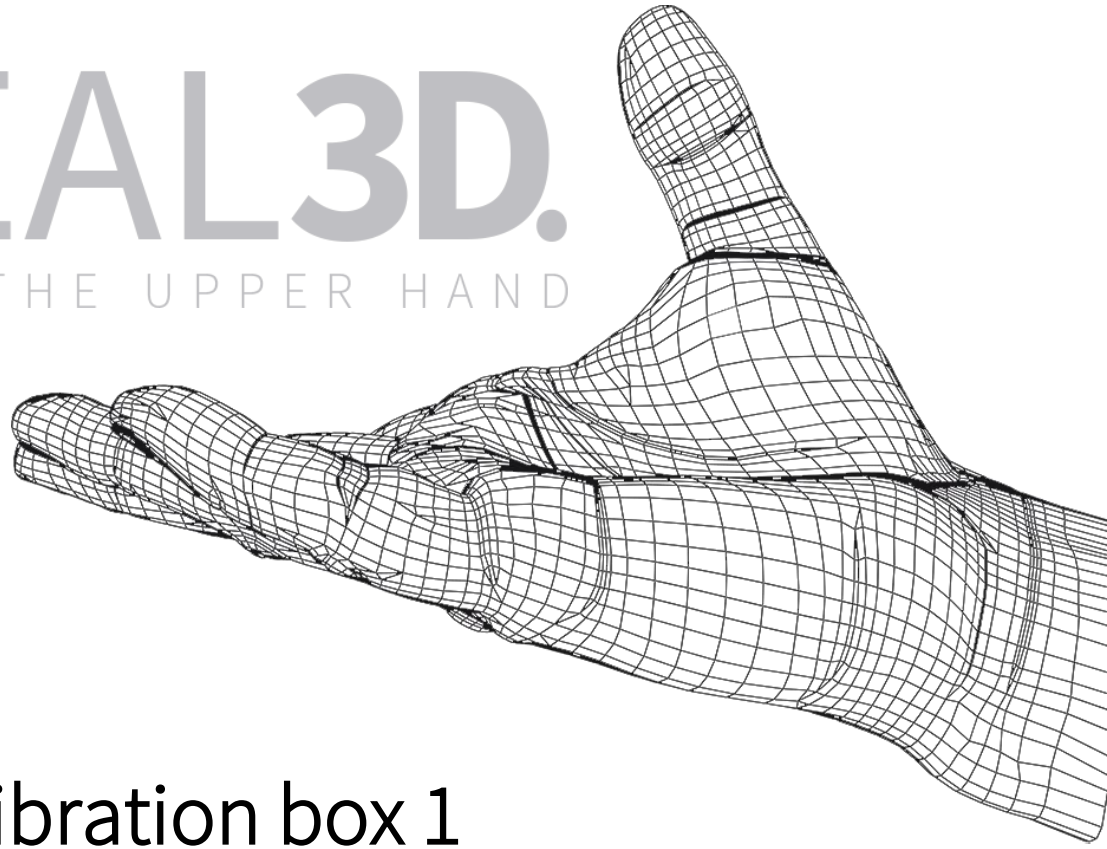
REAL3D.

GAIN THE UPPER HAND

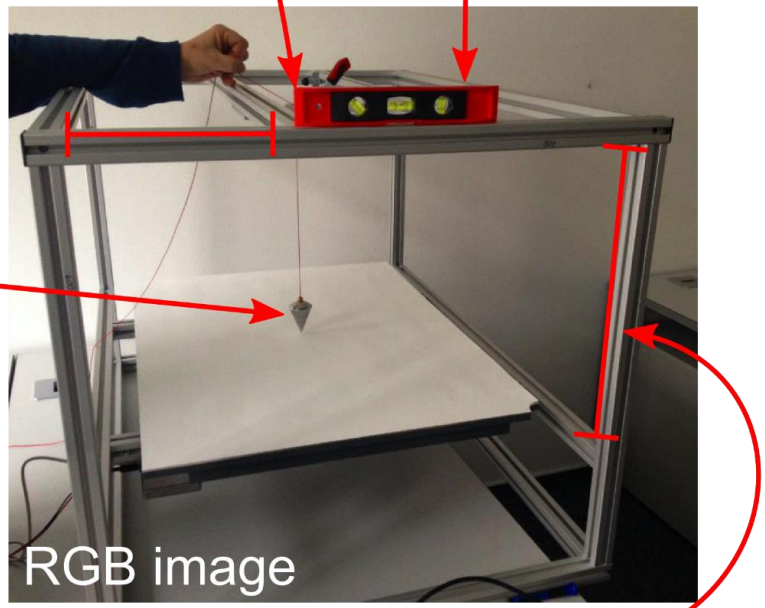


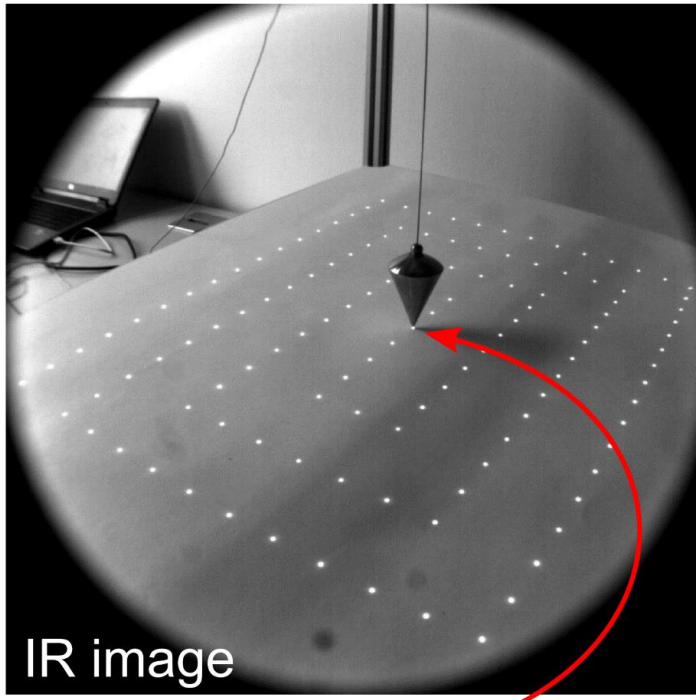
Calibration box 1

Alignment

pmdtechnologies – 2015-09-03

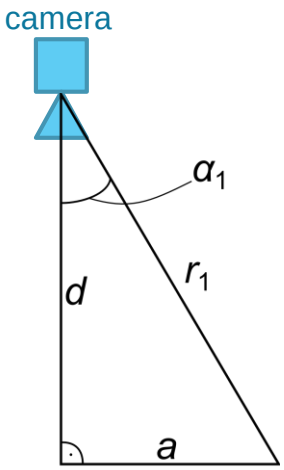
LED-Box alignment



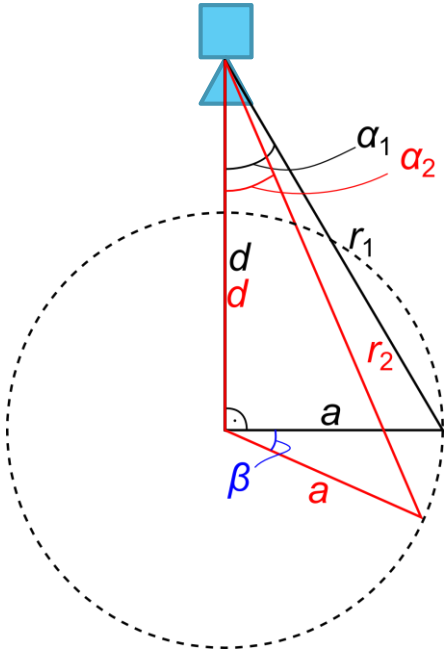


Tilt impact (1)

- The target plane needs to be leveled via spirit level. A “precision spirit level” with defined accuracy should be used. Misalignment leads to calibration errors.
- A tilt inaccuracy β leads to an angular calibration error (lens calibration) as well as an offset calibration error (FPPN):



- lens calibration relies on α_1 as inclination angle
- FPPN calibration relies on r_1 as true radial distance



- the angular error $\Delta\alpha$ due to tilt β is gives by:

$$\Delta\alpha = \alpha_2 - \alpha_1$$

with

$$\alpha_1 = \arctan\frac{a}{d}$$

$$\alpha_2 = \arcsin\left(\frac{a}{r_2}\cos\beta\right)$$

- the FPPN error Δr is given by:

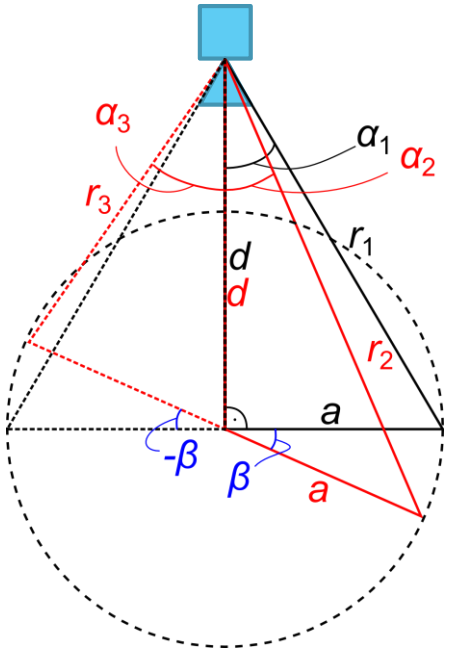
$$\Delta r = r_2 - r_1$$

with

$$r_1 = \sqrt{a^2 + d^2}$$

$$r_2 = \sqrt{a^2 + d^2 + 2ad\sin\beta}$$

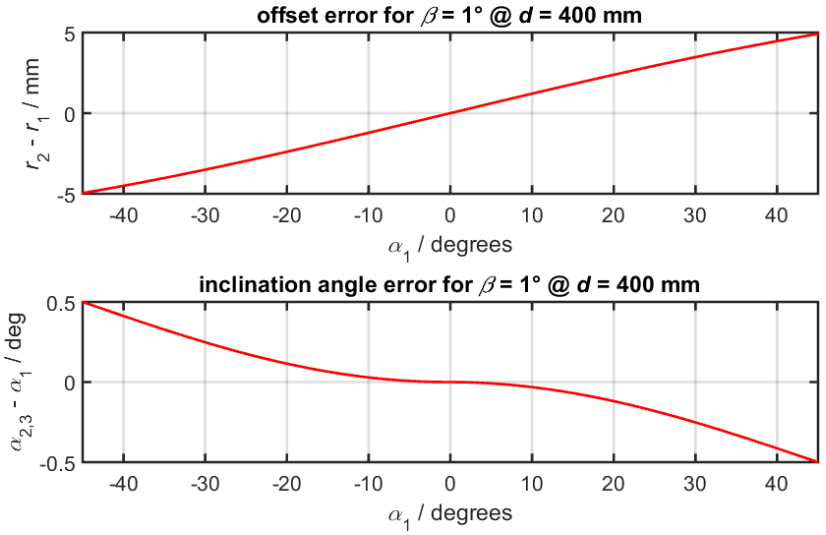
Tilt impact (2)



a tilt leads to an positive offset error (r_2-r_1) for some pixel
and for a negative offset error (r_3-r_1) for others:

The angular and offset errors are higher at increased inclination angles (for cameras with higher field-of-view).

For example:
40 cm calibration distance *d*, 1° tilt accuracy *β*



90° field-of-view ($\pm\alpha_1$ = 45°):
Δr = ± 5 mm for FPPN
$\Delta\alpha$ = ± 0.5° for the lens calibration

60° field-of-view ($\pm\alpha_1$ = 30°):
Δr = ± 3.5 mm for FPPN
$\Delta\alpha$ = ± 0.25° for the lens calibration

Precision spirit level

Highest accuracy can be achieved using a plumb bob with a sharp tip and a “precision spirit level”.

<u>Precision spirit level:</u>
accuracy of one line is
0.1 mm/m = 0.0057°