RIEGL-VZ ROS 2 Driver API

1. Coordinate Systems

RIEGL uses hierarchically structured coordinate systems:

SOCS (Scanner's Own Coordinate System): Angle data and range data are the base for calculation of the data in the Scanner's Own Coordinate System (SOCS).

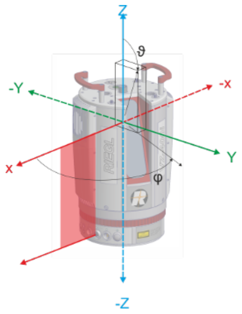

Figure 1: SOCS

PRCS (Project Coordinate System): A number of scan positions and the data acquired therein make up a scan project.The center of the project's coordinate system (PRCS) usually coincides horizontally with the center of the first scan position. The axes of PRCS are strictly pointing to east (x-axis, red), north (y-axis, green) and up (z-axis, blue), respectively.

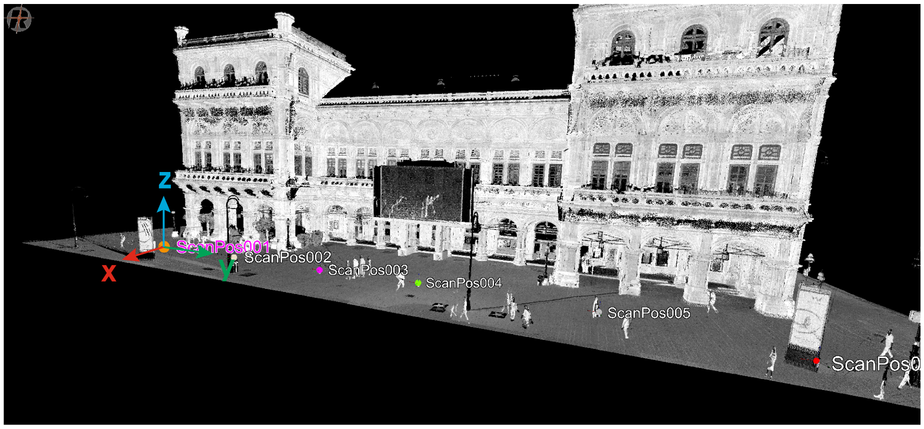

Figure 2: PRCS

VOCS (Voxel Coordinate System): This is an intermediate coordinate system. Origin and orientation are identical to PRCS at the first scan position. Each scan will be registered in the VOCS coordinate system.

- Every scan position is described by SOPV (Scan Orientation and Position in VOCS).
- The position of the VOCS is described by VOP (VOCS Orientation and Position in PRCS).
- With every scan the VOP, especially the orientation, will be readjusted.
- The SOP (Scan Position and Orientation in PRCS) has to be recalculated after each newly registered scan from SOPV and updated VOP.

```
SOCS ---
 |      |
sopv    |
 |      |
VOCS   sop
 |      |
vop     |
 |      |
PRCS ---
```

2. RIEGL Interfaces

2.1 Messages

riegl_vz_interfaces/Status:

```
uint8 scanner_errors           # number or pending errors on laser scanner
uint8 busy_state               # busy state: 0 - ready, 1 - busy with scan data acquisition
uint8 progress                 # progress of scan data acquisition or registration in perce
uint8 memory_usage             # memory usage of active storage media in percent
```

2.2 Services

riegl_vz_interfaces/GetPointCloud:

```
uint32 index   # The scan position number within a project
---
bool success   # indicate successful run of service
string message # informational, e.g. for error messages
PointCloud2 pointcloud
```

A negative index implicitly refers to the last scan position, 0 is the first scan position.
See PointCloud2 definition: sensor_msgs/PointCloud2

riegl_vz_interfaces/GetPoses:

```
---
bool success   # indicate successful run of service
string message # informational, e.g. for error messages
PoseStamped poses[]
```

See PoseStamped definition: sensor_msgs/PoseStamped
The 'frame_id' in the header is either 'SOCS' or 'VOCS'.

riegl_vz_interfaces/SetPose:

```
PoseStamped pose
---
bool success   # indicate successful run of service
string message # informational, e.g. for error messages
```

3. Nodes

3.1 riegl_vz

3.1.1 Parameters

~**hostname** (string, default: "") :

The scanners hostname or IP address.

~**working_dir** (string, default: "~/.ros_riegl_vz") :

The root working directory for runtime execution.

~**ssh_user** (string, default: "user") :

The linux user name for SSH login on the scanner.

~**ssh_password** (string, default: "user") :

The linux user password for SSH login on the scanner.

~**project_name** (string, default: "") :

The scan project name used by service 'set_project'. An existing project will be loaded, otherwise a new project will be created. If string is empty, a default project name will be composed from current local time and date.

~**stor_media** (integer, default: 2) :

The active storage media for scan data (1: AUTO, 2: INTERNAL SSD, 3: USB).

~**scan_pattern** (double[], default: {30.0,130.0,0.04,0.0,360.0,0.04})

Specifies the field of view (FOV) for scanning and the scan increments.
[0]: Line Start Angle
[1]: Line Stop Angle
[2]: Line Angle Increment
[3]: Frame Start Angle

[4]: Frame Stop Angle
[5]: Frame Angle Increment

~**meas_program** (integer, default: 3) :

This is the laser scanner measurement program, which specifies the laser scanner frequency.

~**scan_publish** (bool, default: “True”) :

Enable publishing of point cloud data on topic ‘pointcloud’ after scan acquisition has finished.

3.1.2 Published Topics

pointcloud (sensor_msgs/PointCloud2) :

Point cloud with scan data from the laser scanner in SOCS.

status (riegl_vz_interfaces/Status) :

Riegl VZ status information, published once per second.

3.1.3 Services

set_project (std_srvs/Trigger) :

Create a new or load an existing project on the scanner with name from parameter ‘~project_name’.

Response:
success = True -> message: Project Name
success = False -> message: Error Message

scan_and_register (std_srvs/SetTrigger) :

Start laser scan acquisition and registration within actual project. If parameter ‘~pointcloud_publish’ is enabled and laser scan has finished, scan data will be published on ‘pointcloud’ topic. Use ‘is_busy’ services to check if background tasks have finished or retrieve busy state on ‘status’ topic.

Response:
success = True -> message: success
success = False -> message: Error Message

is_scan_busy (std_srvs/SetBool) :

Check if scan data acquisition has finished, otherwise the device is locked. If ‘data’ in request is true, the call will block until background task has finished.

Request:
data: set blocking execution
Response:

success = True -> message: busy
success = False -> message: ready

is_busy (std_srvs/SetBool) :

Check if background tasks (scan data acquisition and scan registration) have finished, otherwise the device is locked. If 'data' in request is true, the call will block until background task has finished.

Request:
data: set blocking execution
Response:
success = True -> message: busy
success = False -> message: ready

get_pointcloud (riegl_vz_interfaces/GetPointCloud) :

Get point cloud of a previous scan data acquisition.

set_pose (riegl_vz_interfaces/SetPose) :

Set position of the scanner origin in a reference coordinate system. This is used for scan registration.

get_pose (riegl_vz_interfaces/GetPoses) :

Request position ([0] VOP, [1] SOPV) of the previously acquired scan.

get_all_poses (riegl_vz_interfaces/GetPoses) :

Request positions ([0] VOP, [1] SOPV1, [2] SOPV2,. . . , [n] SOPVn) for all previously acquired scans in actual project.

stop (std_srvs/Trigger) :

Stop laser scan data acquisition and registration background tasks.

Response:
success = True -> message: "RIEGL VZ has been stopped"

shutdown (std_srvs/Trigger) :

Stop data acquisition and power down the laser scanner.

Response:
success = True -> message: "RIEGL VZ is shutting down"

3.1.4 Extension

Not available in first implementation but for further extension:

- Providing covariance of pose (see sensor_msgs/PoseWithCovarianceStamped)
- Additional parameters:

~**msm** (integer, default: 1) :

The scan data MSM (monitor step multiplier), used for point cloud data reduction, default disabled.

~**capture__images** (bool, default: False) :

Enable capturing of camera images.

- Additional services:

get__voxel (riegl__vz__interfaces/GetPointcloud) :

Get voxel data of a previous scan data acquisition.

get__image (riegl__vz__interfaces/GetImage) :

Get camera image for scan position.

get__projectmap (riegl__vz__interfaces/GetImage) :

Get the project map overview image.