



Noise in the PMD[vision]® 3k-S

Scanning real world objects without worries
TU-Berlin

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- Suppression of Background Illumination (SBI)
 - Extends the dynamic range by 40 dB
- Resolution: 64 x 48

Chip has a standard
which makes it easy
ation 2D data on top
map.

the camera can be
ys, depending upon
user.

ation can be calcu-
amera, with only 3D
erred to the PC.

utputted from the

Characteristics

- High Speed
- Active Suppression of Background Illumination
- High Frame Rate
- Distance and Grayscale Information for every Pixel
- 4:3 Image Ratio
- Low Cost



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- The distances are given from the camera center, not from the camera plane.
- The real coordinates are calculated by the depth map and the known field of view (fov).





- 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	0.076	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



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- Hard to draw a conclusion about the optimal integration time.
- Data processed internally in contrast to the "raw" output of the PMD[vision]® 19k.



- Unfiltered

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- Median filtered (3x3)

distance (m) / int. time (μ s)	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

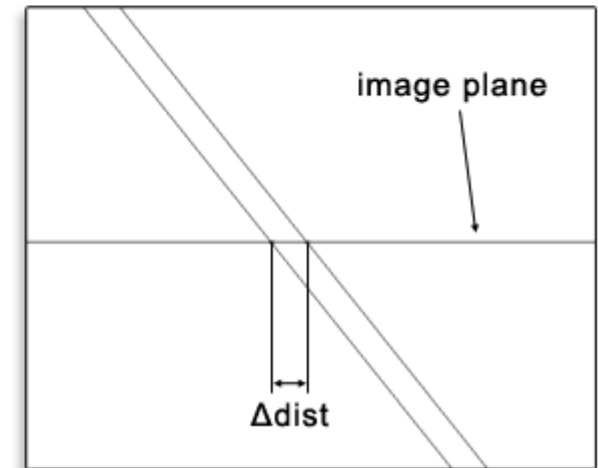
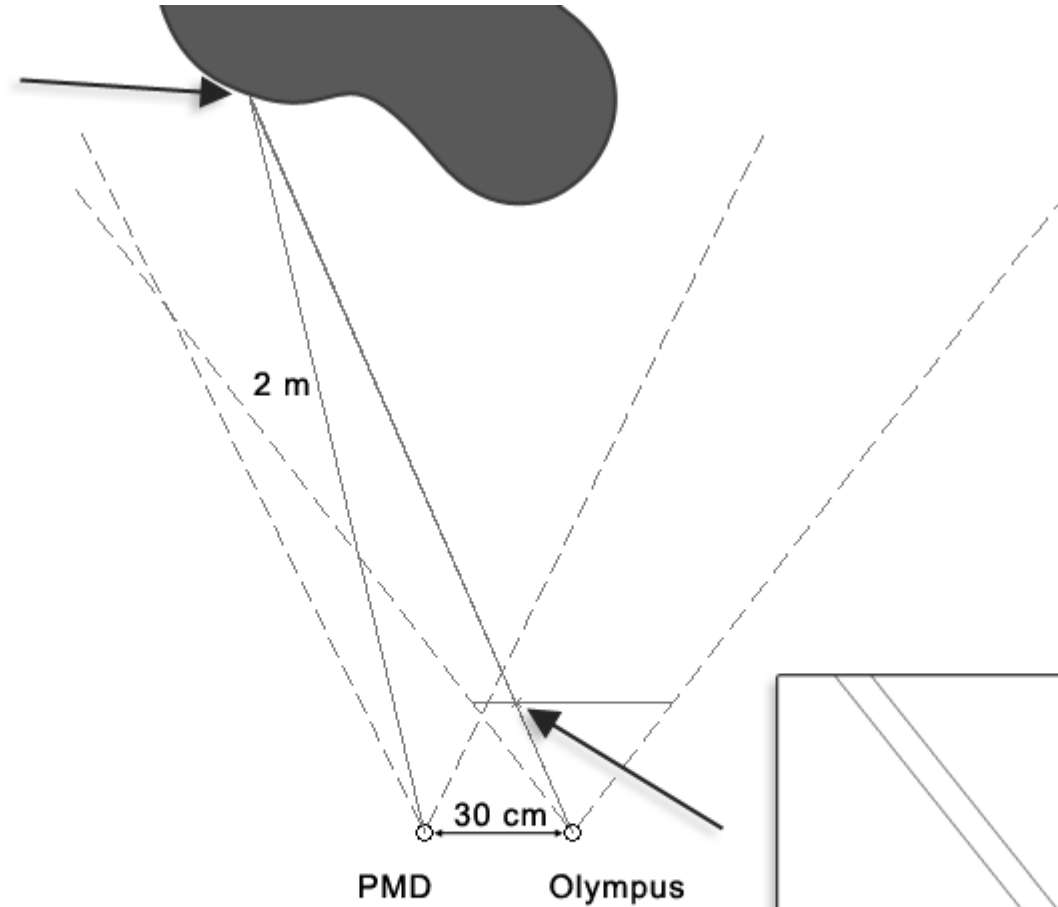
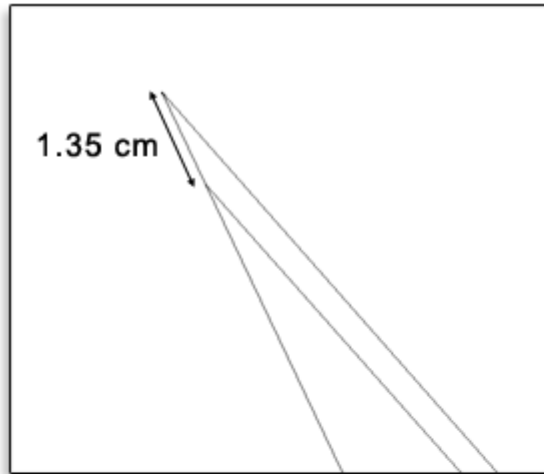


- Distance: 2 m
- Integration time: 10000 μ s
- SSE: 0.2253 m
Number of points: 1232 (not $64 \times 48 = 3072$ points, because of cropped image)

$$\text{sqrt}(0.2252 / 1232) = 0.01352$$

Distance error: ca 1.35 cm

Example



$$\text{fov}_{\text{PMD}} = 40^\circ$$

$$\text{fov}_{\text{Olympus}} = 60^\circ$$

$$\text{resolution}_{\text{Olympus}} = 2816 \times 2112$$

$$\begin{aligned} \Delta\text{dist} / \text{width}_{\text{imPlane}} \cdot \text{resolution}_x &= \\ &= 0.0354 / 40.00 \cdot 2816 = \underline{2.5 \text{ pixels}} \end{aligned}$$



- 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.



- 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>