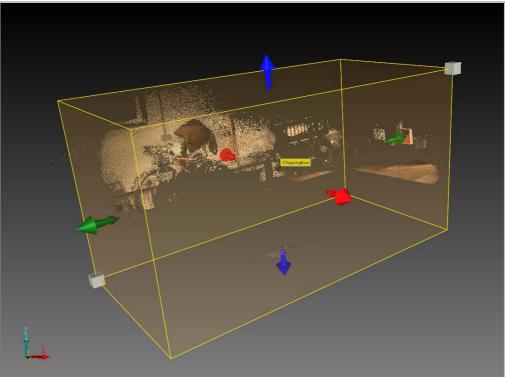


Figure 10-16 Exterior hidden (upper picture) and interior hidden (lower picture)

Depending on this setting the boundaries of the Clipping Box as well as the icon in the **Structure View** will be displayed in different colors:

- transparent blue when the exterior is hidden.
- transparent orange when the interior is hidden,

This setting will be saved in the Clipping Box properties for later use and may also be changed in the properties dialog.

10.14.17 Deleting Points by Means of Clipping Boxes

You may delete points of all active Clipping Boxes.

- 1. Execute **Hide exterior** or **Hide interior** to the Clipping Boxes.
- 2. Right-click an active Clipping Box, then select
 - Delete visible points of all active clipping boxes: All visible points of all active Clipping Boxes will be deleted, no matter if they are insides or outsides the Clipping Boxes.
 - Delete invisible points of all active clipping boxes: All invisible points of all active Clipping Boxes will be deleted, no matter if they are insides or outsides the Clipping Boxes.

10.14.18 Enabling / Disabling Clipping

Enable/Disable clipping button

You may enable or disable clipping of the selected Clipping Box with the **Enable/Disable clipping** button of the Clipping Box toolbar. When disabled, the points hidden by this box will be displayed again; the color of the Clipping Box boundaries and its icon in the **Structure View** change to gray.



Figure 10-19 Disabled Clipping Box

This setting will be saved in the Clipping Box properties for later use and may also be changed in the properties dialog.

Toggle application of Clipping Boxes button

You may also enable or disable clipping of all available Clipping Boxes globally with the **Toggle application of Clipping Boxes** button of the 3D View toolbar. This setting will not be saved in the properties of the individual Clipping Boxes.

10.14.20 Working with Multiple Clipping Boxes

You can combine the point visibility settings of several Clipping Boxes. For this, the following rules apply:

- Adding a Clipping Box with hide exterior enabled to already available and active Clipping Boxes:
 - The points inside this box will always be added to the currently visible points, even if this box intersects with boxes that have the interior hidden.
 - The points outside this box will not be hidden. In that case the clipping settings of the already available Clipping Boxes have the precedence.
- Adding a Clipping Box with hide interior enabled to already available Clipping Boxes:
 - This will cut out the points that are inside of this box from the points that
 are visible at that time, even if this box intersects with boxes that have
 their exterior hidden (and the interior displayed).
 - The points outside this box will not be displayed. In that case the clipping settings of the already available Clipping Boxes have the precedence.

The order of creation of the Clipping Boxes thus matters and has an effect on which points are displayed or not.

Example: We want to show the motor of the car. For this, we use a scan in which the hood is opened:



Figure 10-21 Example: Complete point cloud

Now you add the first Clipping Box around the car that has its exterior hidden (Clipping Box 1).

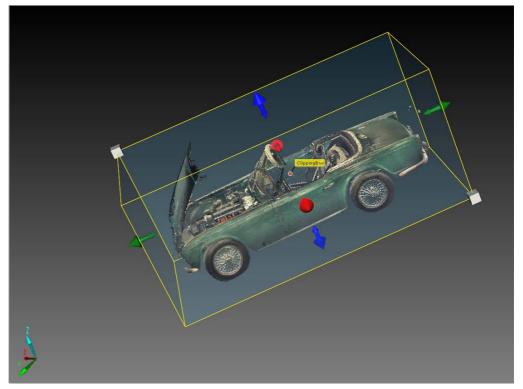


Figure 10-22 Example: First Clipping Box with hide exterior added

All the points outside the Clipping Box are now hidden, only its interior is displayed. Now you would like to remove the hood because it would disturb

the view. So you add a new Clipping Box with hide interior enabled (Clipping Box 2).

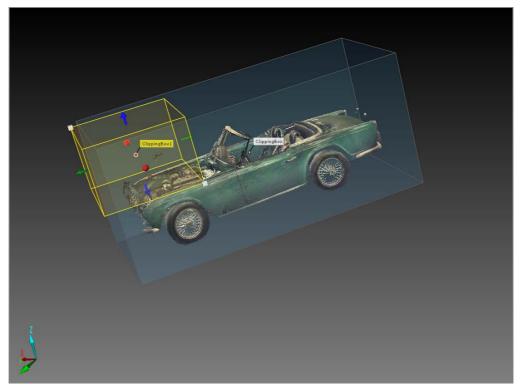


Figure 10-23 Example: Second Clipping Box with hide exterior added

The points within Clipping Box 2 are now hidden. But now you would like to hide the points of the two front fenders. So you add two new Clipping Boxes but this time with hide interior enabled (Clipping Boxes 3 and 4).

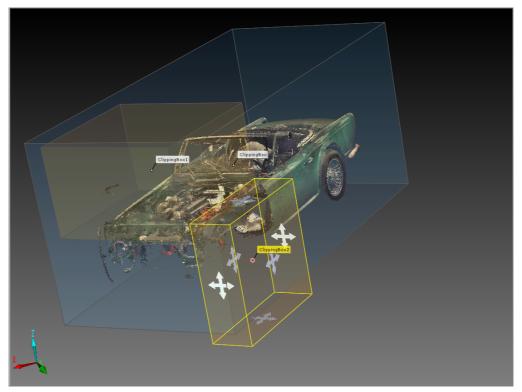


Figure 10-24 Example: Clipping box 3 with hide interior added

The points in the overlapping areas between Clipping Boxes 1 and Clipping Boxes 3 and 4 are now removed from the scene.



Figure 10-25 Example: Result with hidden Clipping Boxes

If you would like to have one or more of the available Clipping Boxes not being regarded in the current scene, you may disable them or delete them from the workspace.

10.14.26 Toggling Visibility of Clipping Boxes

Clipping box visibility button

Toggle the visibility of a Clipping Box

- With the Clipping box visibility button
 in the Clipping Box toolbar,
- · in its context menu,
- · or in its properties dialog.

Disabling the visibility of a Clipping Box will only hide its boundaries; the Clipping Box is still active (if clipping is enabled) and it still has effect on the visibility of the points in the 3D View.

10.14.27 Creating Multiple Clipping Boxes Along an Axis of an Existing Clipping Box

You can create multiple Clipping Boxes along one of the three axes of an already available Clipping Box which also serves as a template for the new Clipping Boxes. This allows slicing the point cloud into specific areas of interest and can be a useful feature, for example to divide a building into its several floors.

Do the following to create multiple Clipping Boxes along an axis of an already available Clipping Box:

- 1. Open the 3D View.
- 2. Navigate to the Clipping Box which should serve as the template.
- 3. Check if this Clipping Box has the clipping mode **Hide Exterior**. If not, select **Hide Exterior**.

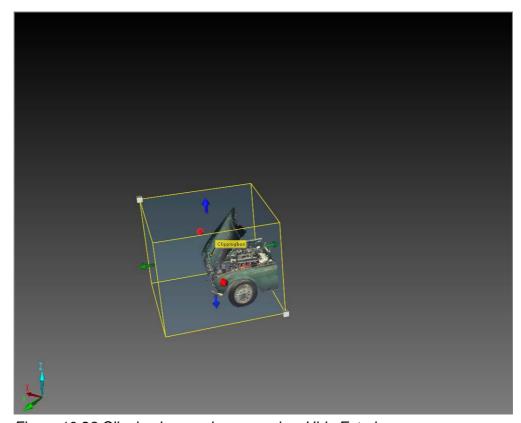


Figure 10-28 Clipping boxes along an axis – Hide Exterior

4. Right-click this Clipping Box, then click **Create Clipping Boxes Along an Axis**. Two new Clipping Boxes will be displayed according to the default settings.

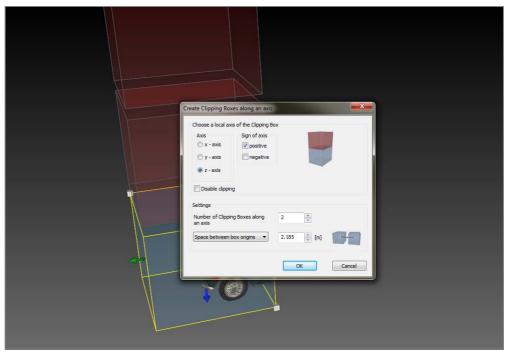


Figure 10-29 Clipping boxes along an axis - Preview

5. Make your settings in the appearing dialog. In our example, we would like to have each one Clipping Box for the front part, for the middle part, and for the rear part of the car.

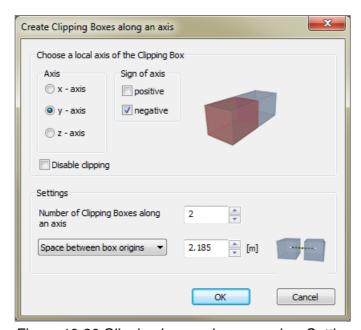


Figure 10-30 Clipping boxes along an axis - Settings dialog

Axis

Select the axis of the existing Clipping Box along which the new Clipping Boxes will be generated. A preview of the new Clipping Boxes will be available in the current 3D View.

Disable Clipping

Disable clipping in the preview.

Sign of Axis

Select the direction of the axis in which the Clipping Boxes will be created.

Settings

Number of Clipping Boxes along axis

Define the number of Clipping Boxes to be created.

Space between boxes / Space between box origins

The distance between the Clipping Boxes. There are two ways to define the distance, either between the origins of the Clipping Boxes or between the adjacent faces of the Clipping Boxes.

6. Click **OK** to create the Clipping Boxes with the selected settings.

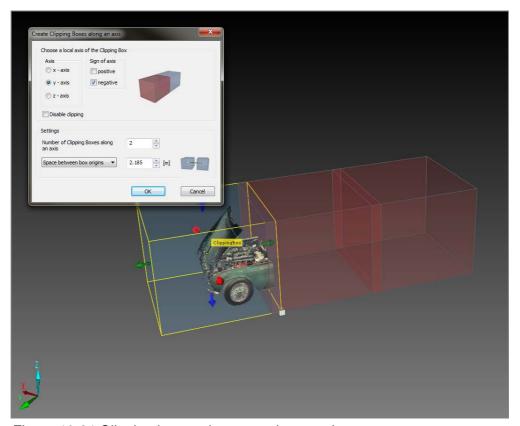


Figure 10-31 Clipping boxes along an axis – preview

The initial Clipping Box will be moved to the new Clipping Box folder and will be renamed according to the folder's name. The other Clipping Boxes

will get the name of the folder and an enumeration. The Clipping Boxes will be surrounded by the so-called **Clipping Box container**.

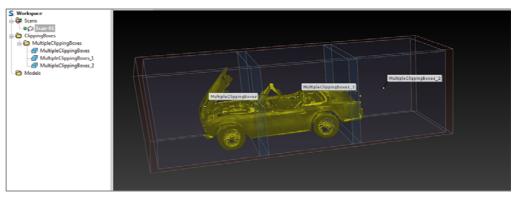


Figure 10-32 Clipping boxes along an axis, with Clipping Box container

Working with Clipping Box Containers

A Clipping Box container contains all the Clipping Boxes which were created along an axis of an existing Clipping Box. It has a transformation which consists of scale, rotation and translation.

You can rotate, move, or resize a Clipping Box container similar to a Clipping Box.

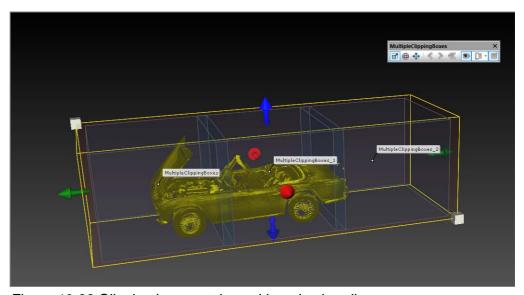


Figure 10-33 Clipping box container with resize handlers

These transformation changes will be proportionally applied to the Clipping Boxes within the container.

If required, you can change the size of the Clipping Boxes inside the Clipping Box container. It is no longer possible to rotate one of the Clipping Boxes, nor

is it possible to move one of the Clipping Boxes to the outside of the Clipping Box container.



NOTE: All Clipping Boxes within a Clipping Box container have constrained functionality:

- The single Clipping Boxes cannot be rotated individually.
- Their clipping mode cannot be changed.
- The single Clipping Boxes cannot leave the volume of the Clipping Box container.
- Change the visibility of the Clipping Box container and the Clipping Boxes in the container with the Clipping box visibility button in the Clipping Box toolbar or in its context menu.
- Any transformation of the Clipping Box container will transform the single Clipping Boxes.
- The visibility state of the Clipping Box container is a global state and not view specific. This state will be saved with the workspace.

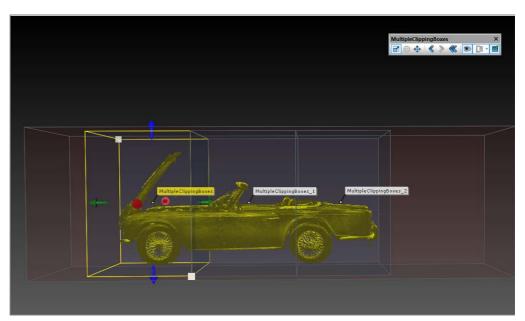


Figure 10-34 Resizing the Clipping Boxes inside the Clipping box container

10.14.35 Exporting Scan Points by Means of Clipping Boxes

You may also export 3D points into different file formats using the active Clipping Boxes.

- 1. Right-click the 3D View, or,
- 2. Right-click a Clipping Box, then, click **Export 3D selection using active Clipping Boxes**.

SCENE will then create a 3D selection and export the selected points afterwards.

Additionally, you may export the points in a local coordinate system defined by one of the available Clipping Boxes. For this, select **Use Local Coordinates** in the export dialog and select the Clipping Box from the available list.



NOTE: Only the points of point clouds will be exported.

The **Export** menu shows the **Color/gray** option as well as the **Full scan** option grayed out, because they don't make sense for a point cloud.

10.15 Meshing (Planar View and 3D View)

This section describes how to use the meshing feature in SCENE.



NOTE: 3D Meshing is only available for point clouds. For information about creating point clouds See *Processing* on page 93.

10.15.1 What is a Mesh?

When an object is scanned, the scan points represent individual spots on the surface of the object. If you want to reconstruct the surface itself, you can create a mesh which takes the scan points as a basis and approximates the surfaces within certain limits.

From scan points to triangles

The approximation of the scanned surfaces is done with a set of triangles.

Depending on the curvature of the real surface and the required approximation quality, the number of triangles can vary between a few and a huge number.

Making Your Mesh Water-Tight

To print a 3D model with a 3D printer, the 3D model must not have any gaps. The 3D model must have a solid volume, it must have a solid surface without gaps. A commonly used term for this is "water-tight".

10.15.2 Creating a Mesh in Planar View



NOTE: Creating a Mesh in Planar View option is only available with the SCENE Classic View.

- 1. Create a 2d selection as described in Selecting Scan Points in the Planar View or the Quick View.
- 2. Right-click the selection, then click **Create Objects Mesh**. The Mesh Generation Parameters dialog is shown.

To create a mesh in Planar View, select the Mesh Generation Parameters in the following dialog:

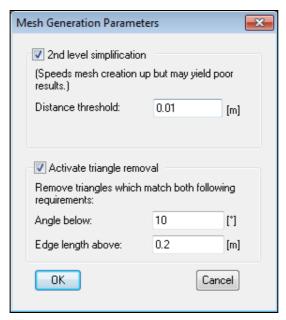


Figure 10-3 Mesh generation parameters

2nd level simplification – Activate 2nd level simplification based on the distance between scan point and nearest triangle.

Distance threshold – A triangle approximates all scan points within this distance threshold. The smaller the value, the more triangles you'll get.

Activate triangle removal – If an object is in front of a different object, neighboring scan points shouldn't be connected by triangles. Here you can activate the removal of triangles which match both following requirements.

Angle below – The angle between the scanner and the surface of the triangle. The larger the value, the more triangles will be removed.

Edge length above – The edge length of the triangle. The smaller the value, the more triangles will be removed.

Although the resulting mesh may be a relatively small collection of triangles, its appearance can show more details. This is done by a texture, which is

similar to a photo glued onto the triangles. By default the display is with textures.

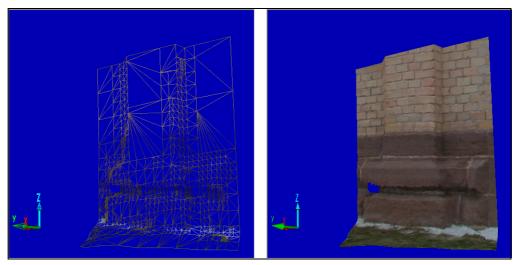


Figure 10-4 Mesh with and without texture

10.15.5 Creating a Mesh in the 3D View



Figure 10-6 Meshing Object

There are two methods to create a mesh:

- Mesh Selection: You can make a freehand selection of scan points.
- Mesh Clipping Boxes: you can use one or more clipping boxes to select what you want to be meshed.

Meshing a Selection

1. Create a 3D selection as described in *Selecting Scan Points (3D View, Planar View, Quick View)*

2. Click the little arrow in the Mesh button to open the drop-down menu, there click Mesh Selection. The **Create Mesh** – **Settings** dialog is shown. You can also right-click the selection, then click Selection – Mesh Selection

Mesh Clipping Boxes

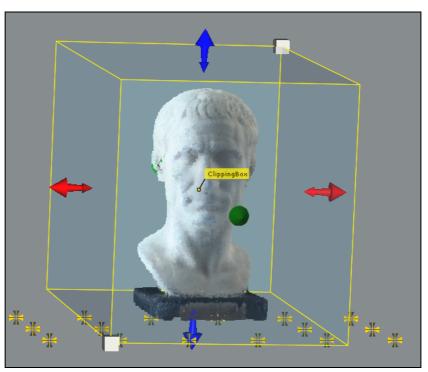


Figure 10-7 Object selected with a Clipping Box

- 1. Create and adapt one or more Clipping Boxes around the object as specified in *Creating a Clipping Box*.
- 2. Click the little arrow next to the **Mesh** button to open the drop-down menu, there click **Mesh Clipping Boxes**. The **Create Mesh Settings** dialog is shown. You can also right-click the clipping box, then click **Create Mesh using Active Clipping Boxes**.

Settings

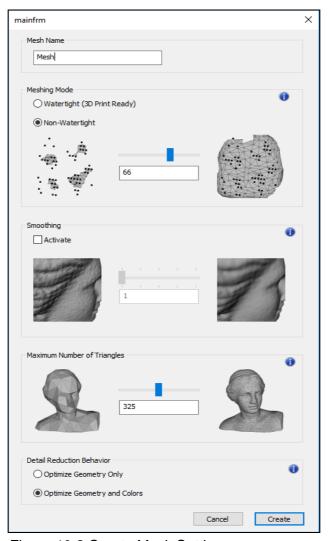


Figure 10-8 Create Mesh Settings

Mesh Name

Specify a name for the mesh.

Meshing Mode

Watertight (3D Print Ready)

Select this option if the mesh will be used for 3D printing. The mesh will then be generated "watertight", which means, it has a solid surface.

Non-Watertight Mode

Select this option if the mesh will not be used for 3D printing.

Slider - Meshing Mode

The slider in the **Meshing Mode** box, allows control to make the meshing close more or less holes and expands the mesh more or less beyond the points. This option is available when **Non-Watertight mode** is selected.

Smoothing

Perform Smoothing

Select this check box to apply a post processing operation to make the mesh smoother.

Slider - Smoothing

The slider in the **Smoothing** box allows control to make the mesh smoother.

The higher the slider value, the mesh will be smoother.

Maximum Number of Triangles

Slider – Maximum Number of Triangles

The slider under this category allows control, how many triangles will be created in the mesh, if non-watertight mode is active.

If you know the maximum number of triangles which your software or your 3D printer is able to process, enter this number. Else, use the predefined value.

Detail Reduction Behavior

Optimize Geometry Only

If you require optimal geometric precision in the mesh image, select **Optimize Geometry Only**.

Optimize Geometry and Colors

If you require optimal color detail in the mesh image, but reduced geometric precision, select **Optimize Geometry and Colors**.

Create

Click the **Create** button to start the mesh creation. The created mesh will be added to the structure view and displayed in the opened 3D view. It is also possible to open a 3D view on the mesh, through the context menu.

Mesh Properties

You can review the mesh properties by right-clicking on the name of the mesh in the structure window and selecting *properties*. The surface area of the mesh is calculated by taking the sum of the surface area of all the triangles in the mesh.

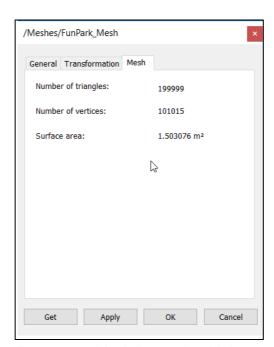


Figure 10-9 Mesh Properties Dialog

10.15.10 Export

- 1. Right-click the mesh, then click **Export**. The **Export** dialog is shown.
- 2. Select the file format in which you want the meshed object to be exported. Available file formats are: .stl, .ply, .obj, and .wrl.
- 3. Click **OK** to start the export.

10.16 Virtual Scans (3D View)

For technical reasons, Freestyle^{3D} scans can not be displayed as a Panorama View in SCENE WebShare Cloud. They have to be converted to so-called Virtual Scans first and can then be uploaded.

Virtual scans are created from the point cloud data of already existing scans. After the virtual scans were created, they behave like scans which were recorded with a laser scanner.

You can open a Virtual Scan in

- · Quick View,
- · Planar View, and
- · 3D View.

You can export a Virtual Scan as

- an image,
- · as an object,
- · as scan points, and
- · as a new scan project.



Figure 10-1 3D View of a scan

4. Click the **Create Virtual Scan** button in the toolbar. The Create Virtual Scan dialog is shown:

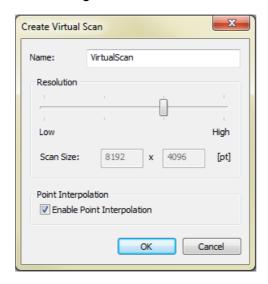


Figure 1: Create Virtual Scan dialog

Name

Enter a name for the virtual scan.

Resolution

Set the resolution with the slider. The first number corresponds to the number of columns, the second number for the number of rows.

Point interpolation

Select, if the virtual scan shall include interpolated points.

5. Click the **OK** button to start the creation of the virtual scans. A folder named VirtualScans will be created which contains the virtual scans.



Figure 10-2 Quick View of the VirtualScans folder

Export the virtual scans

After you are done with creating all the virtual scans, you can continue with the usual **Export to SCENE WebShare Cloud** functions.

10.17 Working with the Project Point Cloud

Like the scan point clouds, the project point cloud is optimized for fast visualization of large amounts of scan points in the 3D View, and is organized in a spatial data structure that facilitates fast visualization of the scan points. The project point cloud consists of the points in of all the scans within your scan project and can thus be seen as a comprehensive point cloud of the complete scan project. For this reason, the amount of points in a project point cloud can be enormous. Unlike scan files, such large amounts of points cannot be loaded into physical memory at once. Therefore, the points of the project point cloud are automatically loaded and visualized on demand based on the camera position and point visibility. The automated point loading of the project point cloud is able to visualize hundreds of scans at once. This empowers you to actually see all scans of a scan project at once, regardless of whether they fit into your computer's physical memory or not. Manual scan file loading is not necessary.

The project point cloud is the best way to visualize and manipulate enormous amounts of scan data interactively. It is accessible from all local workspaces of a scan project. There can only be one project point cloud for each scan project.

If your project has a project point cloud:

- 2. Start exploring.

As the point cloud visualization technique is constantly loading scan points from the hard disk drive based on point visibility, the overall performance strongly depends on the speed of your hard disk drive. While project point clouds outperform all other visualization methods (including scan point clouds) on regular hard disk drives, we recommend using a solid state drive for maximum performance. Using a solid state drive will also speed up the process of creating the project point cloud.

The benefits of the project point cloud are:

- · No manual loading of scans required
- Very fast visualization of large amounts of scans at once
- One optimized single spatial data structure for all scan points in a project
- · Out-of-Core visualization
- Can be accessed from all local workspaces associated with the project.

10.17.1 Creating the Project Point Cloud

The project point cloud is typically created from all the single scans in your project after they have been processed and registered.



NOTE: The creation of the project point cloud is only available if you are directly working on the scan project.

- Open the scan project from the Project Overview, or by clicking the Open Project button in the Project toolbar.
- 2. Click the **Explore** button in the Workflow Bar.
- 3. Click the **Project Point Cloud** button in the toolbar. A drop-down menu opens.
- 4. Select Create .

Preparing your Scan Project

The resulting point cloud is about two to four times the size of your scan files. SCENE will create large amounts of temporary data during point cloud creation, which will be deleted after the point cloud was successfully built. The amount of space needed for the temporary data during the point cloud creation process can be up to seven times the size of the original scan data. The actual amount of temporary data and the size of the project point cloud strongly depend on the point data itself and cannot be safely predicted beforehand. Make sure to have enough free space on your target hard disk drive (the location of your scan project) and in the location of the temporary data folder when creating project point clouds. The temporary data folder can be changed in **Settings** > **General**.



NOTE: Project point cloud creation will only consider the global position of the scan points at the time of the creation. All changes to scan, cluster, folder or workspace transformations that are performed after the project point cloud has been created will not alter the project point cloud. This will lead to an inconsistency between point cloud and the traditional scan-based data of the scan project. For this reason, we recommend creating the project point cloud once you consider your registration to be complete.

Certainly, you may change your registration at any time, even if a project point cloud already exists, but be aware that the project point cloud will not have these changes applied until it is updated or recreated.

Project Point Cloud Creation Settings

After you have initiated the project point cloud creation, the point cloud settings dialog shows up:



Figure 10-2 Create project point cloud settings

Filter

For the creation of the project point cloud, two point filters are available. Each of these filters will reduce the overall point count by eliminating different types of (unwanted) points.

Eliminate Duplicate Points

The filter removes duplicate points that always exist when points are recorded from several different scanner positions. Overlapping areas can be optimized by removing some of the duplicate points. This filter can improve the visual quality of your project point cloud significantly while reducing overall point count and therefore improving interactivity and loading times of the point cloud.

Points are considered duplicates of others when they were recorded from different scanner positions and their 3D positions are similar. The actual distance threshold for duplicate points depends on point to scanner distances. The farther away a point is from the position of the scanner during recording, the "larger" we consider this point to be because points great distances are spatially farther away from each other than points close to the scanner position.

The filter is configured to always keep the highest quality point. Higher quality means smaller distance to the scanner position. If two points are considered duplicates of each other, the point with the greater distance – and therefore lower quality – is dismissed. Only the higher quality point is added to the project point cloud.

When creating a project point cloud from a project that contains both Laser Scanner scans and Freestyle scans, all points are considered. Usually, Freestyle points are used only where no Laser Scanner points are available.

With the **Search Radius** slider you can adjust the distance threshold for point elimination. The default setting should be sufficient for almost all scenarios.

Adjust the **Search Radius** slider to the right to enlarge the search radius and increase the number of eliminated points. This may help to reduce point count when your registration is not very accurate (for example when using natural targets only).

Adjust the **Search Radius** slider to the left to reduce the number of eliminated points. This can be useful if too many points have been deleted by this filter in previous point cloud iterations.

Close Surfaces

Select this checkbox if you want to have additional points interpolated between original scan points, in order to create a more dense impression of the surfaces. The color or gray value of these additional points will also be interpolated.



NOTE: Scans captured using Freestyle are interpolated immediately after they are captured (if the appropriate option was enabled during capture). No additional interpolation is performed for these data sets during project point cloud creation. Nevertheless, you need to select this option to get a closed surface representation of your data. If you don't, points of Freestyle scans are stored with smaller sizes.

Full color detail

Select Full Color Detail if the color of the points shall be retrieved from the laser scanner's high resolution camera images. Moreover, additional even smaller points are interpolated to transfer the color information from the camera images into the point cloud. By using the images from the camera images, smearing effects are reduced and more color details are visible in the project point cloud.



NOTE: The time needed for the interpolation and the creation of the point cloud will greatly increase. The files will need much more disk space.

Homogenize Point Density

This filter balances the density of points within the point cloud by reducing the number of points in areas where the average target density is exceeded. This is especially the case close to scanner positions, where the point density is

particularly high or in areas where two or more scans overlap. By reducing the total number of points in the point cloud, less hard disk space is required and the performance of the point cloud visualization is increased, while preserving the overall visualization quality.

The achievable rate of data reduction is highly dependent on the input data. Outdoor projects with little overlap between scans will benefit less than densely scanned indoor projects where a data reduction of 25% and more can be achieved with hardly any perceivable loss of visualization quality.

Cell size

You can adjust the cell size of the existent homogenization feature. The standard value of 1.5mm was empirically chosen so that no band artifacts emerge. The unit of the maximum distance is adapted according to the setting of the small standard units. The homogenization and Close Surfaces are mutually exclusive, which means that setting the Close Surfaces will unset the homogenization checkbox and vice versa.

Apply Color Balancing

A typical effect seen in real world laser scanning projects is that the overall perception of color may not always be consistent across colored scans. This effect can have two different root causes:

- The internal camera of the FOCUS^{3D} laser scanners performs white balancing on a per-scan basis. As a result, the internal camera may choose to apply a different white balancing at different scan positions, given that the lighting conditions vary. For example, the scanner is set up in a room illuminated by neon lights as opposed to natural light when scanning outdoors.
- While carrying out a scanning project, lighting conditions may vary over time. For example, when the project starts in the morning and is completed in the evening (or even on another day).

This effect may especially become apparent when such differently colored scans are combined into a project point cloud and visualized together as shown in the following figure:



Figure 10-3 Inconsistent color of a floor due to scans taken under varying lighting conditions.

When enabled, the color balancing filter minimizes the color contrast between scans in the project point cloud and results in a more homogeneous overall perception of color as shown Figure 10-4.



Figure 10-4 Significant reduction of color inconsistencies by applying color balancing

Distance Filter

If this checkbox is set, all points which are more than "Maximum Distance" units away from the associated scanner position will not be used to create the project point cloud. This filter can be used to restrict the point cloud to the more precise near the area of the scanner. For example, if you scan a windowed room, you can now ignore most outside stray points, which are probably bad, because they were scanned through the window glass. The unit of the maximum distance is adapted according to the setting of the standard units.

CPU Load

The **Number of CPU cores to use** slider allows adjusting the number of (logical) CPU cores to use for parallel computation throughout certain steps of the point cloud creation process. The more cores are used, the faster the creation may be completed.



NOTE: Less performance is available for other programs running on the machine when increasing the number of CPU cores.

A dialog will also be shown during the point cloud creation process that allows you to adjust the number of cores on-the-fly if you temporarily need processing power for other applications.

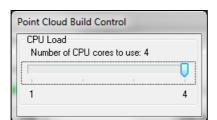


Figure 10-5 CPU load

You may adjust the number of cores used at any time while this dialog is shown.

Temporary Data Folder

During the project point cloud creation process all scans in the project will be loaded successively; their point data will be processed and in a temporary representation. This temporary data will be stored inside the temporary data folder. Do not delete, move or copy any of these files during the point cloud creation process or the process might fail. The temporary data will be deleted automatically after the process is complete.

Section **Disk Space** shows if there is enough free space on the hard disk used for the temporary data and the (target) hard disk used for saving the final point cloud data. The target hard disk is the disk on which the scan project data is stored.

10.17.6 Updating the Project Point Cloud

The project point cloud can be updated to make changes such as deleted points or scans persistent. When points are deleted or scans have been removed from the scan project, they are not deleted from the point cloud but rather marked as removed. The point cloud will no longer visualize these

points; they are filtered out during the point loading process. Unfortunately these filter operations will slow down the process of point loading. This may not be noticeable for only a few delete operations but as you work with your point cloud, deleting more and more points over time, you might notice a decrease in performance. When this happens, the project point cloud should be updated.

- 1. Click the **Project Point Cloud** button in the toolbar. A drop-down menu opens.
- 2. Select **Update** \mathbb{Q} .

Update when saving the project

1. In the Share Changes dialog, select the Update Point Cloud checkbox.

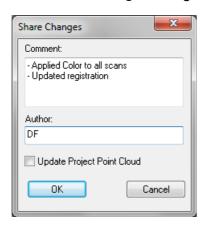


Figure 2: Share changes

This way the project point cloud will be updated automatically after the sharing and saving operation is complete.

After the update has been initiated, you are asked to specify the same parameters as for the initial creation of the point cloud. If point filters where enabled during its creation, it is not necessary to apply them during updating again since the resulting points will just be the same (and the updating will also take longer without any visual benefit).

10.17.7 Deleting the Project Point Cloud

- 1. Click the **Project Point Cloud** button in the toolbar. A drop-down menu opens.
- 2. Select Delete 🕝.

10.18 Visibility Settings

The views can also show objects other than the scan points, such as:

- The positions of the other scans in the workspace.
- The simple objects assigned to a scan that were created by a fit, for example spheres, and 3D points.

CAD models.

Not all views can display all these objects. For further information, see the more detailed description of views.

You can decide whether or not to display the objects using the visibility settings, which are arranged in three levels:

- The visibility of the layer to which the object is assigned.
- The visibility according to the prominence of the object.
- The distance of the object from the observer.

An object is only visible if the visibility on the first two levels is set accordingly and it is located in the set range.

The visibility settings are maintained separately for each view. It is therefore possible that an object is visible in one view and not in another. When you open a new view, this view initially takes over the default values of the visibility settings. You can also change these default values.

⇒ In a view, right-click the view, then Visibility Settings.

10.18.1 View (3D View only)



NOTE: If **Auto apply changes** is selected, new settings are visible immediately; you do not need to click the **Apply** button.

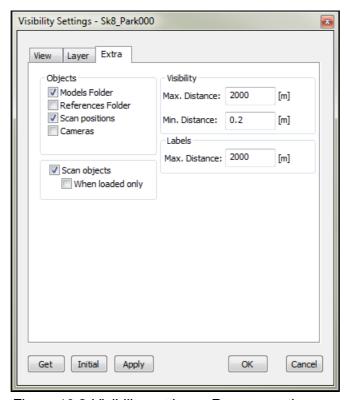


Figure 10-2 Visibility settings –Representation

Quality Settings – Determines the image quality while moving.

If the handle of the slider is moved to the left, the quality of the rendering is reduced during movement in favor of performance.

If the handle of the slider is moved to the right, the quality increases/the performance decreases. If the handle of the slider is moved completely to the right, there will be no quality penalty during movement.

Clear View Settings – In the clear view mode, points in areas with low point density will be displayed more transparently and points in areas with a high point density will be displayed more brightly.

Enable Clear View – check if you want to use Clear View. By changing the settings with the slider you can intensify or weaken this effect.

Gap Filling – The gap filler fills gaps between scan points that are physically close to each other.



Figure 10-3 Gap filling turned off (left) and turned on (right)



NOTE: If clear view and gap filling are grayed out, **Offscreen Rendering** under **Tools > Options > View** might be disabled. Offscreen Rendering must be enabled for Gap Filling and Clear View.

Supersampling – Supersampling renders the point cloud with a resolution higher than the resolution of your screen and then shrinks the point cloud to fit the screen resolution. This reduces anti-aliasing effects and gives the point cloud a smoother visual appearance. Fine and filigree structures look sharper and stray points will appear less annoying. Set the resolution of the initially rendered point cloud compared to the screen resolution by selecting one of the options 2x2, 3x3, or 4x4. For example, choosing 2x2 means that the point

cloud will be rendered with a resolution that is 4 times the resolution of your screen.



Figure 10-4 Supersampling turned off (left) and turned on (right)



Objects like walls might appear transparent when using small point sizes in combination with supersampling.

NOTE: High supersampling resolutions like 4x4 require large amounts of graphics card memory.

10.18.5 Layer

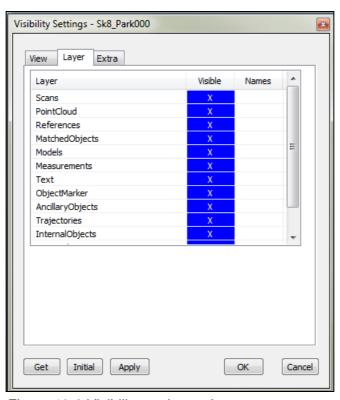


Figure 10-6 Visibility settings – Layer

Toggle the visibility of the available layers and their related objects and the object names in the view. See chapter *Layer* for more information.

10.18.7 Extra

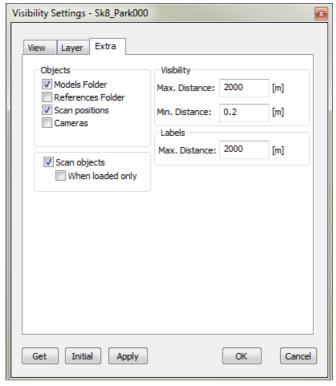


Figure 10-8 Visibility settings -Extra

Objects – Display or hide certain types of objects:

Models Folder - Display CAD models.

References Folder – Display reference objects.

Scan positions – Display the scanner positions in the view. If enabled, the positions will be visualized by this symbol:



Figure 10-9 Scanner position

Cameras – Display the camera positions of other views.

Scan objects – Display or hide the objects that are assigned to the scans in the view. You may display these objects only if the scan is loaded.

Visibility – Set the minimum and maximum distance at which objects are shown.

Documentation Objects – Set the maximum distance at which documentation objects are shown.

Chapter 11: Export

11.1 Introduction

In order to use scan points from the scans in other applications such as CAD systems, SCENE provides the possibility to export scan points in various data formats and write them to a file. You can then import this file into the desired application.

You may change certain settings prior to the export of the scan points. The settings available in the export dialog will be described in this chapter.



NOTE:

- Due to the nature of the underlying data, the export of points from 3D selections provides only a reduced set of export settings. The mismatching will be grayed in the export dialog when exporting points of a 3D Selection.
- Not all export formats are available when exporting points from a 3D selection. The supported formats are CPE, E57, VRML, DXF, XYZ Text, XYZ Binary, IGES, FLS, PTS and POD.
- The export of multiple scan point clouds of a scan folder does not support to export all points into a single file.

Applying Clipping Boxes

The export of scan point clouds and of the project point cloud will consider activated Clipping Boxes in the same way as they are applied in the 3D Views (what you see is what you get).

If Clipping Boxes exist in the project, but should temporarily not be considered during the export, deactivate the Clipping Boxes individually or through the global Clipping Box setting.

11.2 Exporting the Scan Project



Figure 11-1 Export toolbar

- 1. Click the **Export** button the **Workflow** bar. The toolbar will now show the available Export functions.
- 2. Click the button of the Export function you want to execute for the entire scan project.

11.2.2 Export Scans

In the Export toolbar, click Export Scans, then click

• Export Scans – ordered to export all scans of this scan project.

 Export Scan Point Clouds – unordered to export all point clouds of this scan project. Exporting scan point clouds on a scan or cluster will only apply the Clipping Boxes below the scan or cluster, instead of all available Clipping Boxes.

The **Export Scan Points** dialog opens, and you can specify the export format, and the required settings. Export formats are: CPE, E57, VRML, DXF, XYZ Text, XYZ Binary, IGES, PTS and POD.

11.2.3 Export Project Point Cloud

⇒ In the Export toolbar, click Export Project Point Cloud.

The **Export Scan Points** dialog opens, and you can specify the export format, and the required settings. Export formats are: CPE, E57, VRML, DXF, XYZ Text, XYZ Binary, IGES, PTS and POD.

All clipping boxes will be applied.

11.2.4 Export Project

⇒ In the Export toolbar, click Export Project.

The Export as Project dialog will open.

• Format: Select, if the new scan project will be used in SCENE or in ReCap.



NOTE: When exporting a ReCap Cluster Project, SCENE creates a temporary SCENE project in the **TEMP** folder. This may require a large amount of disk space.

- Project Name: Enter a project name for the new project.
- Location: Select the target folder in which the new project shall be saved.

11.2.5 Export Overview Map

Scan Project

The overview map for a scan project can be exported as a high resolution TIF image or as a DXF file that can be opened in any CAD system for further modeling.

- ⇒ In the Export toolbar, click Export Overview Map.
- ⇒ A file dialog opens where you can enter the desired name of the exported file

An additional text file is also created that contains information about the resolution, the image size in pixels and in meter, and the corner points of the image and the associated TIF file.

Scan Cluster

To export the overview map of a single scan or a cluster:

⇒ Right-click the cluster and select Export > Overview Map.

Scan

To export each overview map of a scan into a single file:

- ⇒ Right-click the cluster and select Export > Scans > Overview Map.
- ⇒ A file dialog opens where you can enter the desired base name of the exported file. For each overview map exported, the corresponding scan name is added to the base name.

11.2.6 SCENE WebShare Cloud

⇒ In the toolbar, click SCENE WebShare Cloud.

A drop-down menu opens in which you can select to

- Export SCENE WebShare Cloud Project: Export the project for SCENE WebShare Cloud or WebShare 2Go 2.0.
- Upload SCENE WebShare Cloud Project: Upload an existing export to SCENE WebShare Cloud.
- Upload Project Point Cloud Data: Upload the project point cloud to SCENE WebShare Cloud as a CPE file. This CPE file can be used as source data for the 3D View in SCENE WebShare Cloud.

11.2.7 Export Objects

⇒ In the Structure View, right-click the scan, then click Export > Objects.

The **Export Objects** dialog opens, and you can specify the export format, and the required settings. Export formats are: VRML, DXF, and IGES.

11.3 Exporting scan points

11.3.1 Scan points of an entire scan

 In the Structure Window, right-click the scan, then select Export > Scan Points.

Or:

- 1. Open the scan in **Planar View** or the **Quick View**.
- 2. Right-click into the view, then select the command **Export > Direct Export** or **Export > Export Scan Points** in its context menu.
 - Select Direct Export to export the scan points without opening the settings dialog. The prior settings will be used and the data will be saved directly to a file.
 - Select Export Scan Points to open the settings dialog to make certain settings prior to exporting the points. The available settings are explained in the next sections.

11.4 Exporting scans

To export scans:

- 1. In the Structure View, right-click the cluster.
- 2. Select **Export > Scan Points**. This command will be grayed if a scan point cloud of the respective scan does not yet exist.

11.4.1 Exporting the scans of a cluster

⇒ In the Structure View, right-click the scan, then select **Export > Scan Points**.

The **Export Scan Points** dialog opens, and you can specify the export format, and the required settings.

11.4.2 Exporting the scans bundled as a new project

- ⇒ In the Structure View, right-click the cluster, then select Export > As Project. The Export as Project dialog opens.
 - Format: Select, if the new scan project will be used in SCENE or in ReCap.



NOTE: When exporting a ReCap Cluster Project, SCENE creates a temporary SCENE project in the **TEMP** folder. This may require a large amount of disk space.

- Project Name: Enter a project name for the new project.
- **Location**: Select the target folder in which the new project shall be saved.

11.4.3 Exporting the images of the scans to .jpg format

□ In the Structure View, right-click the scan, then select Export > Panoramic Images. Select Scan Resolution to create images that have the same color resolution as the scan, or select Full Color Resolution if you want to create panoramic images with the highest color quality possible, and which are compensated to remove the offset between the two halves of the scan, as well as any distortion cause by the scanner's rotation. Full color resolution panoramas have a white stripe at the bottom of the picture because the proportions of the scan and the picture are different. (Scans made with FARO scanners versions M70, S70, S350 and later create 160 megapixel images. Scans from older scanners only output panoramic images with 40 megapixel images.)

The **Select folder for images export** dialog opens, and you can browse to the target folder in which the images shall be saved.

11.5 Exporting scan point clouds

11.5.1 Export one scan point cloud

To export the scan points of a scan point cloud:

In the Structure View, right-click the scan, then select Export > Scan Points.
 This command will be grayed if a scan point cloud of the respective scan does not yet exist.

11.5.2 Export several scan point clouds

To export the scan points of several scan point clouds of a scan folder:

In the Structure View, right-click the scan, then select Export > Scan Points.
 This command will be grayed if the respective scan folder does not contain any scan point clouds.

11.6 Exporting the project point cloud

To export the project point cloud of a scan project:

1. Click the **Project Point Cloud** button in the **Export** toolbar. It does not matter what you clicked in the Structure View before.

The Export Scan Points dialog is shown.

- 2. Select the file format in which you want the project point cloud to be exported.
- 3. Click **OK** to start the export.

11.7 Exporting a Cluster

You can export the content of a cluster into three different formats:

- · the scan points of each scan, or the scan points of all scans,
- the scans bundled to a new project,
- the images of the scans. The images are saved in .jpg format.

11.7.1 Exporting the scans of a cluster

⇒ In the Structure View, right-click the scan, then select Export > Scan Points.

The **Export** dialog opens, and you can specify the export format, and the required settings.

11.7.2 Exporting the scans bundled as a new project

⇒ In the Structure View, right-click the cluster, then select Export > As Project. The Export as Project dialog opens.

 Format: Select, if the new scan project will be used in SCENE or in ReCap.



NOTE: When exporting a ReCap Cluster Project, SCENE creates a temporary SCENE project in the **TEMP** folder. This may require a large amount of disk space.

- Project Name: Enter a project name for the new project.
- Location: Select the target folder in which the new project shall be saved.

11.7.3 Exporting the images of the scans to .jpg format

□ In the Structure View, right-click the scan, then select Export > Panoramic Images. Select Scan Resolution to create images that have the same color resolution as the scan, or select Full Color Resolution if you want to create panoramic images with the highest color quality possible. (Scans made with FARO scanners versions M70, S70, S350 and later create 160 megapixel images. Scans from older scanners only output panoramic images with 40 megapixel images.)

The **Select folder for images export** dialog opens, and you can browse to the target folder in which the images shall be saved.

11.8 Format related settings

The appearance of the Export dialog depends on the format selected in the Format dropdown menu. Some file formats support additional settings in which can be configured in up to three tabs.

11.8.1 Export tab

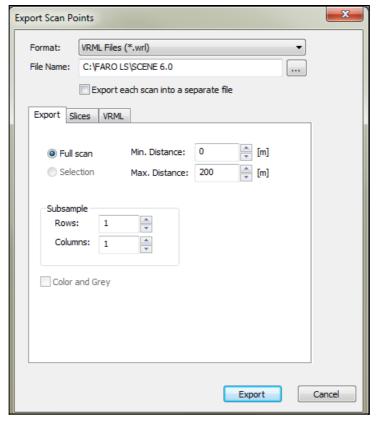


Figure 11-2 Export tab, shown here for the IGES export

Full scan

Export the entire scan.

Selection

Export the selection.

Full Scan and **Selection** become available only when exporting from a single scan within the tree or from a point selection.

Subsample

Since even small selections of a scan can contain a great number of scan points it may be necessary to reduce or thin out the exported scan points. Thinning out is achieved by only exporting every second, or third scan point of a row or column. Therefore, thinning out is done according to the arrangement of the scan points in the planar or **Quick View**.

Rows – Reduction by thinning out the rows

Columns – Reduction by thinning out the columns

With the value 1, every column/row is exported, with 2 every second, and so on. For example, if you enter the value 10 in both fields, you will thin out of a tenth of the columns and a tenth of the rows, therefore in total you will have a reduction of one hundredth of the scan points.

For further reduction, you can indicate the distance threshold a scan point may be away from the scanner:

Min. Distance – The minimum distance the exported scan points can be from the scanner. Scan points situated closer are not exported.

Max. Distance – The maximum distance at in which the exported scan points can be from the scanner. Further away scan points are not exported.

Color and Grey

Export RGB and grayscale (intensity) values of each scan point if available. This function is enabled for the formats CPE, E57, XYZ text, POD, PTX and PTS. To export both values, the scan will be unloaded first and re-loaded with both values. After the export, the scan will be unloaded again and the initial scan status will be restored.

Use Local Coordinates

Enable to export the points in the local coordinate system of an available Clipping Box. Select the box from the drop down list. This option is only available if points of scan point clouds or the project point cloud will be exported and if there is at least one Clipping Box in the workspace. It is not available for exporting points of scans.

11.8.3 Slices tab

If, for example, you want to very quickly create the floor plan of a building from the scan points, it is practical to use the slice export. When exporting slices, only those scan points are exported, which are between the top and the bottom limit you have specified. Therefore, if you select a slice where there is

hardly any furniture or machines blocking the view, you obtain the floor plan of the building very easily.

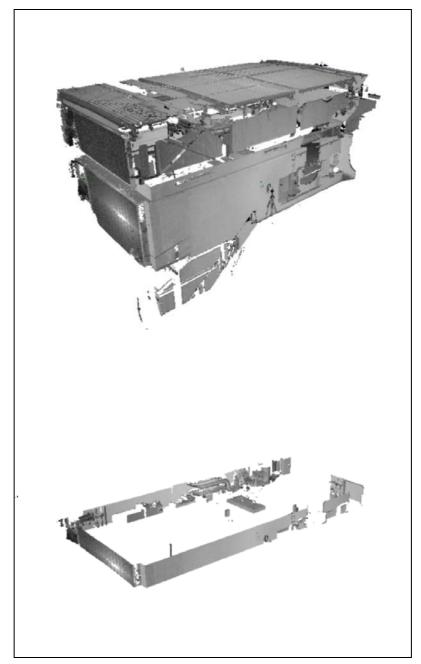


Figure 11-4 Slice of scan points

When exporting slices, only those scan points are exported, which are between the top and the bottom limit you have specified.

Export Scan Points IGES Files (*.igs) Format: File Name: Export Slices IGES Export Slices One Slice Use Tomograph Slice Top: -0.5 [m] Slice Bottom: Custon Slices by Planes Slice Thickness: 0.01 🛊 [m] Max. Slice Radius: 1 Export Cancel

You can of course also apply the threshold outlined above for reducing and thinning out when exporting slices.

Figure 11-5 Export of a single slice

The orientation and position of the slice are defined by the reference plane. The default setting of the reference plane is the ground floor, so top and bottom limits refer to the z coordinate and are limits in height.

If you want to create vertical slices, for example, you can select the corresponding predefined plane with the normal pointing along the x- or y-axis.

The reference plane will be added to the workspace after the export. It will be called **ExportRefPlane** and will be available in the folder References.

However, the export of slices is not limited to planes with normals pointing along the axes. With the **Custom** button you can use arbitrary planes as reference planes. Custom reference planes make it very easy to export scan points of objects that are located above a flat surface, like objects on the floor or on a table, by fitting a plane to the surface and using this plane as a reference.

The Tomograph can be used with any reference plane.

11.8.6 Several slices

If you want to export several slices at the same time, you can define the slices with a set of planes. In contrast to the export of a single slice, here each plane directly defines the location of the slice. Instead of having a plane and a top and a bottom distance, each plane defines the center of the slice. All slices have the same thickness which you can input into the dialog.

Also in contrast to the export of a single plane, here only those points of a slice are exported which are located within a given radius around the center point of the slice.

The center point of each slice is defined by the position of the corresponding plane.

You can create planes either by fitting or manually. Observe that all planes of the workspace will be used as reference planes – even if they are defined in other scans or in completely different folders of the workspace.

In the figure below you can see an example of an export with a set of equidistant planes that had been defined manually. This figure shows the exported scan points after they have been imported back into SCENE.

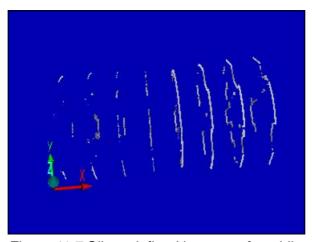


Figure 11-7 Slices defined by a set of equidistant planes

Several Slices: Slice by plane

If you want to export several slices at the same time, you can define the slices with a set of planes. Here, each plane directly defines the location of the slice. Instead of having a plane and a top and a bottom distance, each plane defines the center of the slice. All slices have the same thickness which you can input into the dialog.

Only those points of a slice are exported which are located within a given radius around the center point of the slice.

The center point of each slice is defined by the position of the corresponding plane.

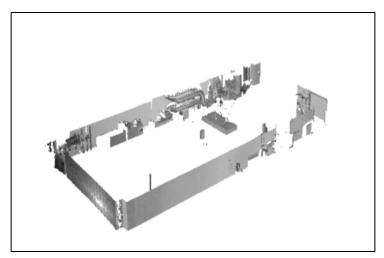


Figure 11-8 Export of several slices

You can create planes either by fitting, or manually. Observe that all planes of the workspace will be used as reference planes – even if they are defined in other scans or in completely different folders of the workspace.

11.8.9 Tomograph

When exporting slices, of course scan points from horizontal surfaces in the slice are also exported, which can make it difficult to define the floor plan. The Tomograph resolves this: it brings out vertical surfaces and hides horizontal surfaces, thereby allowing walls and supports to stand out.

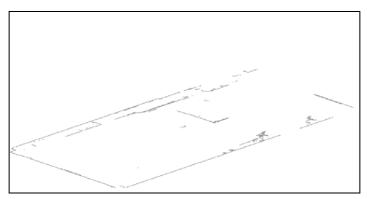


Figure 11-10 Tomograph

The Tomograph works like an X-ray apparatus – the X-ray goes through the slice from above and comes out on a photo plate below. The photo plate is covered with a fine raster and a raster field now either turns black or it remains white. If the X-ray hits sufficient scan points on its way through the slice, the raster field turns black. This occurs predominantly with vertical surfaces. If the X-ray hits only very few scan points, as is the case with horizontal surfaces, the raster field remains white.

The Tomograph brings out vertical surfaces and hides horizontal surfaces, thereby allowing walls and supports to stand out.

11.8.11 CPE Export

CPE is a new file format for point data developed by FARO that combines minimal file size with flexible quality settings.

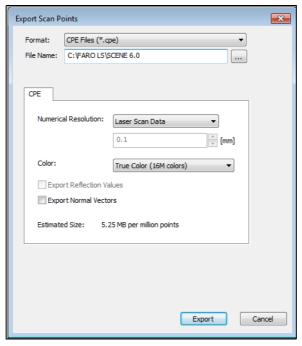


Figure 11-12 CPE Export

When exporting scans to the CPE file format, the following information has to be provided:

- File name Name and location of the file to be created.
- Export each scan in a separate file If not selected, all scans will be saved in one file.
- Numerical Resolution Set the numerical resolution (quantization) for the exported scan points to one of the recommended values or your own desired value.
- Color Set the number of colors used for the exported scan points to "True Color"; or "High Color" for a smaller file size, but with a reduced visual quality of color gradients.
- Export Reflection Values Export with raw reflections, that can be between 0 and 2047 for the FARO Laser Scanner. Otherwise, the monitor brightness will be exported (values between 0 and 255). Export the original reflection values of the scan points if they're available.
- Export Normal Vectors Export the normal vectors of the scan points.
- Estimated size The estimated file size in MB per million exported scan points.

11.8.13 E57 Export

When exporting scans to the E57 file format, the following information will be stored in the exported file:

- For each scan point in a scan, the xyz-coordinate, RGB or intensity values, and the corresponding index of row and column. This information is part of the binary section of the E57 file. It is possible to store several scans in one E57 file.
- Additional Meta information like the scan name, the unique ID (Uuid) of a scan and the software version that is used for the export¹. This information is stored in the XML-part of the E57 file.

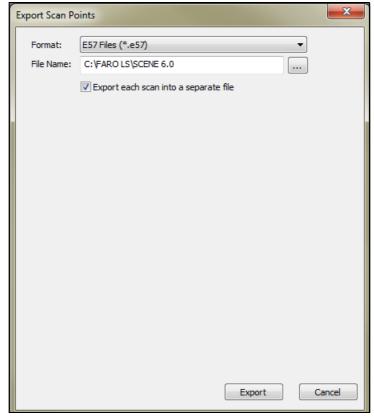


Figure 11-14 Settings for E57 export

File name

Name and location of the file to be created.

Export each scan in a separate file

If not selected, all scans will be saved in one file.

^{1.} For more detailed information we refer to http://www.libe57.org or http://www.astm.org/Standards/E2807.htm

11.8.15 VRML

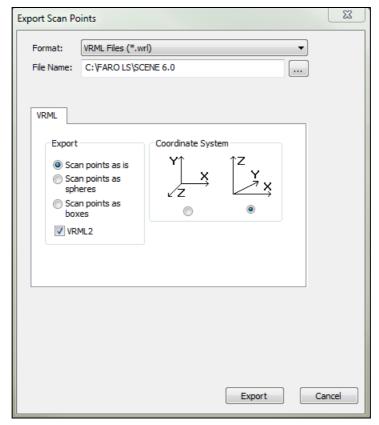


Figure 11-16 Settings for VRML export

File name

Name and location of the file to be created.

Export each scan in a separate file

If not selected, all scans will be saved in one file.

Export

Scan points as is – Scan points are exported as points.

Note: A lot of VRML viewer programs do not support points!

Scan points as sphere – Scan points are exported as small spheres.

Scan points as boxes – Scan points are exported as small boxes.

VRML2 – Export in VRML2 format. Otherwise VRML1 is used.

Coordinate System

Select the target coordinate system.

11.8.17 DXF

DXF is a data format developed by AutoDesk for the exchange of CAD drawings. SCENE uses DXF version 12.

The scan points in DXF are always displayed as points. Since DXF has very few gray scales at its disposal, the visual appearance is not as good as in SCENE.

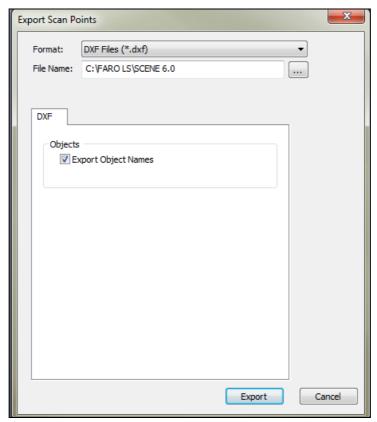


Figure 11-18 Settings for DXF export

File name

Name and location of the file to be created.

Export each scan in a separate file

If not selected, all scans will be saved in one file.

Export Object Names

Select this check-box if the names of the selected objects shall be exported.

11.8.19 XYZ text

With XYZ text format, the export file contains one scan point per row. Each scan point is identified by its 3 Cartesian coordinates X, Y and Z and the reflection value. You can also specify the row and column number of the scan

point. Both these numbers will then be next to the current scan point in the in export file.

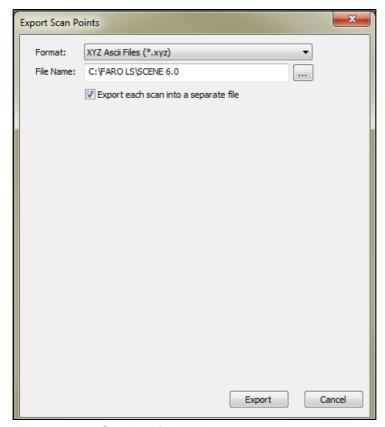


Figure 11-20 Settings for XYZ text

File name

Name and location of the file to be created.

Export each scan in a separate file

If not selected, all scans will be saved in one file.

11.8.21 IGES

IGES is a multi-vendor-capable standard for the exchange of CAD drawings. SCENE uses IGES version 5.3.

The scan points are exported as gray points or color points, if color information is available. When you import the IGES file into your CAD system, it decides how it will represent these points in its in own gray or color space.

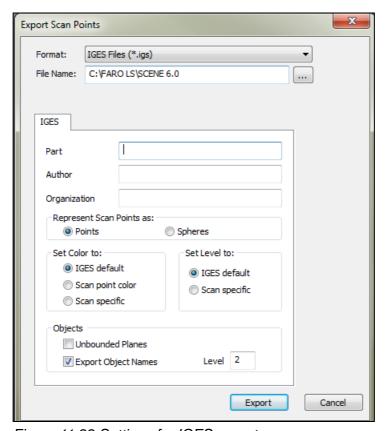


Figure 11-22 Settings for IGES export

File name

Name and location of the file to be created.

Part

naming the parts is a required component of an IGES file.

Author

specifying the author is a required component of an IGES file.

Organization

specifying the organization is a required component of an IGES file.

Represent Scan Points as

Points – Scan points are displayed in the CAD system as points.

Spheres – Scan points are displayed in the CAD system as small spheres.

Set Color to

Settings for the colors to be used.

IGES default – The export file does not contain any color specifications so the CAD system will use the default color.

Scan point color – Use the gray value or color value of the scan point.

Scan specific – If the export consists of several scans, the scan points from the different scans will have different colors.

Set Level to

Settings for the level to be used.

IGES default – The export file does not contain any level specifications so the CAD system will use the default level.

Scan specific – If the export consists of several scans, the scan points from the different scans will have different levels.

Objects

Unbounded Planes – The idealized planes without border are also exported as idealized and without border. Otherwise a square is exported.

Export Object Names – Object names are exported.

Level – Level allocation for object names.

11.8.23 PTS Export

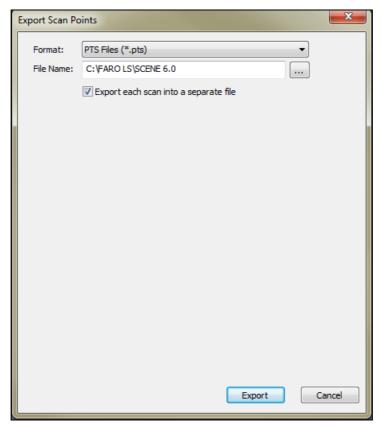


Figure 11-24 Settings for PTS export

File name

Name and location of the file to be created.

Export each scan in a separate file

If not selected, all scans will be saved in one file.

Full scan

Export the entire scan.

Selection

Export the selection.

Full Scan and **Selection** become available only when exporting from a single scan within the tree or from a point selection.

Subsample

Since even small selections of a scan can contain a great number of scan points it may be necessary to reduce or thin out the exported scan points. Thinning out is achieved by only exporting every second or third scan point of a row or column. Therefore, thinning out is done according to the arrangement of the scan points in the planar or **Quick View**.

Rows - Reduction by thinning out the rows

Columns – Reduction by thinning out the columns

With the value 1, every column/row is exported, with 2 every second, and so on. For example, if you enter the value 10 in both fields, you will thin out of a tenth of the columns and a tenth of the rows, therefore in total you will have a reduction of one hundredth of the scan points.

For further reduction, you can indicate the distance threshold a scan point may be away from the scanner:

Min. Distance – The minimum distance the exported scan points can be from the scanner. Scan points situated closer are not exported.

Max. Distance – The maximum distance at which the exported scan points can be from the scanner. Further away scan points are not exported.

Color and Grey

Export RGB and grayscale (intensity) values of each scan point if available. This function is enabled for the formats E57, XYZ text, POD, PTX and PTS. To export both values, the scan will be unloaded first and re-loaded with both values. After the export, the scan will be unloaded again and the initial scan status will be restored.

11.8.25 Export POD (Pointools™)

Pointools is a third-party application that provides an environment for viewing, analyzing, editing and producing visual content from a range of 3D data types.

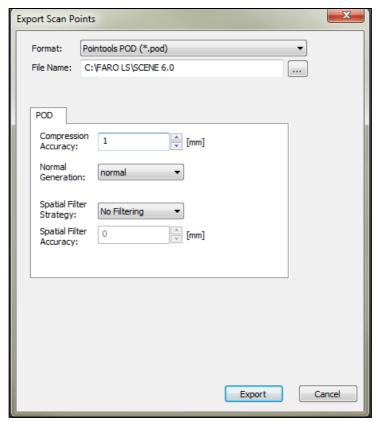


Figure 11-26 Settings for Pointools export

File name

Name and location of the file to be created.

Compression Accuracy

POD files compress cloud data for efficient storage and faster retrieval from disk. You can set the level of accuracy you want to maintain. It is important to consider the accuracy of the instrument used to acquire the data and to not set the compression accuracy too high.

Normal Generation

Normals are required for point lighting. This data is either imported from the source file or generated upon import.

Normal - no altering.

Sharpest, Sharper, Sharp – Quality of normals, degree of faceting on object's surface.

Smoothest, Smoother, Smooth – Quality of normals, degree of curvature on object's surface.

Spatial Filter Strategy

For advanced users. Default setting is usually sufficient.

Spatial Filter Accuracy: Much like the compression accuracy, setting this too high may result errors.



NOTE: For details about the export, refer to the PointoolsTM manual.

11.9 SCENE WebShare Cloud

With SCENE WebShare Cloud, panoramic scan images can be put on the Internet, thus enabling anyone to share scan information of scan projects with other parties, like far-off company sites, customers, suppliers or partners without the need of additional software.

SCENE WebShare Cloud is a web service hosted by FARO Technologies inc. which enables you to share your scan projects without setting up a web server on your own. The project data can be accessed with a standard web browser, no additional software or plug-ins are needed. Connect to faro.websharecloud.com to view the publicly available projects.



NOTE: See the SCENE WebShare Cloud online help for more information: www.manuals.faro.com/documentation.

11.9.1 Export SCENE WebShare Cloud Project

Before publishing a scan project in SCENE WebShare Cloud, special SCENE WebShare Cloud data has to be created from the project. Follow these steps to create such data:

1. Open your scan project. Make sure that the scan project is processed and registered.



NOTE: Freestyle^{3D} scans are visible in overview maps, but if you want to view your Freestyle^{3D} scans as panoramas in SCENE WebShare Cloud, you must first create virtual scans.

See *Upload Project Point Cloud* on page 218 to learn how to create 3D views from Freestyle^{3D} data in SCENE WebShare Cloud.

- 2. Click the **SCENE WebShare Cloud** button in the tool bar. A small menu opens.
- 3. Click the Export SCENE WebShare Cloud Project button in that menu.
- 4. You will be asked to save the scan project first.

- 5. The SCENE WebShare Cloud export dialog appears. This dialog has three tabs:
 - **Export Settings:** allows configuring the data export of the SCENE WebShare Cloud **Overview Map** and the Panorama Views.
 - Project Settings: allows providing the name of the project and its URL identifier plus additional project information to be published in SCENE WebShare Cloud.
 - Upload Settings: allows entering the user login data, and starting the project upload to SCENE WebShare Cloud immediately.
- 6. Configure the data export on tab **Export Settings** of the SCENE WebShare Cloud export dialog.

Export Settings

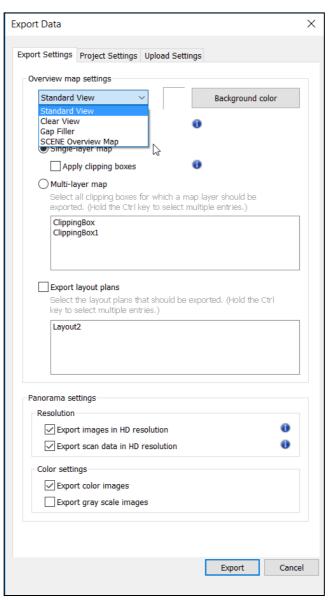


Figure 11-2 SCENE WebShare Cloud export dialog – Export Settings

Overview Map settings

Settings for the **Overview Map**, which is a top view of your entire scan project.

Standard View – Select an option in this drop down list to export the Overview Map with the following options:

- Standard View
- Clear View
- Gap Filler
- SCENE Overview Map

Background color – Select the background color of the **Overview Map**. Selecting a color other than white might be useful when the scan project contains crucial structures which are white themselves. You can test this by selecting a white background in the 3D View and looking at the project from above.

Create Scan Overlays – If this check box is selected, the coverage of each scan can be shown in the overview map.

If this check box is activated, the coverage of each scan can be shown in SCENE WebShare Cloud's overview map. Since the creation of the scan overlays increases the export and upload time significantly, the option is deactivated by default.

Single-layer map

Apply Clipping Boxes – Sometimes, it might be useful to hide points (for example, the roof of a building) with the help of Clipping Boxes to improve readability of the map.

Select this option to create the **Overview Map** from the visible scan points, defined by the available and active Clipping Boxes.

Multi-layer map – These map layers can be toggled on and off separately in SCENE WebShare Cloud. Clipping boxes are used as the basis for the map layers. Select one or more clipping boxes from the given list.

The Clipping Boxes have to show their inside. They do not need to be active.

Export layout plans – If the project contains layout plans, select here if you want them to be exported and if yes, if all layout plans shall be exported or only some of them.

Panorama settings

Settings for the panoramic scan images.

Resolution

Export images in HD resolution – Select whether to export the panorama images in the standard resolutions only (width of the standard panorama images is up to 4096 pixels) or, to export the panorama images in the standard resolutions and additionally in a higher resolution (HD resolution, width of images is 8192 pixels). Such HD images can only be displayed on desktop PCs or Notebooks. On mobile devices like tablet

computers, the panorama images will be displayed in the standard resolutions.

 Export scan data in HD resolution – The scan data which is necessary for measurements and annotations in the panorama images can be exported in two sizes, in the standard size and, additionally, in the maximal size. Exporting scan data in the maximal sizes needs additional storage space of 128 MB per scan on the server, but facilitates the exact positioning of measurements and annotations in HD panorama images.

Color Settings

Panorama images can be exported in color and/or as gray scaled images. If there are scans in the scan project that are not colorized, gray scaled images will be exported from these scans, even if **Export gray scale images** is not selected. And vice versa, if there are scans in the project that do not have their original reflection values anymore, only colored images will be exported from these scans, even if **Export color images** is not selected.

Project Settings

1. Set up project information on tab **Project Settings**:

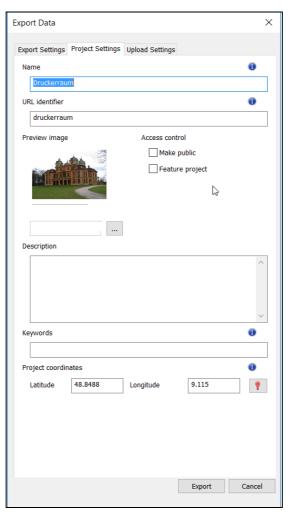


Figure 11-3 SCENE WebShare Cloud export dialog – Project Settings

Name – Enter the name of the scan project.

URL identifier – Enter a unique identifier for the project in the SCENE WebShare Cloud. Every project in the SCENE WebShare Cloud must have a unique URL identifier. The following characters are allowed: "a-z", "0-9", and "-".

Preview image – Select a preview image for the project. This image will be displayed in the SCENE WebShare Cloud project selection. Supported picture formats are BMP, JPEG, and PNG.

Access control

- Make public If you set this option, everybody will be able to see and access the project in SCENE WebShare Cloud. If you do not set this option, the project will not be visible to the SCENE WebShare Cloud users. After project has been uploaded, the appropriate project access rights must be defined in the Administration area of SCENE WebShare Cloud to make the project visible to certain users or user groups. See the SCENE WebShare Cloud online help for more information.
- **Feature project** If you set this option, the project will be shown in the slide show on the SCENE WebShare Cloud Project Overview page.

Description – Enter a description text for the project.

Keywords – Enter keywords associated with the project, separated by commas.

Project coordinates – Enter the project's world coordinates. The project location will be displayed on a map in the SCENE WebShare Cloud. The latitude must be a decimal number between -90 and 90, the longitude between -180 and 180.

- 2. Click **Show the project location in Google Maps** button to test the entered coordinates in Google Maps.
- 3. If you want to upload the data to the SCENE WebShare Cloud immediately, switch to tab **Upload Settings**.

Upload Settings



Figure 11-4 SCENE WebShare Cloud export dialog – Upload Settings

Immediately start upload – Starts to upload all files created during the SCENE WebShare Cloud export immediately. If you do not want to upload the SCENE WebShare Cloud data immediately, you can do this at any time later. For more information, see chapter *Uploading SCENE WebShare Cloud Project*.



NOTE: We recommend to export and upload the data in parallel.

Upload options – enter your login credentials for the SCENE WebShare Cloud web service:

Domain – Enter your organization's subdomain ID on SCENE WebShare Cloud.

User name – Enter your user name to log in to SCENE WebShare Cloud.

Password – Enter your password.

Save Credentials – Select to save your login credentials so that you do not have to enter them again in the future.



NOTE: You must have a SCENE WebShare Cloud account with Uploader rights to upload scan projects. Ask your SCENE WebShare Cloud Administrator for more information.

Once finished, click **Export** to start the creation of the SCENE WebShare Cloud data that will be saved to the project folder. The data is uploaded to the WebShare Cloud.

11.9.5 Uploading SCENE WebShare Cloud Project

If SCENE WebShare Cloud data is already available for your scan project, you can upload it to the SCENE WebShare Cloud at any time. Follow the steps below to do this:

- 1. Click the **SCENE WebShare Cloud** button in the toolbar. A small menu opens.
- Click Upload Data in that menu. The SCENE WebShare Cloud upload dialog will show up. This dialog has two tabs, Upload Settings and Project Settings.



Figure 11-6 SCENE WebShare Cloud upload dialog – Upload Settings

Upload options – enter your login credentials for the SCENE WebShare Cloud web service:

Domain – Enter your organization's subdomain ID on SCENE WebShare Cloud.

User name – Enter your user name to log in to SCENE WebShare Cloud.

Password – Enter your password.

Save Credentials – Select to save your login credentials so that you do not have to enter them again in the future.

- 3. Specify project relevant information on tab **Project Settings**.
- 4. Once finished, click **Upload** to start uploading of the SCENE WebShare Cloud data to SCENE WebShare Cloud.



NOTE:

- You need to have a SCENE WebShare Cloud account with Uploader rights to upload scan projects. Ask your SCENE WebShare Cloud Administrator for more information.
- You can resume interrupted uploads: To resume an interrupted upload, make sure to enter the same URL identifier in the Project Settings as used in the previous upload attempt.

11.9.7 Upload Project Point Cloud

It is now possible to upload point clouds to SCENE WebShare Cloud or export the point clouds generated in SCENE to a particular project in the SCENE WebShare Cloud domain. Select the **Upload Project Point Cloud** option in the SCENE WebShare Cloud drop-down menu to open the **Scene WebShare Cloud** tab.

This functionality can also be accessed from the:

- context menus of scans or clusters, select Point Cloud > Send to SCENE WebShare Cloud.
- context menus of clipping boxes, select Active Clipping Boxes > Send to SCENE WebShare Cloud.
- context menus of selections, select Selection > Send to SCENE WebShare Cloud.



NOTE: It is recommended to upload the project point cloud, or selections based on it.

Due to filtering and color balancing, a better visualization quality can be achieved than with scan point clouds.

Login

The **Login** page is displayed. Enter the login details to access your SCENE WebShare Cloud domain.



NOTE: You must have a SCENE WebShare Cloud account with Project Manager rights to upload point clouds. Ask your SCENE WebShare Cloud Administrator for more information.

If the login credentials are already saved, you are automatically logged in with the saved credentials.

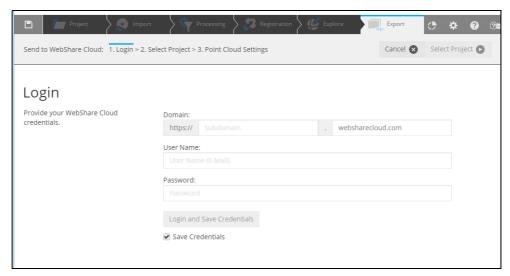


Figure 11-8 Login to upload project point cloud

Select Project Settings

The Select Project Settings page opens.

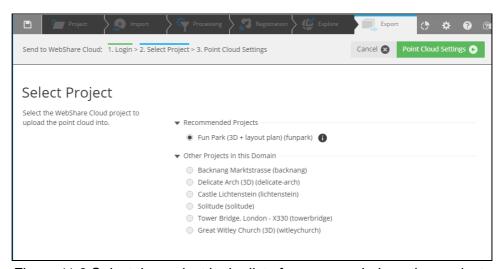


Figure 11-9 Select the project in the list of recommended or other projects

Based on the project properties of the current SCENE project, matching SCENE WebShare Cloud projects are recommended.

Other projects can be selected by expanding the section **Other Projects in this Domain**.

If you want to upload the CPE file into a new empty SCENE WebShare Cloud project, create the project in SCENE WebShare Cloud first.



NOTE: When uploading to an existing SCENE WebShare Cloud project, make sure that you did not modify the scan positions in SCENE after the SCENE WebShare Cloud export. Otherwise, the uploaded point cloud will not be aligned to the scan positions in the SCENE WebShare Cloud project.

Point Cloud Settings

The Point Cloud Settings page opens.

The project point cloud is generated in CPE format. Enter the name of the file, and file format properties.

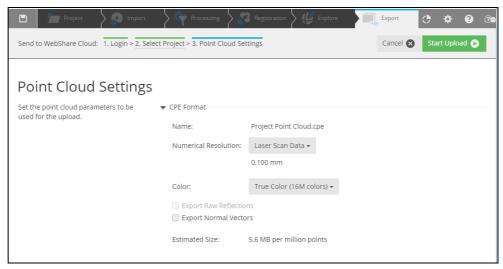


Figure 11-10 Point Cloud Settings

Start Upload

Click **Start Upload** to upload the project point cloud. After the upload has successfully completed, you can use the **Create 3D Data** task in SCENE WebShare Cloud to create the data for the 3D View. Select the uploaded CPE file in the **Select Sources** option. You can additionally select other CPE files or scans to get a combined 3D View. After the 3D data creation has finished, you can view the uploaded point cloud in SCENE WebShare Cloud.

Chapter 12: Virtual Reality

12.1 Introduction

SCENE7.1 introduces the ability to step into your point cloud with virtual reality (VR). You can now experience your scans as if you were on location, take measurements, make screen captures, and read annotations.

12.2 VR System requirements

See System Requirements on page 12 for all VR system requirements.

12.3 SCENE project requirements

- · Your project requires a point cloud.
- Closed surfaces are strongly recommended.

12.4 SCENE Virtual Reality features

When you view your project using VR goggles, the following features are available:

- · View a project point cloud.
- View imported mesh/VRML data.
- · Choose among different movement modes:
 - Teleporting
 - Flying
 - Flying with fixed vertical position (walk mode).
 - Jump directly to measurements, annotations, and scans.
- A virtual tablet that serves as your user interface while using the VR goggles. It can be minimized when you don't need it.
- Keep track of your location with a 2D overview map (if present in your project).
- · Take and delete measurements.
- · View and delete annotations and attached image files.
- Take and delete screen captures. The images are stored in the structure window under the Screenshots folder. To export the screen captures, select the images in the structure window, right-click and choose export images.
- View the help page for Oculus and HTC VIVE that explains how to use the controllers to explore the virtual world.
- VR Settings (Within VR only).

12.5 Starting the Virtual Reality in SCENE.

- 1. Ensure that the VR hardware is correctly connected to the computer.
- 2. Open the Explore Toolbar and click the VR icon.

Chapter 13: Scanning

The Scanning category available in SCENE and FARO[®] Laser Scanner provides the options for Scanner Control, On-Site Registration, and On-Site Compensation.

Activate Scanning in SCENE

Typically, you will not see the **Scanning** feature in SCENE since it is hidden. If you need it, activate it in **Settings > General > User Interface > Show Scanning Category** under the **User Interface** option. The Scanning feature will then appear in the Workflow Bar.

13.1 Scanning



Figure 13-1 Scanning toolbar

The Scanning toolbar provides the following options:

- Scanner Control
- On-Site Registration
- On-Site Compensation
- Open Target PDF

13.2 Scanner Control

The **Scanning** category has the **Scanner Control** option. It can be used to start a remote connection to control the laser scanner. The scanner can be controlled by using the scanner user interface that is displayed in SCENE.

To connect to the scanner:

1. Enter the IP address of the scanner.

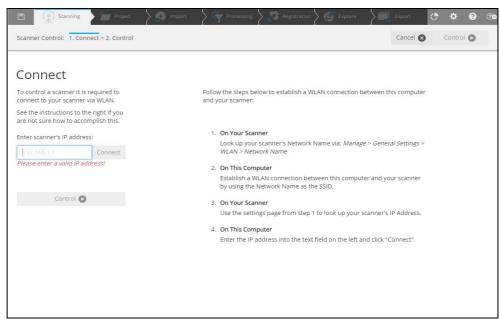


Figure 13-1 Connect page: Enter the IP address

2. Click **Connect** to retrieve the details of the scanner. The page will be updated.

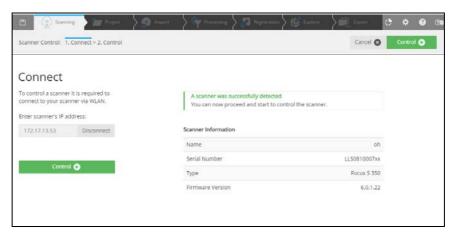


Figure 13-2 Connect to Scanner

3. If the IP address is not associated to an active laser scanner, an error message is displayed.

4. If a connection is successful to a supported FARO Focus Laser Scanner, the **Control** button becomes active and green. Click to control the scanner through the HTML user interface.

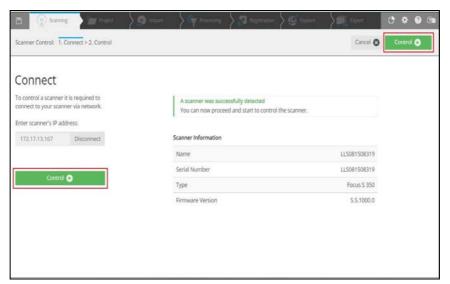


Figure 13-3 Click to Control the Scanner

SCENE starts the Scanner Control task and displays the scanner user interface. You can control the scanner remotely through this HTML interface.



Figure 13-4 Finish or Cancel task

6. Click the **Finish** or **Cancel** button to close the scanner user interface, scanner control task and disconnect from the scanner.

13.3 On-Site Registration

The On-Site Registration feature enables the user to process and register scans on-site remotely through the computer running SCENE software. The

scanner must be connected to SCENE and can be controlled by using the scanner user interface displayed in SCENE. The processing and registration of the scans are performed in SCENE

The user can operate on-site registration functionality as follows:

- directly on the scanner Or
- through a connected device like a smart phone or tablet, showing the scanner user interface
 Or
- within SCENE. The scanner can be remotely accessed through WLAN or Ethernet through a computer running SCENE.

13.3.1 On-Site Registration Setup

To enable on-site registration, see On-Site Compensation.

The procedure to setup on-site registration is as follows.

On the Scanner

Configure the scanner

- 1. Configure the WLAN connection on the laser scanner. See *Connecting the Scanner to WLAN*.
- 2. Configure scan project/cluster, scan name, scan parameters.



NOTE: Refer to the *Operating Software* chapter in *FARO Laser Scanner User Manual* for more information about on-site registration settings and related user interface pages.

Enable On-Site Registration

- 1. Go to Home > Manage > On-Site Registration Settings.
- 2. Turn **On-site Registration** ON or OFF by sliding the button. The scanner now connects to a remote system in the network, running SCENE.
- 3. The IP address and port will be automatically set on the scanner.
- 4. The **Start Scan** button leads to the new map page. When **Start Scan** is selected, the map page will be displayed.

On your Computer

Configure SCENE

1. Configure the WLAN network of the computer.



NOTE: The scanner and computer must be continuously connected to the same WLAN network.

- 2. Start SCENE on the computer.
- 3. Start On-Site Registration task in the Scanning category of SCENE.
- 4. Enter the IP address of the laser scanner. You can find the IP address of the laser scanner by tapping Manage > General Settings > WLAN > IP Address on the scanner user interface. Enter the IP address as it is, following exactly the given scheme of digits.
- 5. Connect to the FARO laser scanner after entering the IP address in the **On-Site Registration** task. The scanner **Home** page is displayed.
- 6. On the scanner home page click the **Map** button. A map is displayed with the available scans in a project.

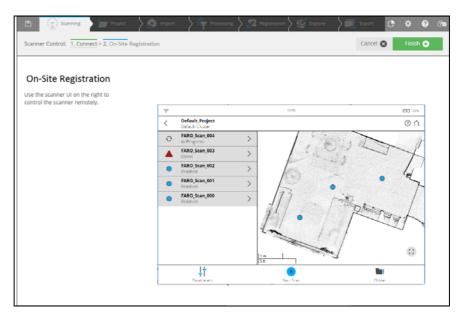


Figure 13-2 On-Site Registration overview map with list and status of scans

7. Now click Start Scan button to start a new scan on your scanner, or remotely in SCENE. All recorded scans on the current cluster or project opened on the scanner will be uploaded to SCENE. The scans will be automatically processed by SCENE.



NOTE: If one scan fails to register, run a connection scan with the scanner placed in between the area of the two different scans. To validate the registration of scans, highlight their points in the map.

13.4 On-Site Compensation

On-Site Compensation process is a procedure to test and improve the angular accuracy of the scanner using SCENE software.



NOTE: On-Site Compensation feature is not available for Focus^M 70.

13.4.1 Preparing the Compensation Station

Site Setup

Before you begin the On-Site Compensation process, ensure that the scan site has the following facilities:

- Target sheets must be setup at the scan site at regular distance to the laser scanners between 1.5 m to 3 m.
- No windows or other reflective planes: The markers on the target sheets would be reflected if the scan site has any windows or reflective surfaces. This can cause incorrect measurements.
- Lighting conditions are less important because On-Site Compensation is done with the laser, video images are not used.

13.4.2 Connect Laser Scanner to Computer through Wireless LAN

To be able to transfer the scanned data directly to your computer, you must connect the computer with the laser scanner and through WLAN to remotely access and control the scanner.

Using the scanner as a WLAN access point



NOTE: Disable the proxy server to make the connection work. If this is not possible for some reason, enter the addresses of both devices in the Exceptions field.

We recommend to use a WLAN card that supports IEEE 802.11n.

On your scanner

- 1. Enable WLAN on your scanner (see *Connect Laser Scanner to Computer through Wireless LAN*).
- 2. Look up your scanner's network name by tapping Manage > General > WLAN > Network Name on the scanner's user interface.

On your Computer

Establish a WLAN connection between the computer or tablet and the scanner by using the network name as the SSID.

13.4.3 On-Site Compensation steps

On your computer Select Output folder

1. Click **Start On-Site Compensation** button in the Scanning toolbar by selecting the "Scanning" toolbar.

All data captured during On-Site Compensation, including the **Compensation Report** will be stored in the output folder.

- 2. Click the **Browse** button to open the file system browser.
- 3. Browse to the folder. Click the **OK** button.

13.4.4 Setup



Figure 13-5 Setup: Select Output Folder



Figure 13-6 Setup: Enter IP Address

Enter Scanner IP Address

- Enter the IP address of the laser scanner. You can find the IP address of the laser scanner by tapping Manage > General Settings > WLAN > IP Address on the scanner user interface. Enter the IP address as it is, following exactly the given scheme of digits and dots.
- 2. Click the Connect button.
- 3. In the dialog, click the Place Targets button to continue with the next step.

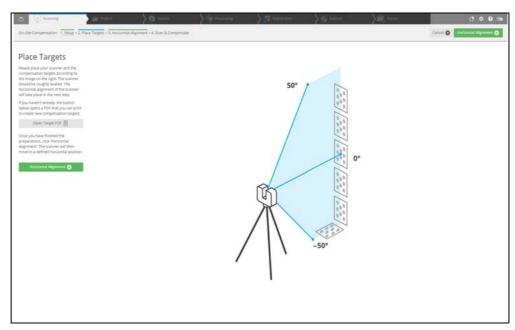


Figure 13-7 Place Targets

13.4.8 Place target

Print target sheets

On your Computer

- 1. In the **Place Targets** page, a picture is shown that describes how to place the targets and the scanner for the compensation.
- 2. If the 6 Target Sheets are not available In SCENE, click the **Open Target PDF** button in the toolbar.
- 3. Select among the DIN/ISO A4 format, or US letter format. Your standard PDF viewer will open, showing the target PDF sheet.
- 4. Print at least 6 marker sheets.



NOTE: We recommend to glue the target sheets on suitable rigid plates, especially if On-Site Compensation is done at an outdoor location.

On Site

Place at least 6 Target sheets on site as follows:

- The target sheets must be placed in a vertical range of -50° to 50° from the scanner device.
- Distribute the target sheets uniformly over the specified range. At least one board must be close to the horizon (0°).
- The distance between the target sheets and the scanner must be between 1.5 m to 3 m.
- All target sheets must be vertically aligned.

Laser Scanner Placement

- Mount the laser scanner on a tripod.
- Place tripod and scanner on a stable and plane ground. The tripod must not move during scanning.

13.4.9 Horizontal Alignment

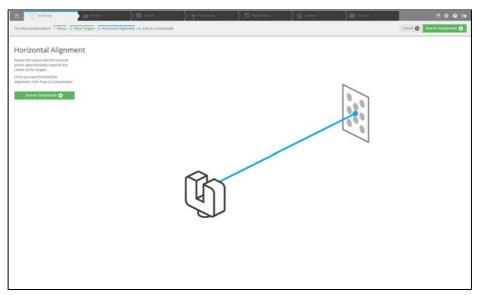


Figure 13-10 Horizontal Alignment

Horizontally align the scanner tripod as follows:

- Rotate the tripod of the scanner to point approximately towards the center of the targets.
- Start scanning and compensation by clicking the button "Scan & Compensate"
- During the compensation process, the status of progress is displayed. You can cancel the process if required.

13.4.11 Scan & Compensate

- Select whether you want to apply the compensation data to the scanner.
- Click disconnect to disconnect from scanner and finish the On-Site compensation.
- To apply this compensation to the scanner choose "yes" and click the **Finish** button. Choose "no" if you do not want to apply this compensation.

When the compensation is finished, the Compensation Report is displayed
with the results of the compensation. Open the compensation report as
PDF by clicking the button **Open Report**. The **Compensation Report** is
saved as PDF to the location specified in the left side of the page.

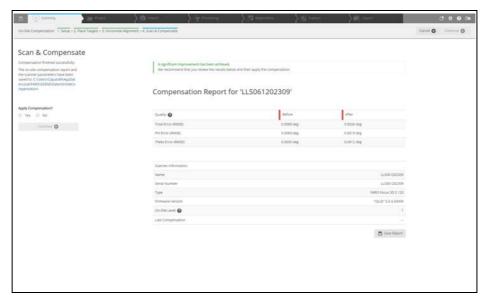


Figure 13-12 Compensation Report

13.4.13 Troubleshooting

Error

Reading and writing to the selected data output folder failed.

Solution

Make sure that you have sufficient rights to read and write in the selected output folder. Ensure that you have sufficient disk space. Approximately 330MB are necessary to perform an On-Site compensation.

Error

The process did not identify enough targets for compensation.

Solution

In the output folder a targetImage.png file is stored. This image shows the identified markers as blue circles. Areas with a sufficient amount of detected targets have a green background color. Areas with an insufficient amount of detected targets the background color is red.

Error

No consistent solution could be determined.

Solution

Make sure that the tripod and the targets did not moving during the procedure.

Error

The SD card of the scanner could not be accessed.

Solution

Make sure that the SD card is inserted and that it is not write-protected and has sufficient free space left (approximately 330MB).

Error

Communication with the scanner failed.

Solution

Make sure that the WLAN connection to the scanner is stable.

If this error appears when connecting to the scanner or applying the compensation parameters, try to repeat the corresponding step.

Chapter 14: FARO Laser Scanner Focus Scanner Administration

The built-in FARO Focus scanner administration functionality of SCENE allows you to manage your Focus SD cards, scanner snapshots and your scan projects.

You can open the scanner administration of SCENE under View > Administration View or in the projects selector by clicking on the Scanner Administration icon.



Figure 14-1 Scanner administration

- 1 Structure View
- 2 Administration view

14.1 Items in the Structure View of the Scanner Administration

14.1.1 Scanner Snapshots

Each time you start a scan on your FARO Focus scanner, it automatically saves its current settings to the currently inserted SD card. Thus, a Focus SD card not only contains the captured scans but also an automatic snapshot of all system settings, scanning parameters, scan profiles, scanner operators and scan projects that are currently available on your scanner. When you insert a Focus SD card into your computer, it will automatically be recognized by SCENE and you will be asked whether to start an automatic data transfer or not. Clicking yes will import new scans from the SD card and create a local copy of the automatic scanner snapshot. The local copy of this automatic

scanner snapshot can be found under the folder **Scanners** in the **Structure View** of the scanner administration and bears the name of your scanner's serial number.

With the scanner administration in SCENE you can also set up new scanner snapshots from scratch. These scanner snapshots can be configured according to the needs of your scan projects, which means that you can create several new snapshots with differing settings, profiles, operators and projects according to the needs of different scan projects and transfer their configurations to your FARO Focus scanner(s) whenever needed. You can find these new scanner snapshots in the **Structure View** under the folder **Scanners**.

The **Structure View** shows the complete file structure of the snapshots. You can perform delete commands on the folders and files via their context menu.

SD Cards

The folder **SD-Cards** contains the FARO Focus SD cards that are currently inserted to your PC. Here, the complete content of the SD Card is shown. You can perform delete commands on the folders and files via their context menu.

Projects

The folder **Projects** contains all scan projects that are already known to SCENE. With the help of the scanner administration you can prepare or create new projects and transfer them to your FARO Focus (see chapter *Transferring Firmware Updates to your FARO Focus Scanner* on page 240).

14.2 Administration View

With the administration view you can view and modify the scanner settings, scan profiles, scanning parameters, projects and scanner operators of all available scanner snapshots. If a SD card is inserted to your PC, the administration view of the automatically created scanner snapshot is initially shown. To open the administration view of another snapshot, double-click the respective item under the **Scanner** or the **SD-Cards** folder in the **Structure View** or select the **administrate** command in its context menu.

Design and functionality of the administration view in SCENE is the same as of the user interface that runs on the touch screen of the FARO Focus scanner. Refer to the FARO Laser Scanner Focus manual for details about how to change the scanner settings, create and edit scan profiles, scanner operators and projects.

14.3 Managing Snapshots

14.3.1 Editing the Automatic Scanner Snapshot on the inserted SD Card

When you open the scanner administration in SCENE, the administration view of the automatic scanner snapshot of the currently inserted SD card will initially be shown. You can also open the administration view of this automatic snapshot by selecting the **Administrate** command in the context menu of the SD card.

Make your changes in the administration view. Refer to the scanner manual for details about how to change the scanner settings and how to create new and edit existing scan profiles, scanner operators or projects.

When finished, remove the SD card from your PC and insert it into your scanner. For more information, see chapter *Transferring a New, Modified or Restored Snapshot to Your Scanner* on page 238.

14.3.2 Creating a New Scanner Snapshot

To create a new scanner snapshot, right-click the **Scanners** folder in the **Structure View** and select **New > Scanner Snapshot** in its context menu. SCENE will create a new scanner snapshot and open its administration view. Configure the scanner settings and create profiles, projects and scanner operators according to your needs.

You can rename the snapshot by selecting the **Rename** command in its context menu.

You can also create a new snapshot based on the content of an already existing snapshot. To do this, create a new scanner snapshot, then select the base snapshot and drag it onto your newly created snapshot. Now you have a duplicate copy of your original snapshot that can be modified according to your needs.

To transfer a newly created snapshot to your scanner, select it in the **Structure View** and drag it to the SD card item under the folder **SD-Cards**.



NOTE: This will replace the data of your SD card snapshot with the data of the new snapshot. The scans on the SD card remain unaffected by this operation.

When finished, remove the SD card from your PC and insert it into your scanner. For more information, see chapter *Transferring a New, Modified or Restored Snapshot to Your Scanner* on page 238.

14.3.3 Restoring and Editing Manually Created Scanner Backups

The FARO Focus scanner allows you to manually create backups of your scanner data. You can modify these backups with SCENE and transfer the modified configuration data back to your scanner.

If you have a scanner snapshot that contains manual backups, open the administration view of this snapshot in SCENE and go to **Manage > Service > Restore**. You will then get a list that contains all the manually created backups

that are available in the currently administrated snapshot as well as its automatically created scanner snapshot.



Figure 14-4 Restore manual backup

Click the backup that you want to restore (_AUTO_BACKUP is the automatically created scanner snapshot, _SCENE_BACKUP the snapshot that has been modified or created with SCENE) and a new screen will appear.



Figure 14-5 Select restore data

Select the configuration data that you want to restore from the selected backup and press the **Restore** button.



NOTE: The restored configuration data will override the configuration data of the administrated snapshot. For example, if you want to restore or import scan profiles, all the existing scan profiles of the administrated scanner snapshot will be overridden by the profiles of the backup.

You can now modify the restored configuration data and transfer it back to your scanner. For more information, see *Transferring a New, Modified or Restored Snapshot to Your Scanner* on page 238.

14.3.6 Restoring the Local Copy of the Automatic Scanner Snapshot

SCENE will create a local copy of the automatic scanner snapshot. This local copy bears the serial number of the scanner and can be found in the **Structure View** under **Scanners**.

- 1. Select local copy of your automatic scanner snapshot in the **Structure View**.
- 2. Drag it to the SD card item under the folder **SD-Cards**.
- 3. The configuration data on the SD card will be replaced by the configuration data of the snapshot, the scans on the SD card remain unaffected by this operation.
- 4. When finished, transfer it to your scanner.

For more information, see chapter *Transferring a New, Modified or Restored Snapshot to Your Scanner* on page 238.

14.3.7 Transferring a New, Modified or Restored Snapshot to Your Scanner

1. Insert the SD card with a new, modified or restored snapshot into your scanner.

You will be asked by the scanner's operating software whether to update the scanner with this snapshot or to keep the current scanner settings.

2. Click yes to transfer the settings from your SD card to the scanner.



NOTE: This will override all current scanner settings, scan profiles and scanner operators with the configuration data of the new scanner snapshot.

You can also transfer your new, modified or restored scanner snapshot later using the restore functionality in the scanner's operating software.

3. Go to Manage > Service > Restore the scanner's operating software.

- 4. Select the list item _SCENE_BACKUP.
- 5. Select the data that you want to restore and press the **Restore** button.

For more information, see the scanner manual.

If you own several scanners and if you want to make sure that they all have the same configuration, you can transfer one snapshot to several scanners which will then have duplicate configurations.

14.3.8 Managing Scan Projects

The scanner administration in SCENE provides a quick and convenient way to prepare your scan projects in advance. Projects prepared with SCENE usually represent the spatial distribution of your real scan projects and can be transferred to your scanner via the SD card. In the scanner's operating software, when carrying out the scan project, you can then assign scans to the created scan project or one of its subprojects. This information is very helpful for the later scans registration and will be used to automatically combine the scans to scan clusters.

Create a new project

- 1. Right-click the **Projects** folder in the **Structure View** of the scanner administration.
- 2. Select New > Project.

You will be asked to give the project a name and to specify its storage directory.

To open an existing project, double-click the project in the **Structure View**.

Add subprojects

Add new scan folders or clusters to your main cluster

1. Select New > Scan Folder in its context menu.

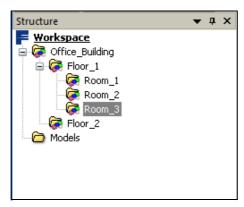


Figure 14-9 Workspace with project structure

- 2. When finished, save the scan project and return to the scanner administration view.
- 3. Select your project in the **Structure View** and drag it onto a snapshot or a SD card.

This will add the new project with all of its subprojects to the respective snapshot. Already existing projects will not be deleted. If the added project

already exists on the snapshot, it will be updated with the changes you have made.

4. Transfer the snapshot with the added project to your scanner.

For more information, see chapter *Transferring a New, Modified or Restored Snapshot to Your Scanner* on page 238.

14.4 Transferring Firmware Updates to your FARO Focus Scanner

- 1. Drag and drop the firmware update file from the windows explorer to the SD card item in the **Structure View** of the scanner administration.
 - SCENE will then copy the file to your SD card into the folder Updates. If this folder does not exist, it will automatically be created.
- 2. Remove the SD card from your PC and insert it into your scanner.
- To install the firmware update on your scanner, go to Manage > Service > Firmware the operating software of the scanner.
- 4. Press the **Update** button.

For more information refer to the scanner manual.

14.5 Scanner Service Request

In case of problems with your scanner, you can send a scanner snapshot with the current settings of the scanner to the FARO Customer Service that can then analyze the snapshot to find the cause of error.

- 1. Select **Scanner Service Request** in the context menu of the respective scanner snapshot.
 - Your default email client should start automatically with an open email window that has the snapshot attached.
- 2. Send this email with a detailed description of your scanner failure to the FARO Customer Service.

Chapter 15: Apps

For developers, SCENE offers an application programming interface (API) which gives the opportunity to integrate own functionality into SCENE. This API allows anyone to create custom applications (Apps) which integrate seamlessly into the SCENE user interface in order to extend the functionality of SCENE. Developers are free to share their Apps with others (for free or for sale), so that everybody can benefit from them.

Publicly available apps may be downloaded from the FARO 3D App Center:

http://3d-app-center.faro.com/

The following apps are available by default:

- Orthographic Photo Generator
- WebShare 2Go 2.0
- Forensic Wizard

15.1 Installing and managing apps

You can install and manage apps with the SCENE App Manager.

⇒ Click the **Apps** button 🗇 on the right side of the Global Workflow Bar.



Figure 15-1 Apps toolbar

The Apps Toolbar shows the **Apps** button, and all the Apps that are available.

15.2 App Manager

The SCENE App Manager provides the following functionality:

- It allows installing new apps. For more information, see chapter *Installing* and managing apps.
- It gives an overview of the already installed Apps with additional information, like the version number.
- Already installed apps can be activated, deactivated or removed from the system. For more information, see chapters Activating / Deactivating Apps or Updating Apps.

 Developers can create an app package file (app in installation file) from their app files (with the Pack App... button that will be displayed when Developer Options is enabled).

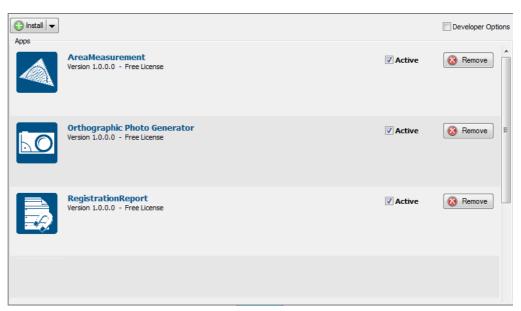


Figure 15-1 App Manager

Use the Remove button to uninstall an app from your system.

15.3 Installing Apps

To install a SCENE App, do one of the following:

- Click the button and select an App package file (with the extension .fpp) from your hard disk. In the drop down menu of the button you will find:
 - the possibility to install an App that is not packed to an App package but whose individual program files are available within a folder on the hard disk.
 - a link to the FARO 3D App Center to download new apps.
- Drag & drop a downloaded App package file into SCENE.
- Double-click an App package file in Windows Explorer.

If the App is already installed you will get an error message and the installation will be canceled.

SCENE also checks whether the App is compatible to the current version of SCENE. If the App and SCENE are not compatible, the installation will be canceled.

After installation is complete, the App will be activated by default.

15.4 Updating Apps

If you would like to install a new version of an already installed App, remove the former version of the App from your system first, and then install the new version as described above.

15.5 Activating / Deactivating Apps

Use the **Activate** checkbox in the App Manager to enable or disable certain Apps at runtime.

15.6 Uninstalling Apps

Use the Remove button to uninstall an App from your system.

Chapter 16: Advanced Functions

16.1 Coordinates

The coordinates of a point describe its exact location in relation to an agreed reference point. This reference point is referred to as the origin of the coordinate system. With a scan, you receive points in the three dimensional space, therefore, for a precise description of a measured point, you need the definition of the origin and three other values which then indicate the relative location to this origin.

Depending on the choice of origin, you can decide between local coordinates or global coordinates. The three other values can be set to different degrees, so that you obtain polar coordinates or Cartesian coordinates, for example.

16.2 Local Coordinates

When scanning, the position of the scanner emerges as the natural origin of the coordinate system because when recording the scan, all position specifications of the points are initially recorded in relation to the scanner. This coordinate system is therefore described as the local coordinate system.

Polar coordinate system

Due to the rotation of the scanner, its natural coordinate system is the polar coordinate system, with which two angles and a distance value are used to determine the position.

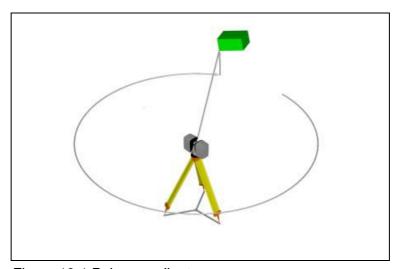


Figure 16-1 Polar coordinates

For the single scan points created by the scanner, you can find the polar coordinates in the bottom status bar:



Figure 16-2 Display the polar coordinates of a scan point

Cartesian Coordinates

In day to day use, you would generally use Cartesian coordinates, which have a direct reference to concepts such as length, width and height, rather than polar coordinates.

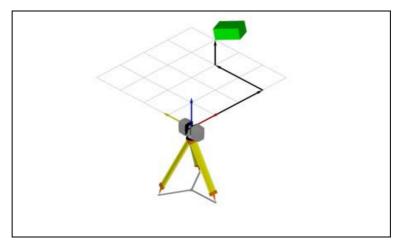


Figure 16-3 Cartesian coordinates

The conversion of polar coordinates into Cartesian coordinates occurs automatically in SCENE. It is completely independent from the location of the scanner or other influencing variables because it simply converts between two types of representation at the same level. The converted coordinates are displayed directly next to the polar coordinates in the bottom status bar:

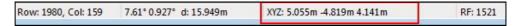


Figure 16-4 Display of the Cartesian coordinates of a scan point

16.3 Global Coordinates

If a scan is viewed in its 3D position against another scan, local coordinates are no longer practical. If, for example, two scans were recorded at different positions, the points within each one can have the same local coordinates; they match reality but not one another.

Therefore, you should relate the coordinates to one reference point which remains the same for all scans. This reference point is normally selected so that it is also possible to make a comparison using other systems, for example a CAD system.

By doing so, you can view polar coordinates and Cartesian coordinates again. However, since the polar coordinates do not produce a clearer representation than the Cartesian coordinates, you will find no use for them in this environment and they are therefore not explained in any more detail here.

Coordinate Transformation

You can calculate the global coordinates using the local coordinates of a point if you know the relationship between the local and the global coordinate system. To do this, you transfer the local coordinates into global coordinates by tracing the movement which would make both coordinate systems match. You can differentiate between two types of movement:

If the local origin does not match the global origin, all coordinate specifications must be moved by the difference between the local and global origin. This movement is also called Translation.

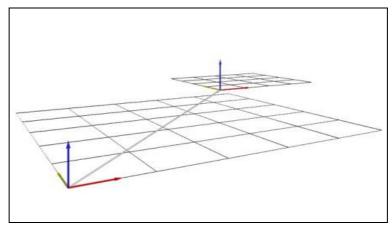


Figure 16-1 Translation

If the orientation of the coordinate axes is different, you must make them match with a Rotation.

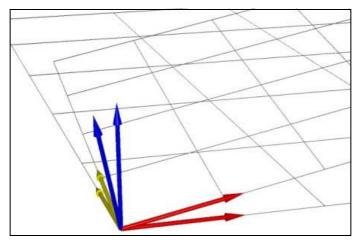


Figure 16-2 Rotation

The rotation is described by a rotation axis and the corresponding angle of rotation. Generally, any rotation can be described with a single rotation axis; this rotation axis, however, does not necessarily match one of the coordinate axes! It is then sometimes difficult to make this rotation graphically clear. However, you can also split the rotation up into three separate rotations around the coordinate axes. In this type of representation you can imagine the result of a rotation more easily. SCENE saves the rotation internally with a single rotation axis and a single angle of rotation; the user interface, however, displays the more comprehensible type of representation of the three rotations around the coordinate axes.



NOTE: When splitting the rotation into three separate rotations around the coordinate axes, it is important to have a defined sequence of the axes. If you first rotate around x, then around y, and finally around z with some specific angles of rotation, you get different results than you would get with the sequence x, z, y.

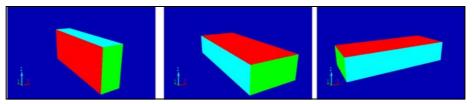


Figure 16-3 Rotation of 90° around y and then 90° around z

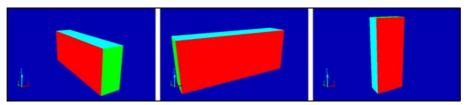


Figure 16-4 Rotation of 90° around z and then 90° around y

In the user interface, SCENE uses the sequence x-y-z.

If you want to fine-tune a rotation on a per-axis basis, this default sequence may lead to some unexpected behavior. For example if you want to place an object interactively and you are so far satisfied with the orientation around the x axis and the z axis. Now you want to adjust the orientation around the y axis – but when you change the corresponding rotation angle, the object seems to move around a totally different axis! This is simply caused by the fact that the rotation around the y axis is applied in the middle of the two other rotations. A more intuitive behavior is achieved when the rotation is last in the sequence. You can enforce this more appropriate sequence, when you select **Axis snap** in the dialog.

Local coordinates can always be transferred into global coordinates with a simple combination of these two basic movements: translation and rotation. This transfer is also called Transformation. The sequence in which the basic movements are executed is important because it makes a big difference whether you first move and then rotate or first rotate and then move. In SCENE the rotation takes place first and then the translation.

Coordinate
Transformation of a
Scan

In order to know the coordinate transformation of a scan, you must know its position and orientation. You can see these values if you click the scan with the right mouse button in the **Structure View** and select **Properties** in the context menu.

On the **Scan** tab, the position and orientation are displayed in compact notation with a single angle of rotation.

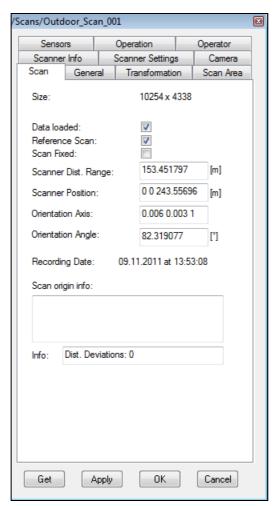


Figure 16-5 Orientation displayed compactly

/CastleLic...LS472_Lichtenstein_024 Sensors Operation Operator Scanner Info Scanner Settings Camera General Transformation Scan Area Position: 2.84464 4.00191 Increments: Υ Z 0.497977 338 88089 Rot. Angle: [°] Axis snap: +/- 45 Global Coordinates: V Auto Apply: 🔽

On the **Transformation** tab, you will see the same information displayed in a more intuitive way.

Figure 16-6 Orientation displayed more intuitively

Cancel

ΟK

Apply

Of course, coordinate transformations can not only be applied to local coordinates but can also be used to convert from one global coordinate system to another. For example, you could use a hall coordinate system as the first coordinate system, which has the origin in the corner of a hall and whose axes run along the walls of the hall. On a greater scale, you could define a plant coordinate system whose origin lies in the south-west corner of the plant premises and whose axes match the four points of a compass.

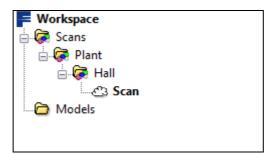


Figure 16-7 Hierarchical transformations

Then you only have to describe the transformation between the hall and the plant premises to automatically obtain all the coordinate specifications within

the hall in plant coordinates. SCENE proceeds hierarchically from inside to outside: first, the local coordinates within the scan are transformed into hall coordinates and these are then converted into plant.

The position of the scan is not only stored in the **Workspace** and its corresponding file .fws, but also in the scan file itself. When using hierarchical transformations, you should note that the scan file only stores the local transformation, not the global. In the example above, this means that the scan file only contains the relative position to the hall, not to the plant.

Transformation and Registration

Registration of scans is always performed in the global coordinate system. If you have added transformations in the scan folders, these transformations will of course also be used during the registration. The result might not be the one you expected: the scans will be positioned on the same global coordinates as they would have without the additional transformations! Only their local coordinates may differ.

If you want to add a transformation because you don't want to use the coordinate system of the surveyor, you should input it into the **References** folder.

16.3.8 Quick Change of Global Origin

For some tasks it might be helpful to use a different coordinate system than it is currently defined globally. But as not all tasks need this specific coordinate system, it should be possible to switch between such coordinate systems easily. For example imagine the examination of a robot cell in a plant. The global coordinate system might be defined according to the plant, but now you would like to export scan points in the local coordinate system of the robot cell. In this case you would like to switch to the local coordinate system of the robot cell temporarily, and later switch back again. For this you need the position and orientation of the robot cell within the plant and you put this transformation in a folder, and the mark this folder to be used as definition for the global coordinate system.

When you want to work in the local coordinate system of a folder (or scans folder or scan), you activate its transformation by **Operations > Global System > Set as Global Origin** in its context menu. The folder is now marked with a red

G [©] to indicate that it is currently defining the global coordinate system.

If you want to switch back to the original global origin, you may select **Operations > Global System > Clear Global Origin** in the context menu of this folder. In addition, this function is also available in the context menu of the Workspace.

16.4 Exemplary Driver Configuration for the Stereoscopic Mode

This chapter describes how to enable OpenGL Stereo for an exemplary hardware and driver configuration. Enabling OpenGL Stereo on comparable configurations should be similar. The stereoscopic mode will most likely run with other driver versions, too. However, the menu structure may look different than described here.

Exemplary hardware and driver configuration used for this description:

- Hardware
 - NVIDIA Quadro Graphic Card
 - NVIDIA 3D Vision (Shutter Glasses)
 - 120 Hz Monitor
 - Compatible cable (HDMI 1.4 or Dual Link DVI)
- Driver
 - NVIDIA Quadro/NVIDIA Tesla Driver (Release 295.73)

Follow these steps to configure your system:

- Enable OpenGL quad buffering:
- Open the NVIDIA system control. For Windows 7: right-click the Desktop and choose **NVIDIA system control** in the context menu.
- In the NVIDIA system control tool
 - select Manage 3D Settings the structure tree on the left.

• In the pane that is shown on the right set **3D OpenGL Stereo** as global preset under global settings.

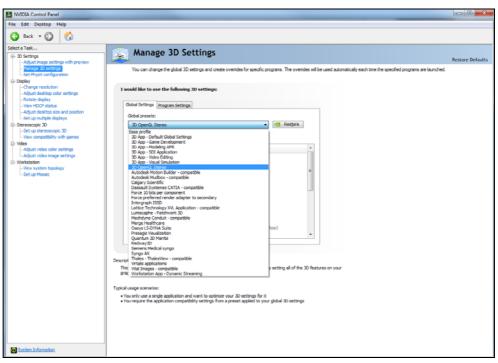


Figure 16-1 Enabling OpenGL quad buffering

- 1. Set the 120 Hz Monitor as the primary output device (only when using multiple displays):
 - Select **Set up multiple displays** in the structure tree on the left. In the pane that is shown on the right, right-click the 3D monitor and select **Make this in the Windows main display**.

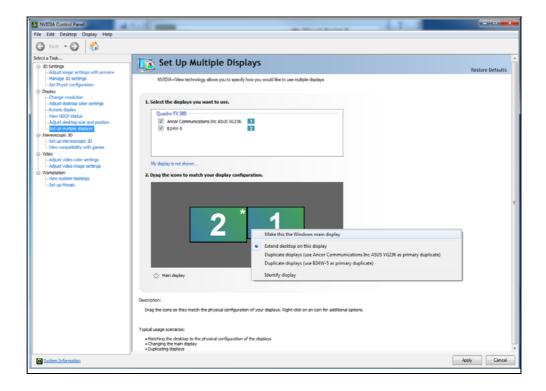


Figure 16-2 Select primary display

- 2. Ensure that the monitor refresh rate is set to 120 Hz.
 - Select Change resolution in the structure tree.
 - Select the 3D monitor and then choose 120 Hz in the refresh rate drop down box. The refresh rate of 120 Hz is not available for some resolutions. If the refresh rate is not available for any resolution, the display was not recognized as a 3D display. In this case refer to the manual of the display.

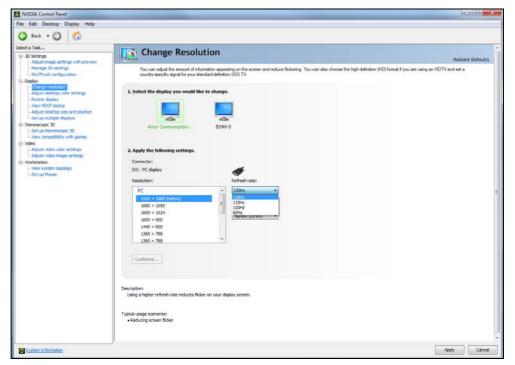


Figure 16-3 Select primary display

- 3. Activate NVIDIA vision.
 - Switch on the shutter glasses by pressing the button on its left temple.

16.5 3DConnexion 3D Mouse Support

3DConnexion is a manufacturer of 3D mice for navigating and manipulating 3D content. The 3DConnexion 3D mice are supported by SCENE. Compared to the use of traditional mice and keyboards, such a 3D mouse may make navigation in your 3D data much more intuitive and controllable.

Gently push, pull, twist or tilt the Controller Cap of the 3D mouse to pan, zoom and rotate in your 3D data. Increase pressure to go faster or decrease pressure to make intricate adjustments.

When operating the Controller Cap, the 3D mouse acknowledges the selected camera mode. In fly mode, for example, you can rotate the camera by twisting the cap. In camera pan mode, twisting it has no effect since only left-right and up-down movements of the cap are recognized. When a 3D View tool such as the measurement tool is selected, the 3D mouse operates in the examine

mode. You can also use the 3D mouse to rotate and zoom in the **Quick View** and to pan and zoom in the **Planar View**.



NOTE: When using a 3DConnexion Mouse, make sure to always use the latest drivers. They can be downloaded from www.3dconnexion.com.

Refer to the 3DConnexion documentation for more information on installing and setting up the 3D mouse.

16.5.1 Predefined Commands

If the 3DConnexion Add-in for SCENE has been installed with the driver of the 3D mouse, the following assignment of keys will be available (the number of available buttons varies with the available 3D mouse model):

- **Fit:** Move the camera to show the whole SCENE in the 3D View; return to the initial zoom level in the **Quick View** and **Planar View**.
- Menu: Open the settings menu of the 3D mouse.
- T: Display the top view.
- B: Display the bottom view.
- L: Display the left view.
- R: Display the right view.
- F: Display the front view.
- Bk: Display the back view.
- Rot: Toggle rotation on/off.
- Pan Zoom: Toggle pan and zoom on/off.

Optionally, the following commands can be assigned to the function keys from 1 to 10 with the 3Dconnexion settings tool (this tool is accessible from the Windows start menu or the task bar. See the manual of the 3DConnexion mouse for more information).

- Switch to fly mode.
- · Switch to examine mode.
- Switch to walk mode.
- Switch to camera pan mode.
- Set the rotation point automatically during movement.
- Set the rotation point automatically after movement.
- Don't set the rotation point automatically.
- · Show the rotation point always.
- Show the rotation point during movement.
- · Hide the rotation point.

16.5.2 Adjusting the 3D Mouse Behavior

To adjust the behavior of the 3D mouse and to access further functions, open the settings menu with the **Menu** button on the 3D mouse.

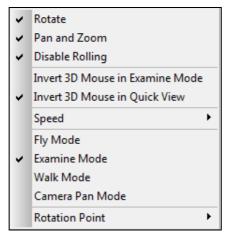


Figure 16-3 3DConnexion Mouse – Settings

Rotate – Switch the rotation capability on or off.

Pan and Zoom –Switch the pan and zoom capability on or off.

Disable Rolling – Switch the roll axis on or off.

Invert 3D Mouse in Examine Mode – Invert all axes in the examine mode.

Invert 3D Mouse in Quick View - Invert all axes in the Quick View.

Speed – Set the speed of movement.

Fly Mode – Switch to fly mode.

Examine Mode – Switch to the examine mode.

Walk Mode - Switch to walk mode.

Camera Pan Mode – Switch to camera pan mode.

Rotation Point – Adjust the behavior of the rotation point. For more information, see *Navigation Toolbar (3D View only)* on page 32.

Chapter 17: Reference Handbook

17.1 Hotkeys

Key(s)	Function
Ctrl + O	Open Workspace
Ctrl + N	Create new scan project
Ctrl + F	Find and locate objects workspace
3D View (general)	
В	Toggle between Walk- and Fly mode
Space	Toggle between Fly mode and Examine mode
Ctrl-Key (hold down)	Temporarily use Examine mode when another navigation mode is active
Middle mouse button (hold Down)	Temporarily use pan mode
Shift + X	Fly to point
Q, E	Roll camera left, right
Page Up / R Page Down / F	Move up Move down
+/-	Zoom or out
Shift + middle mouse button (click):	Set the rotation point
P	Toggle between perspective camera and orthogonal camera
V	Remove camera rolling
С	Toggle Clear View
Т	Align camera to surface normal
Х	Move Camera to 3D point
Alt + P	Save screenshot of current 3D View
Backspace	Go back to previous camera position
1, 2, 3, 4	Point size 1, 2, 3, and adaptive point size (4)
Ctrl + A	Select all points (only the points of scan point clouds or the project point cloud)
Ctrl + D	Dismiss the current scan point selection (only for point selections of the scan point cloud or the project point cloud)
Ctrl + F2	Create new viewpoint
F2	Go to next viewpoint

3D View (fly mode)	
Arrow Keys W, A, S, D 8, 4, 3, 6 (on numeric key pad)	Move camera forward, left, backwards, right
I, J, K, L	Rotate camera upwards, left, downwards, right
3D View (examine mode)	
Arrow Keys W, A, S, D 8, 4, 3, 6 (on numeric key pad)	Move camera backwards (object away), right (objects left), forward (objects closer), left (objects right)
I, J, K, L	Rotate camera downwards (move towards top view of object), counter clockwise (object clockwise), upwards (move towards bottom view of object), clockwise (object counter clockwise)

17.2 Symbols the Structure Window

Symbol	Meaning
	Project Folder
E	Cluster
0	Scan
m30 m84	Virtual scan
+-	Point
0	Sphere
a	Plane, Rectangle
\$	Slab
•	Pipe
/	Line
1	Mesh, Imported object
	Documentation
8	Region
•	Clipping box
3	View point
	Picture
	Overview map
9	Fit
Scans and Cluster	
•	Fully loaded
*	Reference scan or cluster
*	Fixed scan or cluster
a	Locked Scan Manager
G	Global Origin
?	Missing file
-0	Freestyle ^{3D} : Not processed completely
	Freestyle ^{3D} : Recoding finished. Some single frames unloaded because of low memory.
•	Freestyle ^{3D} : Post processing done

0	Freestyle ^{3D} : Reduced quality because of low machine performance
	Freestyle ^{3D} : Capture or Replay
ರ	Freestyle ^{3D} : Next step is Replay
∞ €	Freestyle ^{3D} : Next step is Optimize Scans
	Freestyle ^{3D} : Next step is Color Smoothing
×	Freestyle ^{3D} : Next step is Stray Point Filter
	Freestyle ^{3D} : Next step is Point Cloud Creation
Fitting	
٠	Active fit
•	Outdated active fit
	Good quality
	Compromised quality
•	Seriously compromised quality
Registration	
R	Ignored for Place Scans
c	Object with automatically found correspondence
c	Object with user forced correspondences
G	Global Origin

17.3 Context Menus

17.3.1 3D View

Selection

Delete Selected Points – deletes the selection.

Invert Selection – the objects around the selection get marked, and the selection itself gets canceled.

Dismiss Selection – cancels the selection.

Export Selected Points – exports the selection as a new scan.

Visibility... – Opens the Visibility dialog.

17.3.2 Clipping Box

Visible – Turn visibility of the boundaries of the Clipping Box on or off.

Locate – Displays the selected object the center and enlarged of the active view.

Active – A black check mark indicates whether this fit object is the active fit object of the corresponding object, i.e., whether it is the one that determined the properties of the corresponding object. An object can have several fit objects, of which one at the most can be active.

Hide Exterior – Hide the points that are outside of the Clipping Box.

Hide interior – Hide the points that are inside of the Clipping Box.

Delete visible points of all active clipping boxes: All visible points of all active Clipping Boxes will be deleted, no matter if they are insides or outsides the Clipping Boxes.

Delete invisible points of all active clipping boxes: All invisible points of all active Clipping Boxes will be deleted, no matter if they are insides or outsides the Clipping Boxes.

Export 3D Selection using active Clipping Boxes – Creates a selection of scan points on the basis of the active Clipping Boxes and exports those points.

Create Clipping Boxes along an axis – Creates multiple Clipping Boxes along one of the three axes of the selected Clipping Box.

Properties... – Opens the properties dialog.

17.3.3 Planar View and Quick View

Visible – Make the selected object visible or invisible.

View – Open the scan a new view; either as 3D View, Quick View (available Planar View) or Planar View (available Quick View).

Locate – Display the selected object the center and enlarged the active view.

Scan Points – Apply filters to the scan or create a new scan from the scan.

Find Objects – automatically detect certain types of objects in the scan.

Export -

Direct Export – Exports the scan point with the of the last export.

Export Scan points... – Export the scan points of the scan.

Delete – Deletes the selected object.

Properties... – Opens the properties dialog.

17.3.4 Planar View or Quick View - Point Selection

View – Opens a 3D View of the selected scan points.

Scan Points

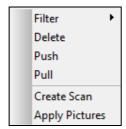


Figure 17-5 Context menu: Point selection > Scan Points

Filter -

Stray... –to remove scan points resulting from hitting two objects with the laser spot or by hitting no object at all, for example the sky.

Distance Based... – to remove scan points a certain distance range from the scanner.

Dark Scan Points... – to remove scan points with too much noise.

Smooth... – to minimize noise on surfaces.

Delete – Delete all scan points of the current selection.

Push/Pull

Push – All scan points of a selection which are situated between Minimal Distance and Maximal Distance, are moved away from the scanner position (being the origin of the local coordinate system of the scan). Pull – All scan points of a selection which are situated between Minimal Distance and Maximal Distance, are moved towards the scanner position (being the origin of the local coordinate system of the scan). Create Scan – Create a new scan from the selected scan points.

Apply Pictures – Apply pictures to the selection of scan points only.

Find Objects – Automatically detect checkerboards, spheres, planes, corner points, rectangles or lines the selected scan points.

Create Objects – Manually fit object from the selected scan points.

Sphere – Perform a sphere fit on the selected scan points.

Sphere Radius – Perform a sphere fit with known radius on the selected scan points.

Plane – Perform a plane fit on the selected scan points.

Slab - Perform a slab fit on the selected scan points

Expand Plane – Starting with the selected scan points, perform an automatic plane expansion.

Mean Point – Determine the mean point of the selected scan points.

Contrast Mean Point – Create a contrast mean point of the selected scan points. Usually used for circular flat targets.

Line – Create Lines.

Pipe – Create a pipe.

Mesh – Create a mesh

Region – Create a region.

Delete Objects - Delete all objects within the selection.

Export – Export the scan points of the selection.

17.3.6 Picture

Locate – Displays the selected object the center and enlarged of the active view.

View – Opens a new Planar View of the picture.

Operations

Correspondences > Delete Correspondences

Global System > Set as Global Origin

Select to work the local coordinate system of the picture. The picture is now marked with a red G to indicate that it is currently defining the global coordinate system.

Import/Export

Export Objects – Exports all objects under the picture.

Export Picture – Exports the picture its original format or JPEG format.

Exchange Picture – Replaces the picture with an imported one.

Apply – Apply the color information of the picture onto the scan. Position, orientation, and zoom factor of the camera are already known. This command is only available if the pictures reside inside a scan.

Undistort – Remove any so-called barrel or pin-cushion distortions from the picture. The distortion parameters have to reside inside the picture.

Colorize Scan – Use the color information of the picture onto the scan. Position, orientation, and zoom factor of the camera are not yet known and have to be calculated with pairs of matching points. This command is only available if the pictures reside inside a scan.

Properties... – Opens the properties dialog.

17.3.7 Plane

Locate – Displays the selected object the center and enlarged of the active view.

New

Reference on Folder Level – Place a copy of the selected object the reference objects folder of the current scan. The copy does not have any link to a fit object that may exist.

Reference on Workspace Level – Place a copy of the selected object the reference objects folder of the workspace. The copy does not have any link to a fit object that may exist.

Intersection Point – Creates an intersection point on the plane at the spot determined by the mouse pointer.

Plane with Border – Creates a new limited plane with border lines from the point selection that was used to create the selected plane.

Slab By Plane – Creates a slab from the plane.

Aligned Clipping Box – Creates a new Clipping Box aligned to the selected plane.

Documentation – Attach a documentation object to the selected object.

View > 3D View - View the selected object 3D View.

Visible – Make the selected object visible or invisible.

Operations > Correspondences > Delete Correspondences - Deletes the correspondences of the selected object. You can select to delete user forced, system found or anti-correspondences.

Alignment – modifies the overall orientation of the entire workspace according to the desired alignment of the plane to a cardinal direction (north, south, east, west, ceiling, ground or custom).

Flip – turns the plane's Normal for 180 degrees.

Export... – Exports the selected object.

Delete - Deletes the selected object.

Properties... – Opens the properties dialog.

17.3.8 Limited Plane

Locate – Displays the selected object the center and enlarged of the active view.

New

Reference on Folder Level – Place a copy of the selected object the reference objects folder of the current scan. The copy does not have any link to a fit object that may exist.

Reference on Workspace Level – Place a copy of the selected object the reference objects folder of the workspace. The copy does not have any link to a fit object that may exist.

Documentation – Attach a documentation object to the selected object.

View > 3D View – View the selected object 3D View.

View Scan Point Distance – Deviations from a level surface relation to a plane are highlighted color.

Operations > Correspondences > Delete Correspondences — Deletes the correspondences of the selected object. You can select to delete user forced, system found or anti-correspondences.

View Scan Point Distance – Analyze the evenness of the surface. Deviations of the scan points from the plane will be highlighted different colors.

Export... – Exports the selected object.

Set Border from Selection – The border line of the plane is replaced by the border line of the selection.

Delete – Deletes the selected object.

Rename – Renames the selected object.

17.3.9 Plane Fit

Select – The selection that was used to create the fit object is reactivated. The selection combination mode determines how the new selection results from the existing selection and the reactivated selection.

Active – A black check mark indicates whether this fit object is the active fit object of the corresponding object, i.e., whether it is the one that determined the properties of the corresponding object. An object can have several fit objects, of which one at the most can be active.

Update – Recalculates the object parameters. The basis for this is again the selection that was also used to create the fit object.

Flip – turns the plane's Normal for 180 degrees.

Delete – Deletes the fit object.

Rename - Renames the fit object.

Properties – Opens the properties dialog.

17.3.10 Constrained Plane Fit

Select – The selection that was used to create the fit object is reactivated. The selection combination mode determines how the new selection results from the existing selection and the reactivated selection.

Active – A black check mark indicates whether this fit object is the active fit object of the corresponding object, i.e., whether it is the one that determined the properties of the corresponding object. An object can have several fit objects, of which one at the most can be active.

Update – Recalculates the object parameters. The basis for this is again the selection that was also used to create the fit object.

Delete – Deletes the fit object.

Rename - Renames the fit object.

Properties – Opens the properties dialog.

17.3.11 Sphere

Locate – Displays the selected object the center and enlarged of the active view.

New

Reference on Folder Level – Place a copy of the selected object the reference objects folder of the current scan. The copy does not have any link to a fit object that may exist.

Reference on Workspace Level – Place a copy of the selected object the reference objects folder of the workspace. The copy does not have any link to a fit object that may exist.

Fit – Only available if a selection of scan points exists. Creates a new fit from the selected scan points. Both the sphere position and the sphere radius are ascertained from the scan points.

Fit (fixed radius) – Only available if a selection of scan points exists. Creates a new fit from the selected scan points with a fixed preset sphere radius. The sphere position is ascertained from the scan points.

View > 3D View – View the selected object 3D View.

Operations > Correspondences > Delete Correspondences - Deletes the correspondences of the selected object. You can select to delete user forced, system found or anti-correspondences.

Update Fit – Recalculates the fit of the sphere.

Export... -

Delete – Deletes the fit object.

Rename – Renames the fit object.

Properties – Opens the properties dialog.

17.3.12 Sphere Fit

Select – The selection that was used to create the fit object is reactivated. The selection combination mode determines how the new selection results from the existing selection and the reactivated selection.

Active – A black check mark indicates whether this fit object is the active fit object of the corresponding object, i.e., whether it is the one that determined the properties of the corresponding object. An object can have several fit objects, of which one at the most can be active.

Update – Recalculates the object parameters. The basis for this is again the selection that was also used to create the fit object.

Delete – Deletes the fit object.

Rename – Renames the fit object.

Properties – Opens the properties dialog.

17.3.13 Region

New

Reference on Folder Level – Place a copy of the selected object the reference objects folder of the current scan. The copy does not have any link to a fit object that may exist.

Reference on Workspace Level – Place a copy of the selected object the reference objects folder of the workspace. The copy does not have any link to a fit object that may exist.

Documentation – Attach a documentation object to the selected object.

Select – The selection that was used to create the region is reactivated. The selection combination mode determines how the new selection results from the existing selection and the reactivated selection.

Import/Export – Export the region as object.

Delete – Delete the region object. The scan points are not deleted.

Rename - Renames the fit object.

Properties – Opens the properties dialog.

17.3.14 Point

Locate – Displays the selected object the center and enlarged of the active view.

New

Reference on Folder Level – Place a copy of the selected object the reference objects folder of the current scan. The copy does not have any link to a fit object that may exist.

Reference on Workspace Level – Place a copy of the selected object the reference objects folder of the workspace. The copy does not have any link to a fit object that may exist.

Documentation – Attach a documentation object to the selected object.

View – Opens a new 3D View of the point.

Set Rotation Point – Sets the rotation point to the center of the scan point.

Visible – Make the selected object visible or invisible.

Operations > Correspondences > Delete Correspondences - Deletes the correspondences of the selected object. You can select to delete user forced, system found or anti-correspondences.

Export... – Exports the selected object.

Delete – Deletes the selected object.

Properties – Opens the properties dialog.

17.3.15 Point Fit

Select – The selection that was used to create the fit object is reactivated. The selection combination mode determines how the new selection results from the existing selection and the reactivated selection.

Active – A black check mark indicates whether this fit object is the active fit object of the corresponding object, i.e., whether it is the one that determined the properties of the corresponding object. An object can have several fit objects, of which one at the most can be active.

Update – Recalculates the object parameters. The basis for this is again the selection that was also used to create the fit object.

Delete – Deletes the fit object.

17.3.16 Pipe

Select – The selection that was used to create the fit object is reactivated. The selection combination mode determines how the new selection results from the existing selection and the reactivated selection.

Active – A black check mark indicates whether this fit object is the active fit object of the corresponding object, i.e., whether it is the one that determined the properties of the corresponding object. An object can have several fit objects, of which one at the most can be active.

Update – Recalculates the object parameters. The basis for this is again the selection that was also used to create the fit object.

Delete - Deletes the fit object.

Rename - Renames the fit object.

Properties – Opens the properties dialog.

17.3.17 Pipe Fit

Select – The selection that was used to create the fit object is reactivated. The selection combination mode determines how the new selection results from the existing selection and the reactivated selection.

Active – A black check mark indicates whether this fit object is the active fit object of the corresponding object, i.e., whether it is the one that determined the properties of the corresponding object. An object can have several fit objects, of which one at the most can be active.

Update – Recalculates the object parameters. The basis for this is again the selection that was also used to create the fit object.

Delete – Deletes the fit object.

Rename - Renames the fit object.

Properties - Opens the properties dialog.

17.3.18 Line

Select – The selection that was used to create the fit object is reactivated. The selection combination mode determines how the new selection results from the existing selection and the reactivated selection.

Active – A black check mark indicates whether this fit object is the active fit object of the corresponding object, i.e., whether it is the one that determined the properties of the corresponding object. An object can have several fit objects, of which one at the most can be active.

Update – Recalculates the object parameters. The basis for this is again the selection that was also used to create the fit object.

Delete - Deletes the fit object.

17.3.19 Line Fit

Select – The selection that was used to create the fit object is reactivated. The selection combination mode determines how the new selection results from the existing selection and the reactivated selection.

Active – A black check mark indicates whether this fit object is the active fit object of the corresponding object, i.e., whether it is the one that determined the properties of the corresponding object. An object can have several fit objects, of which one at the most can be active.

Update – Recalculates the object parameters. The basis for this is again the selection that was also used to create the fit object.

Delete – Deletes the fit object.

Rename - Renames the fit object.

Properties – Opens the properties dialog.

17.3.20 Rectangle

Select – The selection that was used to create the fit object is reactivated. The selection combination mode determines how the new selection results from the existing selection and the reactivated selection.

Active – A black check mark indicates whether this fit object is the active fit object of the corresponding object, i.e., whether it is the one that determined the properties of the corresponding object. An object can have several fit objects, of which one at the most can be active.

Update – Recalculates the object parameters. The basis for this is again the selection that was also used to create the fit object.

Delete – Deletes the fit object.

Rename - Renames the fit object.

Properties - Opens the properties dialog.

17.3.21 Rectangle Fit

Select – The selection that was used to create the fit object is reactivated. The selection combination mode determines how the new selection results from the existing selection and the reactivated selection.

Active – A black check mark indicates whether this fit object is the active fit object of the corresponding object, i.e., whether it is the one that determined the properties of the corresponding object. An object can have several fit objects, of which one at the most can be active.

Update – Recalculates the object parameters. The basis for this is again the selection that was also used to create the fit object.

Delete - Deletes the fit object.

17.3.22 Scan

Visible – Make the selected object visible or invisible.

View

3D View - View the scan 3D View.

Planar - View the scan Planar View.

Quick - View the scan Quick View.

Locate – Resumes the initial perspective of the view. 3D View the rotation point will be set to the position of the scanner.

Loaded – Loads the scan points of the scan. Here a check mark shows whether the scan points of a scan are loaded.

Process Scan – Opens the **Configure Processing** page to configure the settings for processing and start processing.

Point Cloud – Create or delete a Scan Point Cloud from the scans within the scan folder or cluster.

Create Scan Point Cloud – Create a Scan Point Cloud from the scans within the scan folder or cluster.

Delete Scan Point Cloud – Delete a Scan Point Cloud from the scans within the scan folder or cluster.

Export

Image – Obtains an overview image from the scan points and saves it the file system the same folder as the scans.

Objects – Export the objects of this scan.

Scan Points -

- Export Scans unordered to export the scan points of the selected scan.
- Export Scan Point Clouds ordered to export the point cloud of the selected scan.

As Project – Create a new SCENE project, or a new ReCap project. A dialog opens in which you can select the export format, a file name, and the location in which the new project shall be saved.



NOTE: When exporting a ReCap Cluster Project, SCENE creates a temporary SCENE project in the **TEMP** folder. This may require a large amount of disk space.

Delete – Deletes the scan from the workspace. The associated file is not deleted.

Properties – Opens the properties dialog.

for unprocessed Freestyle^{3D} scans

Operations > Registration

Level

- by picking one point, if the plane has an even surface.
- by picking three points, if the plane is uneven, or if you need a high accuracy.

Process the scan – Processes the steps Replay, Optimize Scans, Color Adjustment, and Stray Point Filtering.

Global System > Set as Global Origin — Select to work the local coordinate system of the scan. The scan will be marked with a red G to indicate that it is currently defining the Global Coordinates system.

Split Scan – see Freestyle^{3D} user manual.

Create virtual scans – creates one or several virtual scans from a scan. Virtual scans are required if you want to export Freestyle^{3D} scan projects to SCENE WebShare Cloud.



NOTE: Refer to the Freestyle^{3D} User Manual for detailed information.

for processed Freestyle^{3D} scans

Operations > Registration

Level

- by picking one point, if the plane has an even surface.
- by picking three points, if the plane is uneven, or if you need a high accuracy.

Fixed Scan – Mark the scan alignment as fixed and exclude it from further automatic registration attempts.

Reference Scan – Set the scan as reference scan.

Find Objects – Detect Checker boards, spheres, planes, corner points, rectangles or lines the scan.

Filter – Apply filters to the scan.

Preprocessing > **Preprocess Scan** — Opens the preprocess menu dialog. With the preprocess option you may apply a series of processing steps such as filters, automatic object detection or scan registration to the scan. The scan is automatically loaded, processed, saved and unloaded again.

Correspondences > **Delete Correspondences** — Deletes the correspondences of the scan and of its objects. You can select to delete user forced, system found or anti-correspondences.

Preprocessing > **Preprocess Scan** — Opens the preprocess menu dialog. With the preprocess option you may apply a series of processing steps such as filters, automatic object detection or scan registration to the scan. The scan is automatically loaded, processed, saved and unloaded again.

Correspondences > **Delete Correspondences** — Deletes the correspondences of the scan and of its objects. You can select to delete user forced, system

found or anti-correspondences. **Delete inactive Fits** – Deletes all inactive fit objects.

Color/Pictures

Apply Pictures – Apply the color information of the picture onto the scan. Position, orientation, and zoom factor of the camera are already known. This command is only available if the pictures reside inside a scan.

Adjust Picture Angles - Adjust the picture angles.

Export All Pictures – Exports all pictures of the scan (if the scan has been recorded color). Opens a dialog to select the storage location and the export format of the pictures. You can select between "Original format" and "jpg". "Original Format" will export the pictures without changing their format; "jpg" will convert the pictures and save them as JPG.

Import All Pictures – Opens a dialog to select the storage location of the pictures you want to import. This option is only available for scans which already contain pictures.

Color Contrast Filter – Enhances the dynamic range of the color pictures.

Restore Grey Image – Remove the color information and restore the original reflectance values.

Replace Color Overlay – Import a manually edited picture in order to replace the scan's initial color overlay with this picture. See chapter for more information.

Export Color Overlay – Export the scan's color overlay as a picture to your local hard drive.

Point Cloud Tools – Create a scan point cloud from the scan or delete an existing scan point cloud.

Global System > Set as Global Origin — Select to work the local coordinate system of the scan. The scan will be marked with a red G to indicate that it is currently defining the Global Coordinates system.

Split Scan – see Freestyle^{3D} user manual.

Create virtual scans – creates one or several virtual scans from a scan. Virtual scans are required if you want to export Freestyle^{3D} scan projects to SCENE WebShare Cloud.

Import / Export

Export Objects – Export the objects of this scan.

Export Scan Points – Export the scan points of the selected scan. This applies to the points of the scan only and does not export the scan points of any possible scan point cloud.

Export Scan Point Cloud – Export the scan point cloud of the scan.

Export as Project – Create a new SCENE project, or a new ReCap project. A dialog opens in which you can select the export format, a file name, and the location in which the new project shall be saved.



NOTE: When exporting a ReCap Cluster Project, SCENE creates a temporary SCENE project in the **TEMP** folder. This may require a large amount of disk space

Export Image – Obtains an overview image from the scan points and saves it the file system the same folder as the scans.

Export Compensation – Write compensation data to a file.

Export Scan Parameters – Export the parameters of the scan.

Import Compensation – Import compensation file and use immediately. You may not be able to import a compensation if the scan points were changed by a filter beforehand and have not been saved again.

Save Objects Scan – Save the objects of the scan the scan file.

Delete – Deletes the scan from the workspace. The associated file is not deleted.

17.3.23 Scan Fit

Update – Recalculates the object parameters. The basis for this is again the selection that was also used to create the fit object.

Delete – Deletes the fit object.

Rename - Renames the fit object.

Properties – Opens the properties dialog.

17.3.24 Scans Folder / Cluster

Visible – Make the selected object visible or invisible.

View – Open the scans and objects of the scan folder, the Correspondence View, the 3D View or the Structure View.

Locate – Resumes the initial perspective of the view. 3D View the rotation point will be set to the position of the scanner.

Loaded – Loads the scan points of the scan. Here a check mark shows whether the scan points of a scan are loaded.

Process Scan – Opens the **Configure Processing** page to configure the for processing and start processing.

Point Cloud – Create or delete a Scan Point Cloud from the scans within the scan folder or cluster.

Create Scan Point Cloud – Create a Scan Point Cloud from the scans within the scan folder or cluster.

Delete Scan Point Cloud – Delete a Scan Point Cloud from the scans within the scan folder or cluster.

New – Create a new Cluster within the scan folder.

Delete – Deletes the fit object.

Rename – Renames the fit object.

Properties – Opens the properties dialog.

Export

Scans -

- Export Scans ordered to export the scan points of the selected scan.
- Export Scan Point Clouds unordered to export the point cloud of the selected scan.

As Project – Create a new SCENE project, or a new ReCap project. A dialog opens in which you can select the export format, a file name, and the location where the new project shall be saved.



NOTE: When exporting a ReCap Cluster Project, SCENE creates a temporary SCENE project in the **TEMP** folder. This may require a large amount of disk space.

Images – Obtains panorama images of the Planar View of each scan and saves these images the file system the same folder as the scans.

Delete – Deletes the scan folder and all the scans it from the workspace. The files belonging to the scans are not deleted.

Rename - Renames the fit object.

Properties – Opens the properties dialog.

17.3.25 Scan Manager

Update Scans – Updates the registration of the scans managed by this Scan Manager. To see the results of the update you must open a new Scan Manager window.

Lock – as soon you finished your work with this cluster, you can lock its Scan Manager.

Lock all – locks the Scan Manager of the cluster and the Scan Managers of subordinated clusters.

Unlock – unlocks a locked Scan Manager. **Unlock All** – unlocks the Scan Manager of the cluster and the Scan Managers of subordinated clusters.

Delete - Deletes the Scan Manager.

Rename - Renames the Scan Manager.

Properties – Opens the Scan Manager.

17.3.26 Virtual Scan (3D Picture)

The virtual scan is treated as a normal laser scan.

Visible – Make the selected object visible or invisible.

View > 3D View - View the scan 3D View.

Locate – Resumes the initial perspective of the view. 3D View the rotation point will be set to the position of the scanner.

Export

Image – Obtains an overview image from the scan points and saves it the file system the same folder as the scans.

Objects – Export the objects of this scan.

Scan Points – Export the scan points of the selected scan. This applies to the points of the scan only and does not export the scan points of any possible scan point cloud.

As Project – Create a new SCENE project, or a new ReCap project. A dialog opens in which you can select the export format, a file name, and the location where the new project shall be saved.



NOTE: When exporting a ReCap Cluster Project, SCENE creates a temporary SCENE project in the **TEMP** folder. This may require a large amount of disk space.

Delete – Deletes the scan from the workspace. The associated file is not deleted.

Properties – Opens the properties dialog.

17.3.27 3D Picture Fit (Fit of a Virtual Scan)

Select – The selection that was used to create the fit object is reactivated. The selection combination mode determines how the new selection results from the existing selection and the reactivated selection.

Active – A black check mark indicates whether this fit object is the active fit object of the corresponding object, i.e., whether it is the one that determined the properties of the corresponding object. An object can have several fit objects, of which one at the most can be active.

Update – Recalculates the object parameters. The basis for this is again the selection that was also used to create the fit object.

Delete – Deletes the fit object.

Rename – Renames the fit object.

Properties – Opens the properties dialog.

17.3.28 Workspace

New – Create a new Point, Sphere, Checkerboard, Circular Flat Target, Corner Point, Plane, Slab, Documentation Object, Folder or Scan Folder the Workspace.

View

3D View – Opens a 3D View with all the loaded scans and CAD models. Unloaded Scans are not loaded automatically.

SCENE WebShare Cloud view – Opens SCENE WebShare Cloud. The workspace will only be displayed SCENE WebShare Cloud if it already has been exported as a SCENE WebShare Cloud project.

Structure View – opens a Structure View of the workspace.

Operations

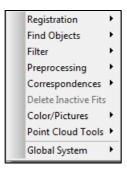


Figure 17-29 Context menu: Scans > Operations

Registration

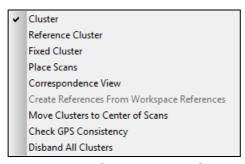


Figure 17-30 Context menu: Scans > Operations> Registration

Cluster - Set scan folder as cluster.

Reference Cluster – Set scan folder as reference cluster.

Fixed Cluster – Mark the cluster alignment as fixed and exclude it from further automatic registration attempts.

Place Scans – Places scans within this cluster (and its sub clusters). This does not register the cluster itself.

Correspondence View – Opens the Correspondence View.

Create References From Workspace References – Copies all references of the workspace to this cluster.

Move Clusters to Center of Scans – Moves the center of the cluster and its sub clusters to the center of their scans. This does not change the global position of the scans. This function is especially useful when working with large coordinates.

Check GPS Consistency – Check which GPS positions will not be used for the registration as they are too far away from the GPS reference position.

Disband All Clusters – This function will recursively move the contents of all sub folders to the cluster it was applied on and will remove the (empty) sub clusters to flatten the hierarchy. This function is useful to clean up the

project after having finished the registration, especially if auto clustering lead to deep project hierarchies.

Correspondences

Delete Correspondences... Force Current Force By Manual Target Names

Figure 17-31 Context menu: Scan folder ▶ Operations ▶ Correspondences

Delete Correspondences – Deletes correspondences of the scan folder, its scans and of all objects that belong to its scans. You can select to delete user forced, system forced, system found or anti-correspondences.

Force Current – Force all already existing correspondences of the scan folder.

Force by Manual Target Names – Forces correspondences by manually created reference name.

Preprocessing > **Preprocess Scans** – Opens the preprocess menu dialog. With the preprocess option you may apply a series of processing steps such as filters, automatic object detection or scan registration to the scans of the scan folder. The scans are automatically processed and saved.

Color/Pictures – Apply the pictures to all the scans within the folder or apply the color contrast filter.

Delete inactive Fits – Deletes all the inactive **Scan Fits**.

Global System > Set as Global Origin — Select to work the local coordinate system of the scan folder. The scan folder is now marked with a red G to indicate that it is currently defining the global coordinate system.

Import/Export

Export Objects – Export objects. Note, scans need not to be loaded and are therefore not loaded automatically.

Export Project – Exports the entire scan project. Select, if the new scan project will be used SCENE or ReCap. Then, select the target location and a project name.



NOTE: When exporting a ReCap Cluster Project, SCENE creates a temporary SCENE project in the **TEMP** folder. This may require a large amount of disk space.

Export Images – Obtains panorama images of the Planar View from all the scans in the workspace. The scans are loaded one after the other, the panorama image is created, then saved and then unloaded again.

Export Positions –Saves the position specifications of all scans and reference objects.

Assemble Meshes -

Delete – Deletes the fit object.

Visibility

3D Visibility – Opens the dialog with the default visibility for **Quick Views** and 3D Views.

Planar View Visibility – Opens the dialog with the default visibility for the **Planar View**.

Layer Manager – Opens the dialog box of the layer manager.

17.3.32 Viewpoint

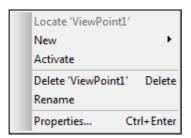


Figure 17-33 Context menu: Viewpoint

New – Create a new Point, Sphere, Checkerboard, Circular Flat Target, Corner Point, Plane, Slab, Documentation Object, Folder or Scan Folder the Workspace.

Activate – Go to the selected viewpoint the current 3D View.

Delete – Deletes the fit object.

Rename - Renames the fit object.

Properties – Opens the properties dialog.

17.4 Properties

17.4.1 Scan Project Workspace

General tab

Name – The name of the object. The green **traffic light** right to the object name indicates that corresponding objects have been found other scans. If corresponding references have not been found, no traffic light will be displayed.

Layer – The representation layer on which the object is located.

Select active layer – Enters the currently active representation layer.

Assign layer to all contained objects – All the scans of the workspace take on the representation layer of the workspace.

Transformation tab

 $\textbf{Position}- The \ translation \ portion \ of \ the \ transformation.$

X – To key in a transformation in the x direction.

Y – To key in a transformation in the y direction.

Z – To key in a transformation in the z direction.

Scroll bar – Set the transformation using the mouse. The direction of the transformation will be the x, y or z coordinate that is highlighted in yellow.

Each tick increments by – Set the increment for the scroll bar.

Rotation Angle – The angle of rotation if the rotation axis is split along the coordinate axes.

- **X** The angle of rotation around the x axis.
- **Y** The angle of rotation around the y axis.
- **Z** The angle of rotation around the z axis.

Scroll bar – Set a new angle of rotation.

To change a value, you can either enter the required value directly into the appropriate field, or you first select the field and then use the corresponding slider to change the value step by step. You can set the increment using the drop-down box. If you hit the edge with the slider, simply reselect the field and the slider will return to the center without you losing your previous changes.

Axis snap – If checked, you can change the rotation for the current axis independently from the others. This is achieved by changing the order in which the rotations are applied.

Global Coordinates – If checked, coordinates are displayed in the global coordinate system; else they are displayed in the coordinate system of the scanner.

GPS Reference tab

Define the reference coordinate system by entering the GPS or UTM position.

17.4.2 Scan Folder

General tab

Name - The name of the scan folder.

Layer – The representation layer in which the scan folder is located.

Select active layer – Enters the currently active representation layer.

Assign layer to all contained objects – All the scans of the scan folder take on the representation layer of the scan folder.

Transformation tab

Position – The translation portion of the transformation

- **X** To key a transformation the x direction.
- Y To key a transformation the y direction.
- **Z** To key a transformation the z direction.

Scroll bar – Set the transformation using the mouse. The direction of the transformation will be the x, y or z coordinate that is highlighted yellow.

Each tick increments by – Set the increment for the scroll bar.

Rotation Angle – The angle of rotation if the rotation axis is split along the coordinate axes.

X – The angle of rotation around the x axis.

Y – The angle of rotation around the y axis.

Z – The angle of rotation around the z axis.

Scroll bar – Set a new angle of rotation.

To change a value, you can either enter the required value directly into the appropriate field, or you first select the field and then use the corresponding slider to change the value step by step. You can set the increment using the drop-down box. If you hit the edge with the slider, simply reselect the field and the slider will return to the center without you losing your previous changes.

Axis snap – If checked, you can change the rotation for the current axis independently from the others. This is achieved by changing the order in which the rotations are applied.

Global Coordinates – If checked, coordinates are displayed in the global coordinate system; else they are displayed in the coordinate system of the scanner.

Folder tab

Cluster – Determine the scan folder as a cluster.

Reference Cluster – Determine the cluster as the reference cluster

Fixed Cluster – Mark the cluster alignment as fixed and exclude it from further automatic registration attempts.

17.4.3 Scan Manager

Scan Manager tab

Name – The name of the Scan Manager.

Managed by – Name of the super ordinate Scan Manager.

Locked – as soon you finished your work with this cluster, you can lock its Scan Manager.

Sub Manager – List of the subordinate Scan Managers.

The Scan Manager also informs whether external references were used for the registration or not.

The traffic lights next to the Scan Managers indicate whether they contain good or failed Scan Fits. If a traffic light next to a Scan Manager is red, this means that this Scan Manager contains bad Scan Fits. Green means that all the quality criteria are met. Amber shows that at least one quality criterion is

somewhat compromised. If there is a symbol next to a Scan Manager or a Scan Fit, this means that registration could not be executed, maybe because of missing references.

If you want to see the critical fits of a subordinate Scan Manager, double-click onto this Scan Manager to open it. Switch to the tab **Scan Results**.

Scan Results tab

The tab **Scan Results** gives you a list of all Scan Fits managed by the Scan Manager and shows the overall quality of each registration. This is symbolized by a traffic light too. Double-clicking on a fit object the list opens its properties dialog.

The average tension of each registration is calculated the **Mean Target Tension** column of this table: the lower the value, the better the registration result. Here

you can easily see which registrations failed or which registration results are bad (in this example the first two Scan Fits have an amber traffic light, so they seem not to be optimal). To identify the critical reference pairs which are responsible for the bad fit, you can switch to tab **Ref. Tensions**.

Correspondence View – opens the Correspondence View with all the scans that are managed by the Scan Manager.

Correspondence Split View - opens the Correspondence Split View.

Target Tensions tab

Tab **Target Tensions** shows all reference pairs used for registration, sorted by their tension.

Tension – describes the discrepancy the global coordinate system between the position and the orientation of the two corresponding reference objects Scan 1 and Scan 2. With reference points in the distance between the positions of the two reference points serves as input for the calculation of the tension. With planes, slabs or pipes the position and the direction of the objects serve as input for the calculation of this value.

Values close to zero indicate a good registration result. Here, you can easily identify reference pairs which are causing problems the registration. Clicking on the scan name selects the corresponding reference this scan, double-clicking opens the reference's properties.

Weighted Tensions – Global references and inclinometer data have higher weightings the registration algorithm. When you activate this option, these different weightings will be considered the calculation of the tensions.

Full Hierarchy – When activated, the reference pairs of all **Scan Managers** will be displayed.

Weighted Statistics

Mean - Mean value over all tensions.

Deviation – Deviation over all tensions.

Min. - Minimum tension

Max. - Maximum tension

Scan Point Tensions

Tab **Scan Point Tensions** shows all reference cluster pairs used for the scan registration.

Mean – describes the discrepancy between the two corresponding referenced clusters.

Full Hierarchy – When activated, the reference pairs of all **Scan Manager**s will be displayed.

Overall Statistics

Mean – Mean value over all tensions.

<4 mm – Deviation smaller than 4 mm, displayed percent. This value gives a quick overview on the overall quality of the registration.</p>

17.4.4 Scan

Depending on the used scanner type, the scan properties dialog might have different tabs. On the following pages the scan properties dialog will be described for scans recorded with the FARO Laser Scanner.

General tab

Name – Name of the scan. Scans cannot be renamed.

Layer – The representation layer in which the scan is located.

Select active layer – Enters the currently active representation layer.

Assign layer to all contained objects – All the objects of the scan take on the representation layer of the scan.

Transformation

See chapter Workspace.

Scan tab

Size – The number of columns and rows. If a scan is loaded reduced resolution, the reduced number of columns and rows is displayed and, light gray underneath, the complete number of columns and rows.

Data loaded –Indicates whether the scan is loaded.

Reference Scan –Indicates whether the scan is used as a reference scan for registration.

Scan Fixed – Mark the scan alignment as fixed and exclude it from further automatic registration attempts.

Scanner Dist. Range – range of the scanner.

Scanner Position – The position of the scanner with the mirror being the point of origin.

Orientation Axis – Rotation axis of the scan.

Orientation Angle – The scan's angle of rotation.

Recording Date – The time the scan was recorded.

Scan Origin Info – Additional information on the origin of the scan, for example, where it was recorded and information about issues (scanner warnings or errors) that occurred during recording of the scan.

Info – Further details that were provided when recording.

Scan area tab

Selected Profile – The scan profile that was selected for the recording of the scan (only available for FARO Focus scanners).

Angular Area – The recorded angular area.

Vertical – The vertical angular area.

Horizontal – The horizontal angular area.

Resolution – The resolution of the scan, measured fractions of the maximum resolution.

Quality – The quality setting that was selected for the recording of the scan. This setting has influence on the quality respectively on the noise of the scan data. The corresponding measurement rate is displayed too (in 1000 points per second).

Filters

Clear Sky – Checked if the Clear Sky Filter was applied during the recording of the scan.

Clear Contour – Checked if Clear Contour Filter was applied during the recording of the scan

Scan Size – Number of rows and columns.

Resolution – The resolution of the scan. You can select between:

pt/360°, pt/0°, °/pt, ,/pt, ,/pt, mm/10m,/30ft.

File Size - File size of the scan.

Distance Range – The distance range that was selected for the recording of the scan (only available for FARO Focus scanners V7 or greater).

Operation tab

This tab is only available for scans taken with the FARO Laser Scanner LS, the FARO Laser Scanner Photon or the FARO Laser Scanner Focus.

Name – The name of the project or the order.

Company – The client's company name.

Division – The client's or order's division.

Subdivision – The client's or order's sub-division.

Area - The scanned area.

Info – Additional information.

Min. Reflection – The reflection value limit set when recording.

Project tab

This tab is only available for scans taken with the FARO Laser Scanner Focus.

This tab shows information about the scan project. This information was given before the scan was recorded.

Project Name – The name of the project / or sub-project that was assigned to the scan.

Customer –formation about the potential project customer.

Additional information – Additional information provided for the project.

Operator tab

The FARO Laser Scanner Focus allows to create operator profiles with names, contact details and further information. While scanning, it also allows to specify the operator who is currently working with the scanner. This information will then be saved in the meta data of the recorded scans and is shown on this tab. It might be useful for the person who is post processing the scans; especially when there are several scanner operators working on the same scan project.

You can still add or change this information when processing the scans SCENE.

Scanner info tab

Scanner - The name of the scanner.

Revision – The revision number which is allocated during servicing.

Scanner Type – The type of scanner.

Serial Number – The serial number of the scanner.

Range – The range of the scanner.

Compensation – The name of the compensation file.

Scanner tab

This tab contains some compensation data of the scanner.

Sensors tab

Inclinometer

Use – Enable or disable the use of the inclinometer data for registration.

Inclinometer Axis – Shows the up direction of the inclinometer the scan system.

Inclinometer Angle – Shows the angle between the z-axis and the inclinometer axis the scan system.

Ignore Measurement – Overwrites the inclinometer axis and the angle with values that level the scan.

Transformation mismatch – Shows the difference between the z-axis defined by the inclinometer and the z-axis defined by the scan's transformation.

Compass

Use – Enable or disable the use of the compass data for the correspondence search.

Compass Axis – Shows the orientation of the scan the scan system.

Compass mismatch – Shows the difference between the orientation defined by the compass and the orientation defined by the scan's transformation.

Altimeter

Use – Enable or disable the use of the altimeter data for correspondence search.

Measured Height – The height measured by the altimeter of the scanner based on a given reference height.

Global Positioning System (GPS) – the values measured by the scanner's GPS sensor.

Position (lat./long.) –GPS position longitude and latitude.

Position (UTM) – GPS position UTM coordinates.

Measured Height – Height above sea level.

Transformation mismatch – Shows the difference between the position defined by the GPS data and the position defined by the scan's transformation.

Advanced – Shows the raw data from the GPS sensor.

Place using Sensors – Restores the initial placement of the scan according to the measurements of the various sensors.

Camera tab

This tab is only available for scans taken with the FARO Laser Scanner LS or the FARO Laser Scanner Photon.

Camera Mount – Type of the camera bracket that has been used for taking a colored scan.

Non-winding is the old, fixed type for scans taken with FARO Photon and LS scanners and the type for all scans taken with FARO Focus scanners.

No parallax is the new mount with the sliding mechanism.

No parallax, with pins is the camera mount with the sliding mechanism and pins that fit into the bushes on the side of newer FARO Laser Scanners. Note that older models of the FARO Laser Scanner are not equipped with these bushes.

Camera Orientation - Camera orientation

Top – The camera was fixed the top position of the mount bracket: Therefore the camera was pointing slightly upwards when taking pictures.

Horizontal – The camera was fixed the lower position of the mount bracket and therefore oriented horizontally.

Exposure

Manual – Exposure time, exposure index, and f-number is set directly at the camera.

By Scanner – The scanner determined a balanced exposure setting.

Correction – Correction factor for the exposure that have been determined by the scanner.

Color tab

This tab is only available for scans taken with the FARO Laser Scanner Focus.

Scan with Color - Checked if the scan was recorded color.

Exposure Metering Mode – The exposure metering mode used to take the color pictures when colored scan recording was switched on:

Even Weighted Metering – The light information coming from the entire SCENE without giving special weighting to a particular area was used to determine the exposure of the camera.

Horizon Weighted Metering – The light information coming from the horizon was used to determine the exposure setting of the camera.

Zenith Weighted Metering – The light information coming from above the scanner was used to determine the exposure setting of the camera.

17.4.5 Scan Fit

Scan Fit tab

Scan Name – Name of the scan. Scans cannot be renamed.

Name – The name of the fit object.

Transformation

Position - The calculated position of the scan.

Orientation Axis – The calculated rotation axis of the scan.

Angle – The calculated angle of rotation of the scan.

Click the **Used** button to check which registration method was performed.

Global Coordinates – If checked, coordinates are displayed in the global coordinate system; else they are displayed in the coordinate system of the scanner.

Target Tensions tab

Normalized Tension – In most cases, this value is identical to the *Point Distance* (see below). It is only different if you have reference coordinates based on GPS measurements. For example if you use a GPS device to measure the position of a sphere, the position of the spheres is not very accurate. As a consequence, the **Scan Fit** cannot be as good as it normally is, and would show very large deviations.

In such cases the indicator of the **Scan Fit** quality should not base on this, therefore the *Normalized Tension* puts a lower weight on the GPS reference positions, leading to smaller numbers for the tension.

Point distance – The standard deviation of the distance between the local reference points and their corresponding references.

The traffic light indicates the quality of this individual criterion:

```
green: < 10mm
orange: ≥ 10mm and ≤ 20mm
red: > 20mm
```

Point drift – The mean value of the deviations between the local reference points and their corresponding references. In contrast to viewing purely the distance, the direction of the deviation is also taken into account here. Deviations can therefore cancel each other out.

The traffic light indicates the quality of this individual criterion:

```
green: < 1mm
orange: ≥ 1mm and ≤ 5mm
red: > 5mm
```

Long. mismatch — The standard deviation of the longitudinal distance between the local reference points and their corresponding references. The longitudinal distance is the difference between the distance values to the scanner.

The traffic light indicates the quality of this individual criterion:

```
green: < 10mm
orange: ≥ 10mm and ≤ 20mm
red: > 20mm
```

Angular mismatch – The standard deviation of the angular distance between the local reference points and the corresponding references. The angles are measured the local coordinate system of the scanner.

The traffic light indicates the quality of this individual criterion:

```
green: < 0.08°

orange: ≥ 0.08° and ≤ 0.17°

red: > 0.17°
```

Orthogonal mismatch – The standard deviation of the orthogonal distance between the local reference points and the corresponding references. This is a way to express the angular mismatch as distance mismatch.

Inclinometer mismatch – Angular difference between the calculated orientation axis and the axis defined by the inclinometer.

The traffic light indicates the quality of this individual criterion:

```
green: < 1°

orange: ≥ 1° and ≤ 5°

red: > 5°
```

List of targets used

Object – The name of the reference object. If reference object is a specific real reference, the full path of the corresponding object will be displayed; if referenced object is a virtual mean reference (mean reference from several scans) only its name will be displayed.

Distance – The distance between the local reference point and the corresponding global reference.

Long. – The longitudinal distance between local reference point and the corresponding global reference.

Angular – The angular distance between the local reference point and the corresponding global reference.

Orth. – The orthogonal distance between the local reference point and the corresponding global reference.

The traffic light here is green if a minimum of three references (including the inclinometer) are available; it's red if there are less than three references.

When you press the **View** button, a 3D View will open which gives you an overview of the placement of the scanner and the local and global references.

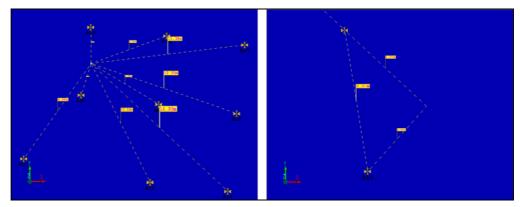


Figure 17-6 Overview of references

17.4.7 Constraints Object

Name – The name of the constraints object.

Scanpoint Distance – A quality parameter of a plane.

Max – The scan point distance of the plane with the highest distance. The traffic light indicates the quality of this individual criterion. It is green at values <4mm, red at values >20mm and orange between them.

Mean – The mean value of all managed planes. The traffic light indicates the quality of this individual criterion. It is green at values <4mm, red at values >20mm and orange between them.

Constraint Error – Constraints are implemented by functions that are zero if the constraint is met. Deviations from zero are called Constraint Error.

Max – Highest value of all constraint functions. The traffic light indicates the quality of this individual criterion. It is green at values <2.2e-013, red at values >1e-005 and orange between them.

Mean – Mean value of all constraint functions. The traffic light indicates the quality of this individual criterion. It is green at values <2.2e-013, red at values >1e-005 and orange between them.

Planes - Planes used to define constraints.

Plane – Name and path of the plane.

Fixed – Fixed planes are only used to define the constraint but will not be changed.

Constraints – List of pairs of planes and the constraint chosen for this pair.

Plane 1 – First plane.

Plane 2 - Second plane.

Description – The constraint chosen.

17.4.8 Constrained Plane Fit

Global Coordinates – If checked, coordinates are displayed in the global coordinate system; else they are displayed in the coordinate system of the scanner.

Plane Name - Name of the corresponding plane

Name – Name of the fit (by default named according to the constraints object that manages this fit)

Normal – The orientation determined by the fit. The orientation is given by the direction which stands perpendicular to the plane.

Position – The position determined by the fit.

Number of scan points – The number of scan points in the selection used for the fit. The traffic light indicates the quality of this individual criterion. It is green at values >80, red at values <20 and orange between them.

Scan point distance – The standard deviation of the distance of the scan points from the calculated plane. The traffic light indicates the quality of this individual criterion. It is green at values <4mm, red at values >20mm and orange between them.

Scan point drift – The average distance of the scan points from the calculated plane. With this, the scan points above the plane can be averaged out with the scan points below the plane. The traffic light indicates the quality of this

individual criterion. It is green at values <1mm, red at values >5mm and orange between them.

Last Constraint – The name and path of the last constraints object that has been used to manage this fit.

17.4.9 Measurement

Overall Distance – Measured distance. When measuring between two points, the result will be the point-to-point distance. When using a plane or rectangle, the measurement is automatically taken perpendicular to this plane or rectangle. Note that negative distances will occur if the normal of the plane or rectangle points opposite direction.

Vertical Distance – Vertical part of the point-to-point distance.

Horizontal Distance – Horizontal part of the point-to-point distance.

Along X – The distance along the x axis of the point-to-point distance.

Along Y – The distance along the y axis of the point-to-point distance.

Show Distance – Select which values shall be shown in the views.

Measure Objects –List of objects that were used for the measurement. List is empty for point-to-point measurements.

17.4.10 Picture

General tab

Name – The name of the object. The green **traffic light** right to the object name indicates that corresponding objects have been found in other scans. If corresponding references have not been found, no traffic light will be displayed.

Layer – The representation layer on which the object is situated.

Picture Properties tab

Spherical – A checkmark to indicate spherical pictures.

17.4.11 Pipe

General tab

Name – The name of the object. The green **traffic light** right to the object name indicates that corresponding objects have been found other scans. If corresponding references have not been found, no traffic light will be displayed.

Layer – The representation layer on which the object is situated.

Pipe Properties tab

Global Coordinates – If checked, coordinates are displayed in the global coordinate system; else they are displayed in the coordinate system of the scanner.

Pipe Name – The name of the pipe.

Axis – The axis of the pipe.

Position – The position of the pipe.

Diameter – The diameter of the pipe.

Length – The length of the pipe.

17.4.12 Pipe Fit

Global Coordinates – If checked, coordinates are displayed in the global coordinate system; else they are displayed in the coordinate system of the scanner.

Pipe Name – The name of the corresponding pipe.

Name – The name of the fit object.

Axis – The axis determined by the fit.

Position – The position determined by the fit.

Diameter – The diameter determined by the fit.

Length - The length determined by the fit.

Number of scan points – The number of scan points in the selection used for the fit.

The traffic light indicates the quality of this individual criterion:

green: >80 points

orange: ≥ 20 and ≤ 80 points

red: <20 points

Scan point distance – The standard deviation of the distance of the scan points from the calculated pipe.

The traffic light indicates the quality of this individual criterion:

green: < 4mm

orange: ≥ 4mm and ≤ 20mm

red: >20 mm

Scan point drift – The average distance of the scan points from the calculated pipe. With this, the scan points inside the pipe can be averaged out with the scan points outside the pipe.

The traffic light indicates the quality of this individual criterion:

green: < 1mm

orange: ≥ 1mm and ≤ 5mm

red: >5 mm

17.4.13 Plane

General tab

Name – The name of the object. The green **traffic light** right to the object name indicates that corresponding objects have been found other scans. If corresponding references have not been found, no traffic light will be displayed.

Use for Place Scans, Correspondence Search and Automatic Name – The object will be used for the registration. Correspondence relationships to this

object are enabled and its name will automatically be changed if corresponding objects have been found or the name of a corresponding object has been changed.

Local reference objects will have this option activated by default if their name has not been changed by the user manually.

Use for Place Scans and Correspondence Search – The object will be used for registering scans, correspondence relationships to this object are enabled but its name will not be changed automatically. This means that the name of this object is fixed and corresponding reference objects other scans will be named accordingly.

Global reference objects and local references which have been (re-)named manually will have this option activated by default.

Use for Place Scans – The object will only be used for registering scans but excluded from any correspondence search. Its name will not be changed automatically.

Ignore for Place Scans – The object will not be used for registering scans and is excluded from any correspondence search. Its name will not be changed automatically.

These options are relevant for the automatic correspondence search and for the registration of scans which are only available SCENE.

Layer – The representation layer on which the object is situated.

Plane Properties tab

Global Coordinates – If checked, coordinates are displayed in the global coordinate system; else they are displayed in the coordinate system of the scanner.

Normal – The orientation of the plane, given by the direction that stands perpendicular to the plane.

Position – A point of the plane.

17.4.14 Plane Fit

Global Coordinates – If checked, coordinates are displayed in the global coordinate system; else they are displayed in the coordinate system of the scanner.

Plane Name – The name of the corresponding plane. You can enter a name manually or choose one from the drop down menu. This menu contains the names of the last 10 fitted planes other scans and helps choosing the right name for the registration and accelerates the manual naming process.

Name – The name of the fit object.

Normal – The orientation determined by the fit. The orientation is given by the direction which stands perpendicular to the plane.

Position – The position determined by the fit.

Number of scan points – The number of scan points in the selection used for the fit.

The traffic light indicates the quality of this individual criterion:

```
green: >80 points

orange: ≥ 20 and ≤ 80 points

red: <20 points
```

Transversal normal deviation – The standard deviation of the normal, which is determined using the interim results of the fit. A high standard deviation indicates that the selected area is not as flat as it should be. There could be a ripple or there might be other objects in the plane. The standard deviation is broken down a transversal and longitudinal deviation.

The traffic light indicates the quality of this individual criterion:

```
green: < 1°
orange: ≥ 1° and ≤ 2.29°
red: >2.29°
```

Longitudinal normal deviation – The standard deviation of the normal longitudinal direction.

The traffic light indicates the quality of this individual criterion:

```
green: < 1.15°
orange: ≥ 1.15° and ≤ 2.29°
red: >2.29°
```

Scan point distance – The standard deviation of the distance of the scan points from the plane that has been determined. This is a good measurement for noise.

The traffic light indicates the quality of this individual criterion:

```
green: < 4mm
orange: ≥ 4mm and ≤ 20mm
red: >20 mm
```

17.4.15 Limited Plane Fit

Global Coordinates – If checked, coordinates are displayed in the global coordinate system; else they are displayed in the coordinate system of the scanner.

Border Points – A list of all the corner points of the plane.

Plane Name – The name of the corresponding plane. You can enter a name manually or choose one from the drop down menu. This menu contains the names of the last 10 fitted planes other scans and helps choosing the right name for the registration and accelerates the manual naming process.

Name – The name of the fit object.

Normal – The orientation determined by the fit. The orientation is given by the direction which stands perpendicular to the plane.

Position – The position determined by the fit.

Number of scan points – The number of scan points in the selection used for the fit.

The traffic light indicates the quality of this individual criterion:

green: >80 points

orange: ≥ 20 and ≤ 80 points

red: <20 points

Transversal normal deviation – The standard deviation of the normal, which is determined using the interim results of the fit. A high standard deviation indicates that the selected area is not as flat as it should be. There could be a ripple or there might be other objects in the plane. The standard deviation is broken down a transversal and longitudinal deviation.

The traffic light indicates the quality of this individual criterion:

```
green: < 1°
orange: ≥ 1° and ≤ 2.29°
red: >2.29°
```

Longitudinal normal deviation – The standard deviation of the normal longitudinal direction.

The traffic light indicates the quality of this individual criterion:

```
green: < 1.15°
orange: ≥ 1.15° and ≤ 2.29°
red: >2.29°
```

Scan point distance – The standard deviation of the distance of the scan points from the plane that has been determined. This is a good measurement for noise.

The traffic light indicates the quality of this individual criterion:

```
green: < 4mm
orange: ≥ 4mm and ≤ 20mm
red: >20 mm
```

17.4.16 Slab

General tab

Name – The name of the object. The green **traffic light** right to the object name indicates that corresponding objects have been found other scans. If corresponding references have not been found, no traffic light will be displayed.

Layer – The representation layer on which the object is situated.

Slab Properties tab

Global Coordinates – If checked, coordinates are displayed in the global coordinate system; else they are displayed in the coordinate system of the scanner.

Face – The visible face of the slab object.

Thickness – The thickness of the slab object.

Normal – The orientation of the slab, given by the direction that stands perpendicular to the slab.

Position – A point of the slab.

17.4.17 Slab Fit

Global Coordinates – If checked, coordinates are displayed in the global coordinate system; else they are displayed in the coordinate system of the scanner.

Slab Name – The name of the corresponding slab. You can enter a name manually or choose one from the drop down menu. This menu contains the names of the last 10 fitted slabs other scans and helps choosing the right name for the registration and accelerates the manual naming process.

Face - The visible face of the slab object.

Thickness – The thickness of the slab object.

Name – The name of the fit object.

Normal – The orientation determined by the fit. The orientation is given by the direction which stands perpendicular to the plane.

Position – The position determined by the fit.

Number of scan points – The number of scan points in the selection used for the fit.

The traffic light indicates the quality of this individual criterion:

```
green: > 80 points
orange: ≥ 20 and ≤ 80 points
red: < 20 points</pre>
```

Transversal Normal deviation – The standard deviation of the Normal, which is determined using the interim results of the fit. A high standard deviation indicates that the selected area is not as flat as it should be. There could be a ripple or there might be other objects in the plane. The standard deviation is broken down a transversal and longitudinal deviation.

The traffic light indicates the quality of this individual criterion:

```
green: < 1°
orange: ≥ 1° and ≤ 2.29°
red: > 2.29°
```

Longitudinal Normal deviation – The standard deviation of the Normal longitudinal direction.

The traffic light indicates the quality of this individual criterion:

```
green: < 1.15°
orange: ≥ 1.15° and ≤ 2.29°
red: > 2.29°
```

Scan point distance – The standard deviation of the distance of the scan points from the plane that has been determined. This is a good measurement for noise.

The traffic light indicates the quality of this individual criterion:

green: < 4mm

orange: ≥ 4mm and ≤ 20mm

red: > 20 mm

17.4.18 Point

General tab

Name – The name of the object. The green **traffic light** right to the object name indicates that corresponding objects have been found other scans. If corresponding references have not been found, no traffic light will be displayed.

Layer – The representation layer on which the object is situated.

Point Properties tab

Global Coordinates – If checked, coordinates are displayed in the global coordinate system; else they are displayed in the coordinate system of the scanner.

Position – The position of the point.

Add GPS Position – Add GPS information to the point.

17.4.19 Point Fit

Global Coordinates – If checked, coordinates are displayed in the global coordinate system; else they are displayed in the coordinate system of the scanner.

Point Name – The name of the corresponding point.

Name – The name of the fit object.

Position – The position determined by the fit.

Number of scan points – The number of scan points in the selection used for the fit.

The traffic light indicates the quality of this individual criterion:

For (contrast) mean points:

green: > 80 points

orange: ≥ 20 and ≤ 80 points

red: < 20 points

For checkerboard points:

green: > 400 points

orange: ≥ 100 and ≤ 400 points

red: < 100 points

GPS Position – Enable to add a GPS position to the object.

Format – Select to enter the GPS position either as coordinates decimal degree notation or UTM format.

Position – the GPS position decimal degree notation or UTM format.

Altitude – The altitude above sea level of the position.

Accuracy - The accuracy of the position.

Only bright points – Is set for the contrast mean point of a selection.

Objects – When creating an intersection point, the fit is depending on the properties of the corresponding plane. This dependency is listed here.

17.4.20 Sphere

General tab

Name – The name of the object. The green **traffic light** right to the object name indicates that corresponding objects have been found other scans. If corresponding references have not been found, no traffic light will be displayed.

Use for Place Scans, Correspondence Search and Automatic Name – The object will be used for the registration. Correspondence relationships to this object are enabled and its name will automatically be changed if corresponding objects have been found or the name of a corresponding object has been changed.

Local reference objects will have this option activated by default if their name has not been changed by the user manually.

Use for Place Scans and Correspondence Search – The object will be used for registering scans, correspondence relationships to this object are enabled but its name will not be changed automatically. This means that the name of this object is fixed and corresponding reference objects other scans will be named accordingly.

Global reference objects and local references which have been (re-)named manually will have this option activated by default.

Use for Place Scans – The object will only be used for registering scans but excluded from any correspondence search. Its name will not be changed automatically.

Ignore for Place Scans – The object will not be used for registering scans and is excluded from any correspondence search. Its name will not be changed automatically.

These options are relevant for the automatic correspondence search and for the registration of scans which are only available SCENE.

Layer – The representation layer on which the object is situated.

Sphere tab

Global Coordinates – If checked, coordinates are displayed in the global coordinate system; else they are displayed in the coordinate system of the scanner.

Radius – The radius of the sphere.

Position – The position of the sphere mean point.

17.4.21 Sphere Fit

Global Coordinates – If checked, coordinates are displayed in the global coordinate system; else they are displayed in the coordinate system of the scanner.

Sphere Name – The name of the corresponding sphere.

Name – The name of the fit object.

Radius – The sphere radius determined by the fit.

Position – The position of the sphere mean point determined by the fit.

Number of scan points – The number of scan points in the selection used for the fit.

The traffic light indicates the quality of this individual criterion:

```
green: > 80 points

orange: ≥ 20 and ≤ 80 points

red: < 20 points
```

Radius deviation – The standard deviation of the radius, which is determined using the interim results of the fit.

The traffic light indicates the quality of this individual criterion:

```
green: < 1mm
orange: ≥ 1mm and ≤ 4mm
red: > 4mm
```

Position deviation – The standard deviation of the position of the sphere mean point, which is determined using the interim results of the fit.

The traffic light indicates the quality of this individual criterion:

```
green: < 15mm
orange: ≥ 15mm and ≤ 80mm
red: > 80mm
```

Scan point distance – The standard deviation of the distance of the scan points from the calculated sphere surface.

The traffic light indicates the quality of this individual criterion:

```
green: < 4mm
orange: ≥ 4mm and ≤ 20mm
red: > 20mm
```

Scan point drift – The average distance of the scan points from the calculated sphere surface. Scan points outside the sphere can be averaged out with scan point within the sphere.

The traffic light indicates the quality of this individual criterion:

```
green: < 1mm
orange: ≥ 1mm and ≤ 5mm
red: > 5mm
```

GPS Position – see fit of point object chapter Point Fit on page 294.

17.4.22 Clipping Box

General tab

Clipping – Select between hiding the points outside the Clipping Box (hide exterior) or inside the Clipping Box (hide interior).

Clipping Box enabled – Enable or disable clipping of the Clipping Box. When disabled, the points hidden by this box will be displayed again; the color of the Clipping Box boundaries and its icon in the **Structure View** change to gray.

Clipping Box visible – toggle visibility of the Clipping Box. Disabling the visibility of a Clipping Box will only hide its boundaries; the Clipping Box is still active (if clipping is enabled) and it still has effect on the visibility of the points in the 3D View.

Transformation tab

Position – The translation portion of the transformation

- **X** To key in a transformation the x direction.
- **Y** To key in a transformation the y direction.
- **Z** To key in a transformation the z direction.

Scroll bar – Set the transformation using the mouse. The direction of the transformation will be the x, y or z coordinate that is highlighted in yellow.

Each tick increments by – Set the increment for the scroll bar.

Rotation Angle – The angle of rotation if the rotation axis is split along the coordinate axes.

- **X** The angle of rotation around the x axis.
- **Y** The angle of rotation around the y axis.
- **Z** The angle of rotation around the z axis.

Scroll bar – Set a new angle of rotation.

To change a value, you can either enter the required value directly into the appropriate field, or you first select the field and then use the corresponding slider to change the value step by step. You can set the increment using the drop-down box. If you hit the edge with the slider, simply reselect the field and the slider will return to the center without you losing your previous changes.

Axis snap – If checked, you can change the rotation for the current axis independently from the others. This is achieved by changing the order in which the rotations are applied.

Global Coordinates – If checked, coordinates are displayed in the global coordinate system; else they are displayed in the coordinate system of the scanner

17.4.23 Documentation Object

Global Coordinates – If checked, coordinates are displayed in the global coordinate system; else they are displayed in the coordinate system of the scanner.

Position – determines the position of the documentation object in the workspace.

Description – detailed information about the documentation object.

Hyperlinks – hyperlinks to files or web sites. Add a new hyperlink by entering its address into the lower text field, then press **Add**. You can change the order of the hyperlinks with **Up / Down**, delete them with **Remove** or open them by double-clicking on the list item or by selecting the **Open** button.

17.4.24 Virtual Scan (3D Picture)

General tab

Name – The name of the object. The green **traffic light** right to the object name indicates that corresponding objects have been found in other scans. If corresponding references have not been found, no traffic light will be displayed.

Use for Place Scans, Correspondence Search and Automatic Name — The object will be used for the registration. Correspondence relationships to this object are enabled and its name will automatically be changed if corresponding objects have been found or the name of a corresponding object has been changed.

Local reference objects will have this option activated by default if their name has not been changed by the user manually.

Use for Place Scans and Correspondence Search – The object will be used for registering scans, correspondence relationships to this object are enabled but its name will not be changed automatically. This means that the name of this object is fixed and corresponding reference objects in other scans will be named accordingly.

Global reference objects and local references which have been (re-)named manually will have this option activated by default.

Use for Place Scans – The object will only be used for registering scans but excluded from any correspondence search. Its name will not be changed automatically.

Ignore for Place Scans – The object will not be used for registering scans and is excluded from any correspondence search. Its name will not be changed automatically.

These options are relevant for the automatic correspondence search and for the registration of scans which are only available in SCENE.

Layer – The representation layer on which the object is situated.

Scan tab

Size – The number of columns and rows. If a scan is loaded in reduced resolution, the reduced number of columns and rows is displayed and, in light gray underneath, the complete number of columns and rows.

Data loaded –indicates whether the scan is loaded.

Reference Scan –indicates whether the scan is used as a reference scan for registration.

Scan Fixed – Mark the scan alignment as fixed and exclude it from further automatic registration attempts.

Scanner Dist. Range – range of the scanner.

Scanner Position – The position of the scanner with the mirror being the point of origin.

Orientation Axis – Rotation axis of the scan.

Orientation Angle – The scan's angle of rotation.

Recording Date – The time the scan was recorded.

Scan Orig info – Additional information on the origin of the scan, for example, where it was recorded and information about issues (scanner warnings or errors) that occurred during recording of the scan.

Info – Further details that were provided when recording.

Chapter 18: Error Messages

The application must be started once by someone with sufficient privilege to register controls. Otherwise several modules won't work as expected. You should at least have "Power User" rights. – SCENE must be started at least once by a power user or administrator to ensure all functions can be executed smoothly.

Version of model is not supported – The workspace was saved with a later version of SCENE and cannot be read by your version. Use a later version of SCENE.

Version of scan is not supported – The scan was saved with a later version of SCENE and cannot be read by your version. Use a later version of SCENE.

Failed to rename 'Scan'. Renaming scan files is not permitted! – You cannot rename scans.

One or several objects failed to read in successfully. Please check properties of marked objects. – The workspace contains scans that do not exist as a file.

Not all contents of 'Object' were copied successfully. One or several children are bound to their original location. — When copying objects that were created by a fit, it is not possible to also copy the fit object to the new location.

The move request was rejected, because either 'Object' or one of its children is bound to its current location. – Some objects cannot be moved or copied to different locations, for example fit objects, or unloaded pictures.

Chapter 19: Frequently Asked Questions

Why can I not rename scans?

scans in the workspace must have the same name as the corresponding scan file on your data medium. You cannot rename the scan file at the same time as the scan the in workspace because scans can be used in several workspaces simultaneously.

Why do I always get the message "Load data reduced size" when loading scans?

Check settings the under **Tools > Options > Scan Data**. The maximum scan size permitted is set there. You can lift the size restriction by setting the setting to **unlimited**.

Why does my license not work any more?

The license is linked to the Ethernet address of your network card. When checking the license, SCENE compares the Ethernet address of the network card with the saved license. Unfortunately, a lot of network cards hide the Ethernet address if you are not physically connected to a network.

Why is the scan loaded even when starting a Quick View?

The **Quick View** is normally saved in the scan. If this is not the case for a scan, SCENE has to first load the scan before it can display the **Quick View**. If the security settings permit it, SCENE then writes the **Quick View** in the scan, so that next time you open the **Quick View**, it is no longer necessary to load.

When I call the context menu, why do I sometimes get the dialog to select the object?

If several objects are lying next to one another or objects are lying within the selection, SCENE has to ask which object you mean.

Why can I no longer load some scans?

Some virus scanners have problems with the extensive scan files. Disable the virus scanner when working with SCENE.

Why do I get a black window when opening the 3D View?

SCENE requires a graphics card that supports OpenGL 2.0 or higher. If your graphics card supports older versions only, the 3D View might not work on it. Switching off the advanced textures and/or off-screen rendering under **Tools** > **Options** > **View** might solve this. When switching off advanced textures, the stereoscopic view is not available anymore. When switching off onscreen rendering, the stereoscopic view, the clear view and gap filling are not available anymore.

Why is the rendering performance in the 3D View slow or intermittent?

On systems equipped with NVIDIA Quadro graphics processors, rendering performance in 3D View might be slow or intermittent. In order to improve rendering performance, start the NVIDIA Control Panel application (available in the Windows Control Panel) and select the global preset 3D App – Game Development from the Global Settings tab.

Why don't I get the most current position and orientation when I open an fls scan file in a 3rd party application?

Point data and transformation information for scans may be stored in separate revisions. If you want to make sure that an fls scan file contains the most current transformation, you need to use the command **Export as Project** in the context menu of the scans or scan folders.

Visit the FARO Customer Service area on the Web at www.faro.com to search our technical support database.

Chapter 20: Glossary

Context menu – a menu with commands that can be applied to the object selected. It appears if you click an object with the right mouse button.

Fit object – an auxiliary object created by the **object fit** that stores the selection used for the fit and the quality values of the fit.

Folder – an object type which stores any objects other than scans. It is similar to the Windows file system folder. The complement to this is the **Scan Folder**, in which scans are received.

Layer – is used to draw a grouping of objects in order to be able to control the visibility of objects.

Measurements – in the **Structure View** a visible object of the **workspace**. It contains the measurement logs.

Menu bar – the top horizontal section in the SCENE screen. The menu bar contains all the menus with commands for the general operation. Further commands can be found in the **toolbars** and **context menus**.

Models – in the **Structure View** a visible object of the **workspace**. It contains the CAD objects.

Object – Objects are abstract shapes included in a scan, like spheres, planes, slabs.

Object fit – ascertaining the best fitting object parameters possible from the scan points.

Project Point Cloud – consists of the points of all the scans within a scan project and can be seen as a comprehensive point cloud of the complete scan project. It is typically created from all the single scans in the project after they have been preprocessed, colorized and registered.

Registration – Registration means the process of determining the spatial relationship between scans.

References – in the **Structure View** a visible object of the **workspace**. It contains the reference objects for positioning scans (for example, survey coordinates) and should not be renamed.

Scan Folder – An object type that receives scans. It is similar to the Windows file system folder. The complement to this is the **folder**, in which all other objects are received.

Scan – A scan is the scan file as it is recorded by the scanner with its millions of data records that include position, reflectance, and color for single scan points. A scan consists of scan points that were recorded from a single scanner location. Its points are organized in a row column order.

Scan Point Cloud – A scan point cloud is an alternative representation of a scan. It has to be created from a single scan and is organized in a spatial data structure that facilitates fast visualization of scan points and automated point loading based on point visibility.

Scan Project – In SCENE a scan project can be seen as a central storage which contains all the shared data of a project that all team members can access. This includes the project workspace, scan project revisions, the project point cloud, SCENE WebShare Cloud data and much more.

Scans – a visible object of the **workspace** in the **Structure View**. It is a kind of **Scan Folder** and contains **Scans**.

Status bar – the bottom horizontal section on the SCENE screen. The status bar displays command details or responses to the last command executed as well as scan point data.

Structure View – shows the structure of the **workspace**, including subfolders and objects.

Target – scan points or objects in a scan which can be used for registration.

Toolbar – a toolbar has buttons with which you can easily start commands. SCENE has many toolbars, which you can hide or unhide where necessary. Toolbars are mostly situated the in upper area of the screen, below the **menu** har

Workspace – the combination of all data required to process and analyze scans. This includes scans, CAD data, survey data, measurement results and much more.

Project Workspace – is the workspace of the centrally provided scan project. It contains the shared data of the scan project.

Local Workspace – contains private and non-shared data owned and is maintained by the individual user. It is typically saved to the local hard disk of the individual user and is linked to a centrally provided scan project. Changes done on the basis of a local workspace will not change the data of the scan project until it is explicitly shared with the scan project. Sharing the local changes with the scan project will update the project data and the project workspace accordingly.

Appendix A: Technical Support

FARO Technologies, Inc. is committed to providing the best technical support to our customers. If you have any problem using one of our products, follow these steps before contacting our Technical Support Team:

- Be sure to read the relevant sections of the documentation to find the help you need.
- Visit the FARO Customer Care area on the Web at www.faro.com to search our technical support database. This is available 24 hours a day 7 days a week.
- Document the problem you are experiencing. Be as specific as you can. The more information you have, the easier the issue will be to solve.
- Email or faxes sent outside regular working hours usually are answered before 12:00 p.m. In the next working day. Should our staff be on other calls, leave a voice mail message; calls are always returned within 24 hours. Remember to leave a detailed description of your question. Do not forget to include your name, fax number, telephone number and extension so we can reach you promptly.

North America Support Hours (Monday through Friday)

8:00 a.m. to 7:00 p.m. Eastern Standard Time (EST)

email: support@faro.com

Phone: +1 800 736 2771, +1 407 333 3182 (Worldwide)

Mexico: 866-874-1154 Fax: +1 407-562-5294

Europe Support Hours (Monday through Friday)

8:00 a.m. to 5:00 p.m. Central European Standard Time

(CET)

email: support.emea@faro.com

Phone: +800 3276 7378, +49 7150 9797-400

(Worldwide)

Fax: +800 3276 1737, +49 7150 9797-9400 (Worldwide)

Asia Support Hours (Monday through Friday)

8:30 a.m. to 5:30 p.m. Singapore Standard Time (SST)

email: supportap@faro.com

Phone: +1 800 511 1360, +65 6511 1350 (Worldwide)

Fax: +65 6543 0111

Japan Support Hours (Monday through Friday)

9:00 a.m. to 5:00 p.m. Japan Standard Time (JST)

email: supportjapan@faro.com

Phone: +81 561 63 1411 (Worldwide)

Fax: +81 561 63 1412

China Support Hours (Monday through Friday)

8:30 a.m. to 5:30 p.m. China Standard Time (CST)

email: supportchina@faro.com

Phone: +400.677.6826

Fax: +86 21 6494 8670

India Support Hours (Monday through Friday)

9:30 a.m. to 5:30 p.m. India Standard Time (IST)

email: supportindia@faro.com

Phone: 1800.1028456 Fax: +91 11.4646.5660

End User Documents

All documents related to the Software End User License Agreement, Purchase Conditions, and FARO Products Service Policy can be found on the FARO Knowledge Base at the following URL:

knowledge.faro.com/Essentials/General/FARO_End_User_License_Agreeme

nt_Location.

Appendix B: Software License Agreement

This Software License Agreement is part of the Operating Manual for the product and software System which you have purchased from FARO TECHNOLOGIES, INC. (collectively, the "Licenser") By your use of the software you are agreeing to the terms and conditions of this Software License Agreement. Throughout this Software License Agreement, the term "Licensee" means the owner of the System.

- I. The Licenser hereby grants the Licensee the non-exclusive right to use the computer software described in this Operating Manual (the "software"). The Licensee shall have no right to sell, assign, sub-license, rent or lease the software to any third party without the Licenser's prior written consent.
- II. The Licenser further grants the Licensee the right to make a backup copy of the software media. The Licensee agrees that it will not decompile, disassemble, reverse engineer, copy, transfer, or otherwise use the software except as permitted by this section. The Licensee further agrees not to copy any written materials accompanying the software.
- III. The Licensee is licensed to use the Software only in the manner described in the Operating Manual. Use of the Software in a manner other than that described in the Operating Manual or use of the software in conjunction with any non-Licenser product which decompiles or recompiles the software or in any other way modifies the structure, sequence or function of the software code, is not an authorized use, and further, such use voids the Licenser's set forth below.
- **IV.** The only warranty with respect to the software and the accompanying written materials is the warranty, if any, set forth in the Quotation/Purchase Order pursuant to which the software was purchased from the Licenser.
- V. THIS WARRANTY IS IN LIEU OF OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE SOFTWARE AND WRITTEN MATERIALS. IN NO EVENT WILL THE LICENSER BE LIABLE FOR DAMAGES, INCLUDING ANY LOST PROFITS OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE SOFTWARE, NOTWITHSTANDING THAT THE LICENSER HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, THE LICENSER WILL NOT BE LIABLE FOR ANY SUCH CLAIM BY ANY OTHER PARTY.
- VI. In the event of any breach by the Licensee of this Agreement, the license granted hereby shall immediately terminate and the Licensee shall return the software media and all written materials, together with any copy of such media or materials, and the Licensee shall keep no copies of such items.
- VII. The interpretation of this Agreement shall be governed by the following provisions:
 - **A.** This Agreement shall be construed pursuant to and governed by the substantive laws of the State of Florida (and any provision of Florida law shall not apply if the law of a state or jurisdiction other than Florida would otherwise apply).
 - B. If any provision of this Agreement is determined by a court of competent jurisdiction to be void and non-enforceable, such determination shall not

affect any other provision of this Agreement, and the remaining provisions of this Agreement shall remain in full force and effect. If any provision or term of this Agreement is susceptible to two or more constructions or interpretations, one or more of which would render the provision or term void or non-enforceable, the parties agree that a construction or interpretation which renders the term of provision valid shall be favored.

C. This Agreement constitutes the entire Agreement, and supersedes all prior agreements and understandings, oral and written, among the parties to this Agreement with respect to the subject matter hereof.

VIII.If a party engages the services of an attorney or any other third party or in any way initiates legal action to enforce its rights under this Agreement, the prevailing party shall be entitled to recover all reasonable costs and expenses (including reasonable attorney's fees before trial and in appellate proceedings).

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Mohan Cooperative Industria Estate,

New Delhi-110044, India

Tel.: 1800.1028456

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