Laboration 2:
ASUS Xtion Pro: Calibration, noise characterization and filtering

Sensors and Sensing

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1 Introduction: Structured light cameras

Structured light cameras are a low-cost option for depth measuring in three dimensional space. The cameras project a known light pattern to a scene and record the reflection of that light pattern. This recorded data is then used for triangulation.

For this lab, the ASUS Xtion Pro sensor was used as a structured light camera.

2 Task and implementation

The task at hand was to set up and calibrating the sensor, as well as to characterize the noise in the depth measurement and to set up filtering routines.

2.1 Basic setup

To set up the camera, the package `openni2` for ros-indigo was used. When launching the node `openni2.launch`, it publishes a wide range of topics from the camera.

For this laboration, only the topics which publish a viewable image were of interest. This included two main topics:

- `/camera/rgb/`
  This topic publishes data from the RGB camera on the ASUS Xtion Pro. The topic `/camera/rgb/raw` shows the unprocessed RGB image like a regular camera. A sample image from this topic is shown in figure 2.1.
- `/camera/depth/`
  This topic publishes the depth data as a 2D-array of float variables containing the depth values in meters. A sample image from this topic is shown in figure 2.
- `/camera/depth_registered`
  This topic combines the RGB and the depth image into a coloured point cloud. A visualization of this topic through the tool `rviz` is shown in figure

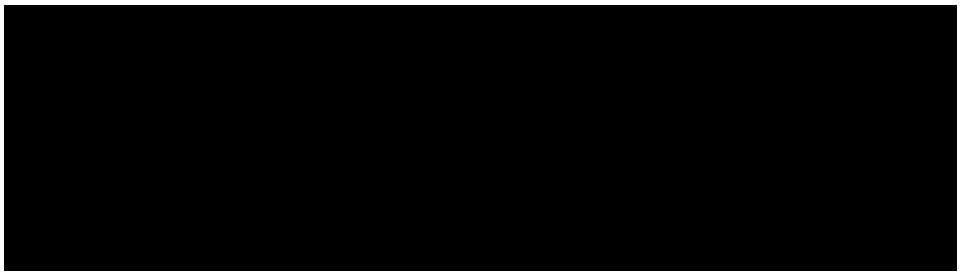

Figure 1: Output image of `/camera/rgb/raw`

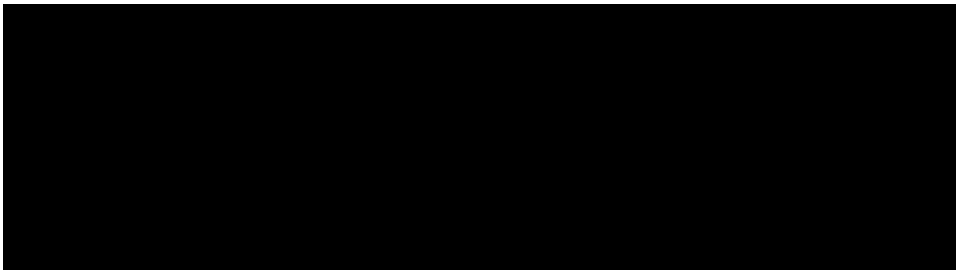

Figure 2: Output image of `/camera/depth/`

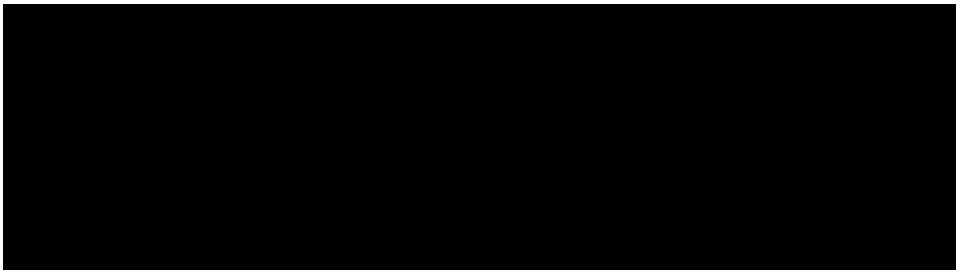

Figure 3: Screenshot of the vizualized pointcloud of `/camera/depth_registered`

2.2 Basic ROS node

After the basic setup, a ROS node template was used as a base to process the images and point clouds published. The received images are shown in figure 4 and figure 5.

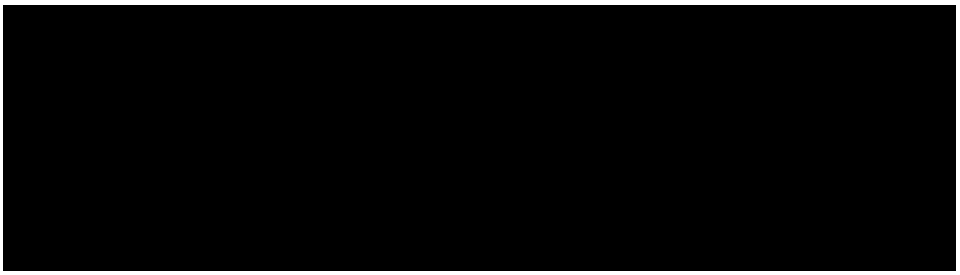

Figure 4: Save of the RGB image

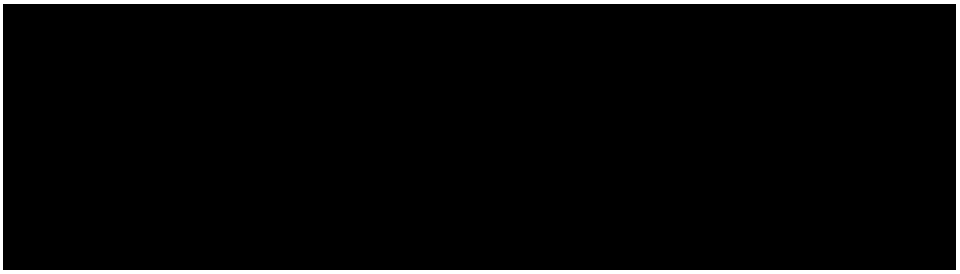

Figure 5: Save of the depth point cloud

2.3 Color Camera Calibration

2.4 Noise Characterization

2.5 Noise Filtering

In this part we applied several filters to the depth images in order to remove the noise from the measurement data. These filters are:

- Gaussian blur
- Median filtering
- Bilateral filtering
- Median over several image samples
- Average over several image samples

The effect on the image data after the application of the filters will be discussed in the following.

2.5.1 NaN values

If objects in the scene are closer than the minimum range of the camera allows