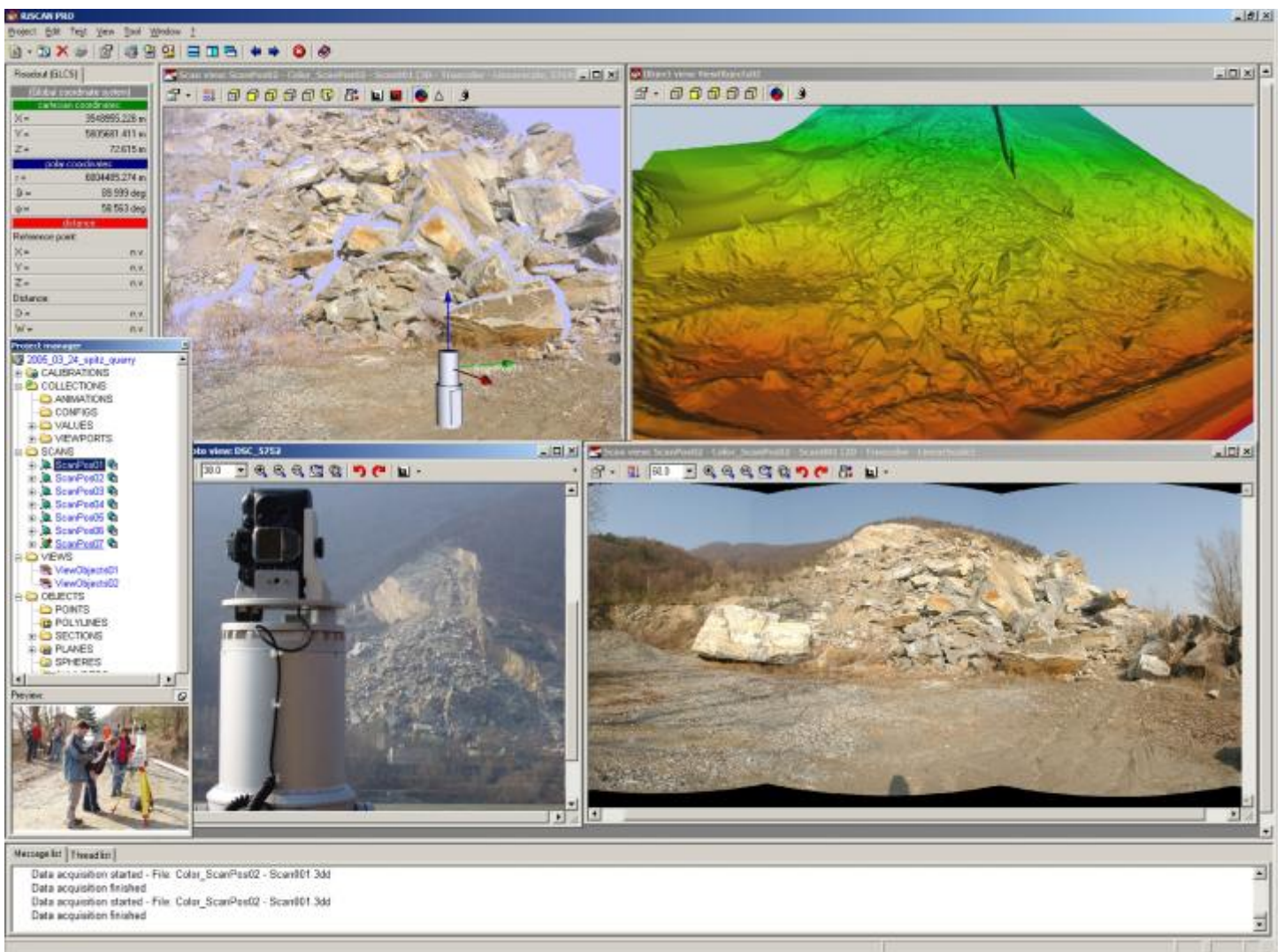


Operating & Processing Software

RiSCAN PRO

for RIEGL 3D Laser Scanners

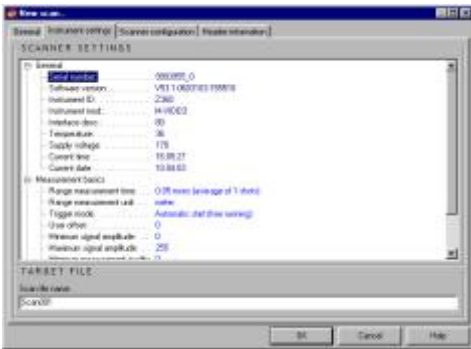


- Companion Software to RIEGL 3D Scanners LMS-Z210i, LMS-Z360i, and LMS-Z420i
- Data Acquisition, Visualization and Processing
- Interfacing to Post Processing Software
- Straightforward Global Registration

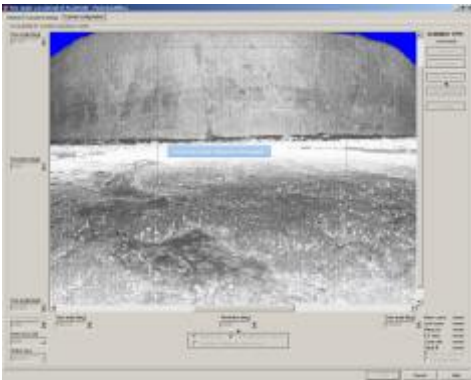


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General



Parameter setting of the scanner



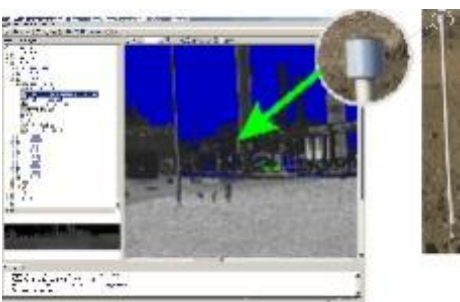
Preview for defining detail scan

RiSCAN PRO is the companion software for the *RIEGL*'s *LMS-Z* instrument series of 3D laser imaging scanner systems. RiSCAN PRO is project orientated, i.e., the entire data acquired during a measurement campaign are organized and stored in RiSCAN PRO's project structure. These data include the scan data itself, coordinates of control points and tie points, and all transformation matrices necessary to transform the data of multiple scans into a common well-defined coordinate system. Furthermore, in case the scanner is equipped with an optional High-Resolution 'HR' digital camera, camera images are also managed by RiSCAN PRO (see description of camera module for details). RiSCAN PRO is designed to minimize the acquisition time in the field while providing the tools for visual inspection of completeness of data coverage already in the field in 3D. Automated scans of signal points, e.g., reflecting targets, allow the user to embed the scan data into a predefined coordinate system with high precision in a straightforward way.

In addition to data acquisition RiSCAN PRO offers functionality to post process data. Included in the base package are functions to generate meshes from the point clouds representing the scan data, to attribute color information to every laser measurement, to generate undistorted and also merged high-resolution images for texturing the mesh, point cloud decimation, object construction from point clouds and many more.

RiSCAN PRO and its project structure and project file have been designed carefully to enable smooth data transfer to numerous post-processing packages (see details on already available packages capable of utilizing RiSCAN PRO's projects directly in the section "Interfacing to Post Processing Software"). The XML-based project file structure is published and well-documented thus enabling open access to all project information in an easy way. In conjunction with the available RiSCANLib also all scan data can be accessed in a convenient way.

Straightforward Global Registration



retro-reflective targets

GPS on top of the scanner



RiSCAN PRO allows the user to embed the scan data into a global coordinate system in a straightforward and flexible way. In general all *RIEGL* Laser Sensors provide their data in their own well-defined coordinate system. The user defines a project coordinate system which is subsequently embedded in a global coordinate system. The transition from a global to a project coordinate system is in most cases a mere translation and depending on the definition of the global coordinate system in some cases an exchange of coordinates too in order to have a right-handed project coordinate system with single precision coordinate values. RiSCAN PRO proposes a transformation matrix and thus a project coordinate system automatically on basis of the global coordinates of the control points.

Highest embedding accuracy is achieved by using retro-reflective targets of well-known coordinates (e.g., gained by surveying with a total station) and fine scanning at least 4 at each scan position. Thanks to the automatic reflector extraction and the auto-merging features of RiSCAN PRO registration of the scan positions can be achieved in the field allowing the operator to check the status of data acquisition and data coverage by building compact point cloud objects and view them in 3D. For applications where positioning of these control targets is inconvenient and the accuracy requirements are relaxed, scanner position can be gained via DGPS measurement and by levelling the instrument, thus reducing the degrees of freedom to one.

Data Visualization and Data Processing

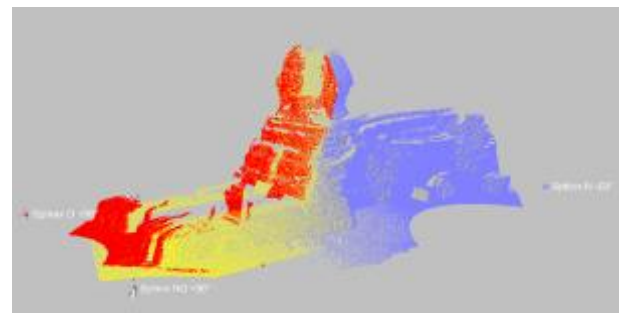
RiSCAN PRO provides different tools to visualize scan data and image data. Scan data are displayed on request online during data acquisition in 2D and 3D. For off-line visualization the scans can be viewed in 2D and 3D with various options for color-encoding, including the laser sensor's intensity, color-encoding by range or height, and color of the optional true-color channel. The 3D visualization feature allows the display of single scans but also multiple scans in a common coordinate system. In both views signalled points (tie points and control points) can be visualized. In 3D the scanner's own position and orientation is indicated by a 3D model of the sensor. Signalled points can also be displayed in the registered and calibrated images taken with the optional high-resolution digital camera and the camera module. RiSCAN PRO allows automated extraction of signalled points based on retro-reflective targets from scan data and from image data.

The original scan data can be addressed as organized point cloud with additional descriptors, e.g., intensity information. Due to the fast data acquisition rate of *RIEGL's* 3D laser sensors the number of points acquired tends to be quite large. RiSCAN PRO provides an octree-based filter to reduce the number of points of numerous scans by averaging all scandata within a volume element of definable size. These averaged point clouds are very useful for checking the completeness of data acquisition in the field. Point cloud data can be colored from the registered HR digital image. Point clouds can be segmented into smaller point clouds for modeling and exporting. Generation of meshed surfaces allows to move from the point cloud data to triangulated surfaces. By applying data cleaning algorithms the data quality can be improved. Further on, smoothing and subsequent decimation reduces noise in the data and reduces data size while

preserving predefined data accuracy. Meshed data contain again vertex related information such as intensity information and color information, but also include texture coordinates to map the high-resolution images onto the triangulated surface. RiSCAN PRO always provides geometric data, i.e., coordinates in cartesian or polar coordinates in different coordinate systems including the project coordinate system and the global coordinate system. Furthermore additional information on intensity and color can be retrieved, too. RiSCAN PRO allows the efficient generation of orthophotos with additional depth information. Information is retrieved from the scan data and the HR digital images to form a so-called true orthophoto with depth information which can be used in, e.g., CAD programs to construct 3D elements based on the orthophoto image.



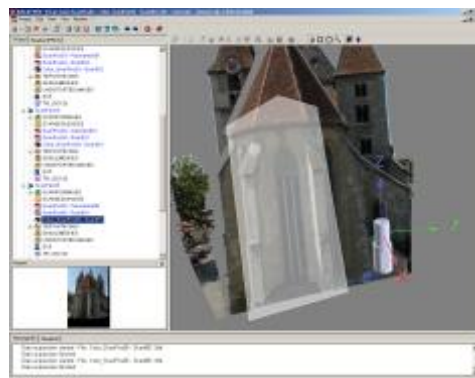
Colored point cloud in 2D view



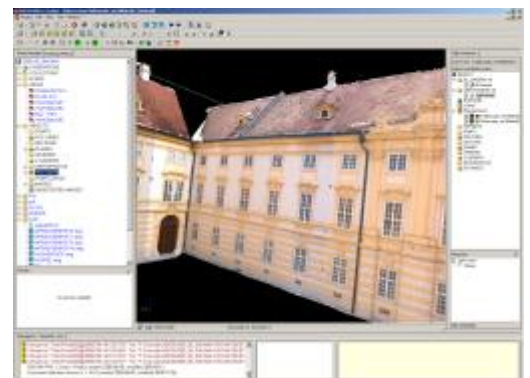
Object view of three different scans in 3D view, color coded



Read out panel with global coordinates



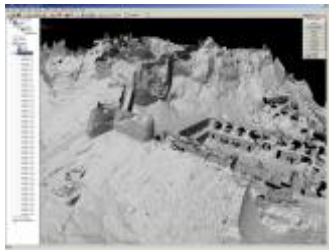
Colored point cloud with polygon filter



Textured mesh

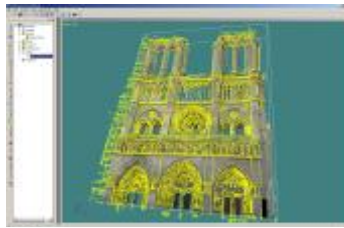
Interface to Post Processing Software

Mesh Processing



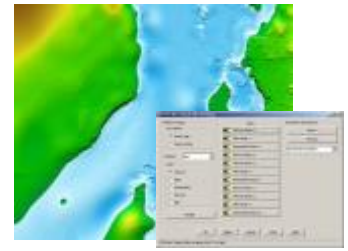
Polyworks (stand alone)
www.innovmetric.com

General Purpose Processing



Reconstructor and Surveyor
(stand alone) www.topotek.it

Terrain Modeling



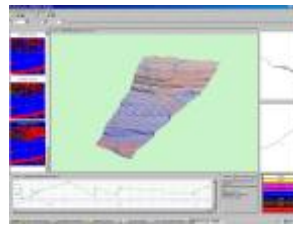
Scop ++ (stand alone)
www.ipf.tuwien.ac.at

Point Cloud Processing



Point Cloud (AUTOCAD plugin)
www.kubit.de

Monitoring and Analysis Software



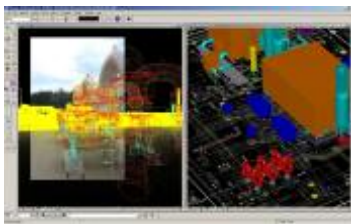
SiteMonitor (stand alone)
www.3dlasermapping.com

Orthophoto Processing



ScanDig3D (AUTOCAD plugin)
www.scanDig3D.com

3D Monoplotting



Phidias (Microstation plugin)
www.phocad.de

3D Mesh Processing



QT Sculptor (stand alone)
www.polygon-technology.de

3D Mesh Documentation



aSPECT 3D (stand alone)
www.arctron.com

System Requirements

Operating system:

Windows XP (recommended), Windows NT SP4 or Win2000 SP2 or above

Memory requirements:

256 MB RAM minimum, 1024 MB or more recommended

Disk space requirements:

5 GByte available on HDD

Interface for scanner communication:

TCP/IP interface (Serial and ECP parallel)

Graphics requirements:

OpenGL accelerated graphics, nVIDIA GeForce series recommended, GeForce 2 or better

Peripherals:

3 button mouse, optical scroll-wheel mouse recommended

Information contained herein is believed to be accurate and reliable. However, no responsibility is assumed by RIEGL for its use. Technical data are subject to change without notice. Data sheet, RiSCAN PRO, 21/09/05



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Camera Module

The combination of a high-performance laser imaging sensor with a high-resolution digital camera forms a measurement system providing the advantages of both fields: laser scanning and photogrammetry. The optional high-resolution digital camera is firmly mounted on top of the laser sensor.

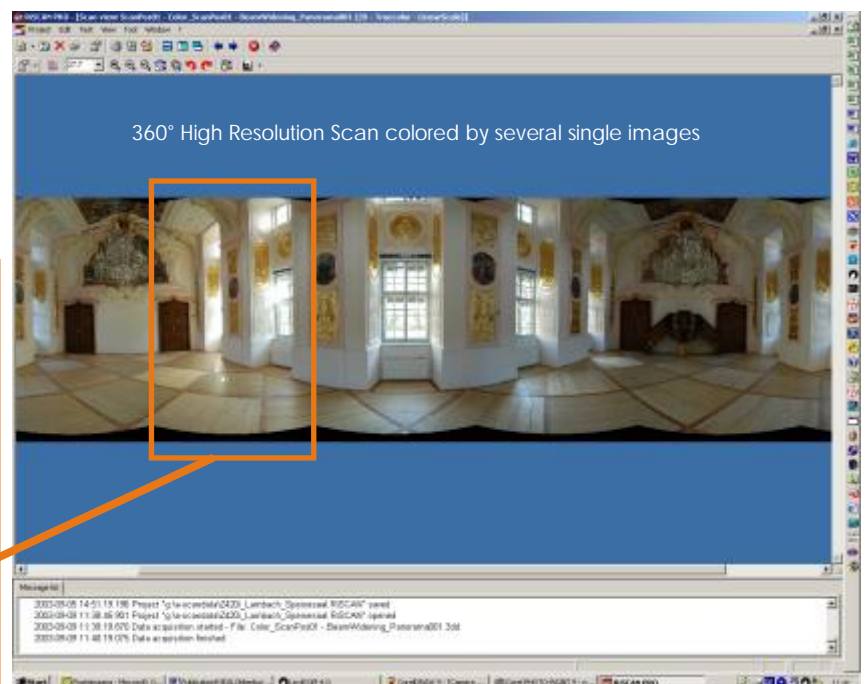
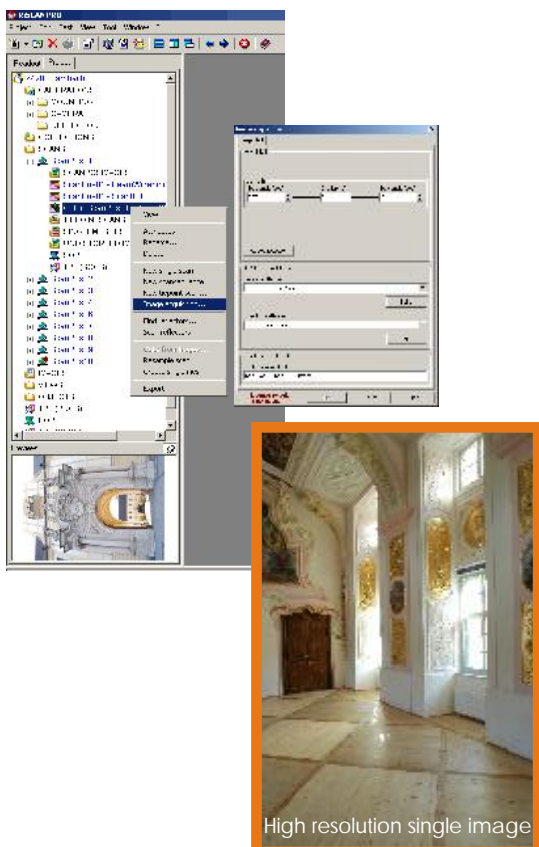
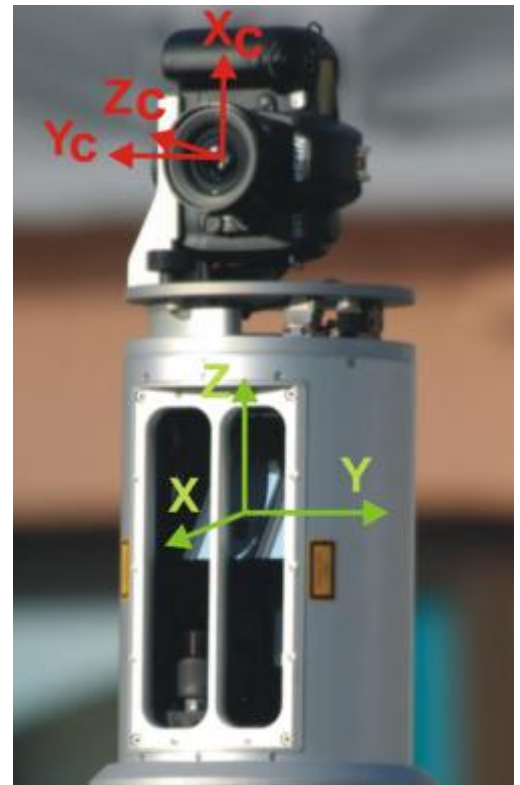
The camera module provides the access to the features of RiSCAN PRO related to the use of high-resolution digital images. The camera module contains the functions for on-line image acquisition and camera calibration.

After acquisition of the scan data, RiSCAN PRO takes a series of photos covering the field of view of the scan data. As the mounting position and orientation of the camera with respect to the scanner's coordinate system is well defined, every image represents a calibrated and registered image.

The image data can be used to assign a color to every vertex of the scan data or to apply the images as a high-resolution texture to the meshed surface generated from scan data.

The cameras are delivered already calibrated. In case a re-calibration is necessary, RiSCAN PRO's camera module provides the necessary features to perform the calibration task.

As the images are embedded in the open documented project structure with all information regarding image calibration and image registration documented and accessible, the images can be used also in 3rd party applications for, e.g., near-range photogrammetry.





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RiSCAN PRO
plugin

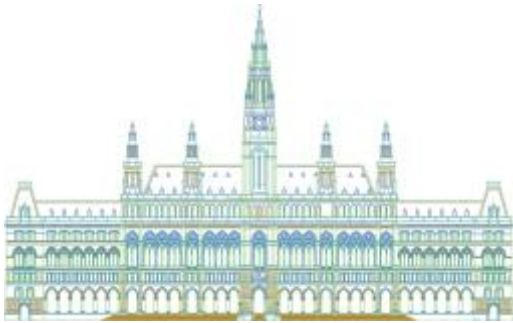
True - Orthophoto Module



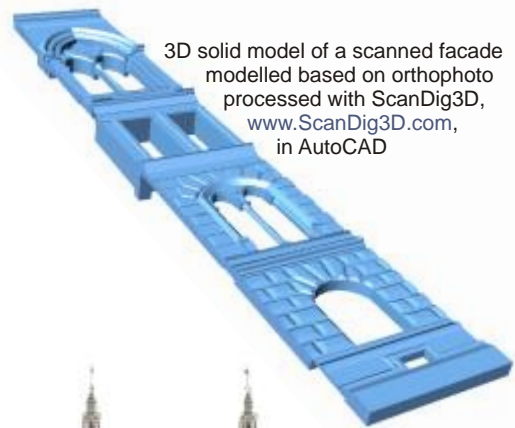
CITYGRID ORTHO

www.citygrid.at

This RiSCAN PRO plugin enables the user to create TRUE - ORTHOPHOTOS from scan data and image data. Additionally the module provides also depth information and orientation information in the project's coordinate system corresponding to the plane of projection of the orthophoto. This additional information stored in a separate well documented file provides the ability to reconstruct scanned objects in 3D based on the orthophoto directly in CAD applications, e.g., AutoCAD. Data generation is conducted by user-defined specification of orientation, position, resolution and size of the orthophoto to be calculated with depth information.



3D CAD drawing based on orthophoto processed with ScanDig3D, www.ScanDig3D.com, in AutoCAD.



3D solid model of a scanned facade modelled based on orthophoto processed with ScanDig3D, www.ScanDig3D.com, in AutoCAD



3D orthophoto computed out of 83 single scans and 88 digital images with an overall length of 155 metres and 98 metres in height.

Key Features:

- Fully integrated within RiSCAN PRO
- Processing of unlimited number of scans from different scan positions (depending on PC hardware performance)
- Sophisticated multistage triangulation algorithms considering edges
- Minimization of shadowing effects by consideration of object visibility
- Automated extrapolation of texture into shadowed areas
- Usability of free shot images
- Automatic color adjustment for smooth overall appearance



GEODATA
www.geodata.at



RIEGL
LASER MEASUREMENT SYSTEMS

RiSCAN PRO
plugin

Hybrid Multi-Station Adjustment Module

The module for hybrid multi-station adjustment within RiSCAN PRO is based on the program ORIENT developed at the Institute of Photogrammetry and Remote Sensing TU Vienna. ORIENT is a program system widely used to do rigorous adjustments in the field of photogrammetry.

The main objective of the hybrid multi-station adjustment feature is to minimize the overall error after adjusting the orientation and position of the scanner positions available in a project.

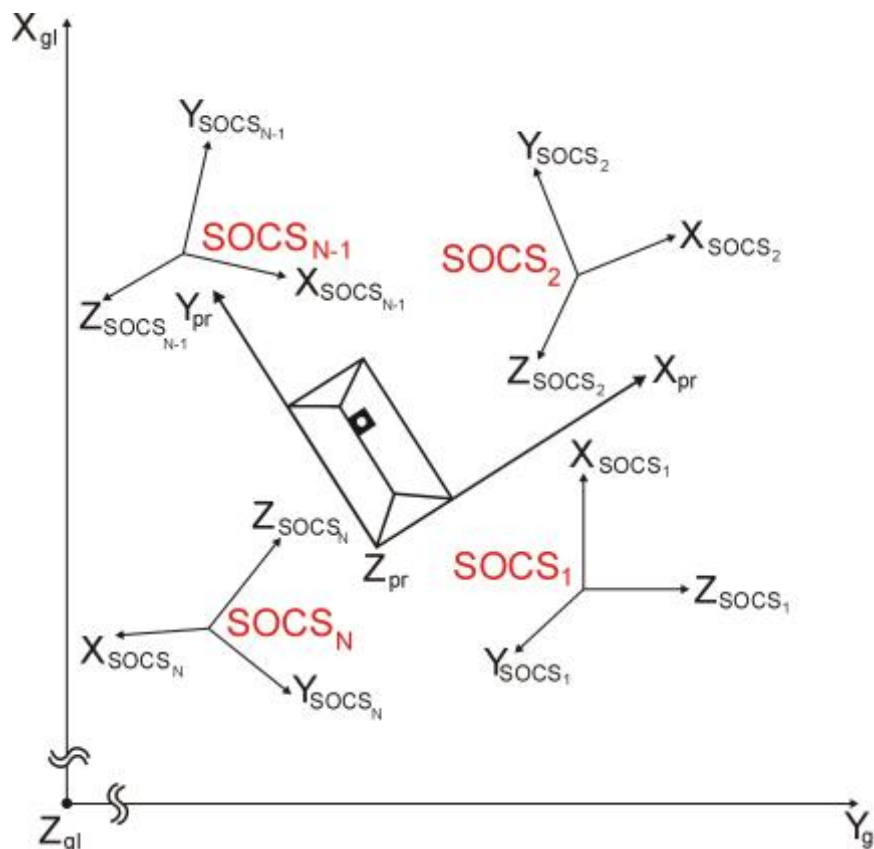
Many kinds of observations and/or parameters may be treated simultaneously. The subset of features required in the context of RiSCAN PRO include

1) observations, i.e., signal points in the scanner's own coordinate system SOCS, image points in calibrated images, control points in the project coordinate system PRCS stemming from, e.g., total station measurements and

2) parameters, i.e., orientation matrices of scanner positions (origin and rotations), object points in PRCS, and additional parameters as image deformation, mounting eccentricity and more.

ORIENT is smoothly integrated into RiSCAN PRO. It makes use of the pre-adjustment of RiSCAN PRO based on automatically matching scan positions using retro-reflecting targets. Furthermore, the module allows the user to include also control points and tie points showing up only in the high-resolution images, e.g., colored non-reflective signals, and it provides an extensive precision analysis for the adjustment.

Especially advantageous in registration tasks of long linear acquisition areas and/or chained acquisition sequences or arbitrary combinations of both.



Example of PRCS, GLCS, and a number of SOCS
at a site for scanning of a building