1 Introduction

PMD cameras are generally sensitive to background illumination and this is resulting in noisy data.

The questions that this paper tries to answer is:

- How much noise is in the depth data given from the PMD[vision]® 3k-S for different distances?
- Can this be lowered by increasing the integration time?
- The PMD[vision]® 3k-S has built in suppression of background illumination (SBI). How is this changing the results of the tests?
- Is this camera behaving the same way as the PMD[vision]® 19k?

2 Method

The camera was aimed at a flat surface, in this case a wall, and the data was analyzed to see how much the sampled points diverged from the surface. This was done for the distances 1.0, 1.5, 2.0 and 2.5 meters. Distances smaller than one meter tended to give very noisy data, and the size of the room limited the test to two and a half meter.

2.1 Distance

The distances are given from the camera center, not from the camera plane. This was corrected by calculating the relative 3d coordinates of the points, knowing the field of view.

This image shows points within a certain distance. This illustrates that points in the middle of the image has lower distances than the ones in the corners.

3 Results

distance (m) / int. time (µs)	5000	10000	20000	30000	40000
1	0.076	5.5	4.07	3.4	3.2
1,5	(0.98	1.4	11	15	15)
2	0.057	0.23	0.43	2.5	6.0
2,5	0.029	0.38	1.9	7.8	16

The sum of the square distances to the best fitting plane through the points.

distance (m) / int. time (µs)	5000	10000	20000	30000	40000
1	0.31	0.99	0.14	0.078	0.076
1,5	0.30	1.2	2.4	4.6	6.8
2	0.041	0.13	0.097	0.14	0.51
2,5	0.012	0.072	1.6	3.03	4.18

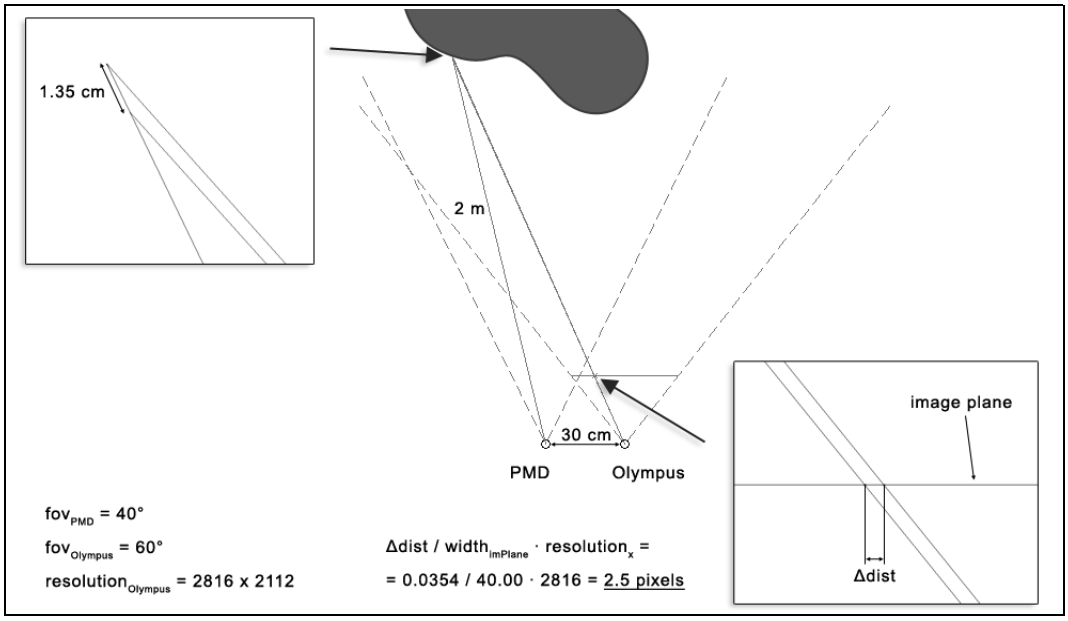
The same tests but after filtering the depth data with a 3x3 median filter. This shows that there are a relative low number of outliers that has a large affect on the error in the unfiltered result.

4 Example

Here an example is given to show how much the error in the depth data affects the rest of the scanning workflow. The setup for this example is the following:

- Distance: 2 m
- Integration time: 10000 µs
- Sum of square error: 0.2253 m
- Number of points: 1232, sqrt(0.2252 / 1232) = 0.01352, distance error: ca 1.35 cm

The aim is to see how much the search span increases in the right camera:



5 Conclusion

- The SBI removes much of the noise we saw in the depth data from the PMD[vision]® 19k.
- High integration times does not necessarily produce better data. Which we assumed for the PMD[vision]® 19k.
- The error given by noise is only producing a small increase of the search span in the 2d image.

6 References

- **PMDTechnologies GmbH**
  http://pmdtec.com
- **Fitting an Orthogonal Regression Using Principal Components Analysis**
  http://www.mathworks.com/products/statistics/demos.html?file=/products/demos/shipping/stats/orthoregdemo.html