Surface reconstruction with laser scanner and accelerometer
Lab Report

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The measurement

Our task was to reconstruct a 3D surface with the help of a 2D laser scanner and a 2-axes accelerometer. The two sensors were mounted to the same measurement platform. The laser scanner returns with distance values of those points, which are intersecting points between an imaginary flat, circular shape around the head of the sensor and the environment. The standstill accelerometer helped to define the tilt angles of the measurement platform in two different directions.

Used equipment

- MATLAB software environment
- 2D laser scanner (Hokuyo URG-04LX-UG01)
- 2-axes accelerometer (Phidget 1053)
- the wall of an arbitrary carton-box

Phidget 1053

- dual axis accelerometer
- measure both dynamic acceleration and static acceleration
- measures ± 5 gravities change per axis [1]

Hokuyo URG-04LX-UG01

URG-04LX-UG01 is a laser sensor for area scanning. The scan area is 240° semicircle with the maximum radius of 4000 mm. [2]

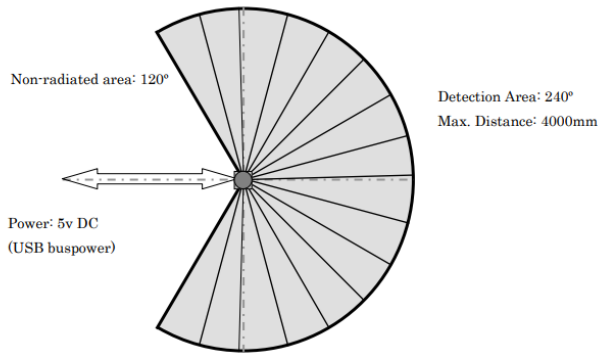

Figure 1: The detectable and non-radiated area of the scanner. [2]

Measurement method

The sensor was placed on a mounted surface and it was moved by hand. Approximately 20 different 2D plane was measured. Every plane included local coordinates. The measurement file contained 20 rows, correspond to the 20 different tilt angles and in every row there are 3 columns containing the x and y local coordinates and the tilt angles along the axis.

The 3D reconstruction

We loaded the "hokuyo_and_phidget_measurement_data.mat" file. Then, we converted the local x, y, z values of the data to global values. For that, the scheme was the following:
x_Global = x_Local;
y_Global = y_Local × cosine(tilt angle);
z_Global = y_Local × sine(tilt angle);

We created a 20x3 cell array for the global vectors from which we could plot the result of the reconstruction. As a last step, we excluded all the data points whose x or y absolute value was greater than 700.

Results

Figure 2. shows the result of the reconstruction. We can clearly see the bow in the middle, also if we look at the right hand side, we notice that the scanner also recorded the heater.

In the middle of the figure, there is a there is a distinct dot, which shows where the scanner was placed during the recording.

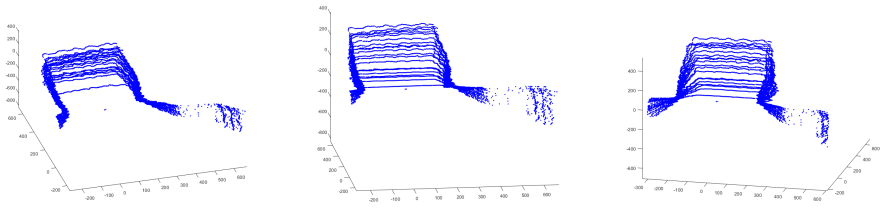

Figure 2: The result of the 3D reconstruction from different angles

Bibliography

[1] 1053 - PhidgetAccelerometer

[2] Scanning Laser Range Finder URG-04LX-UG01 (Simple-URG) - Specifications, 2009.