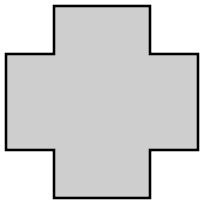
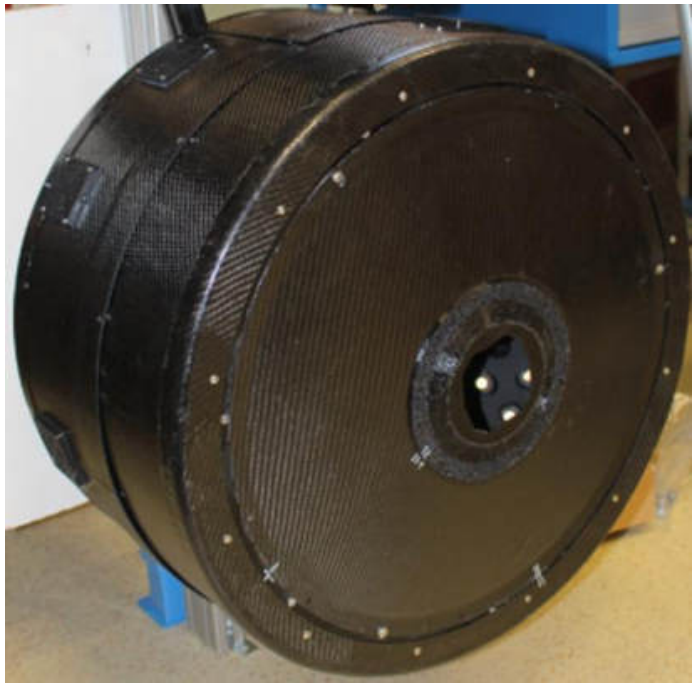
Robot stability testing UR16e operating payload 14kg

13/February/2020



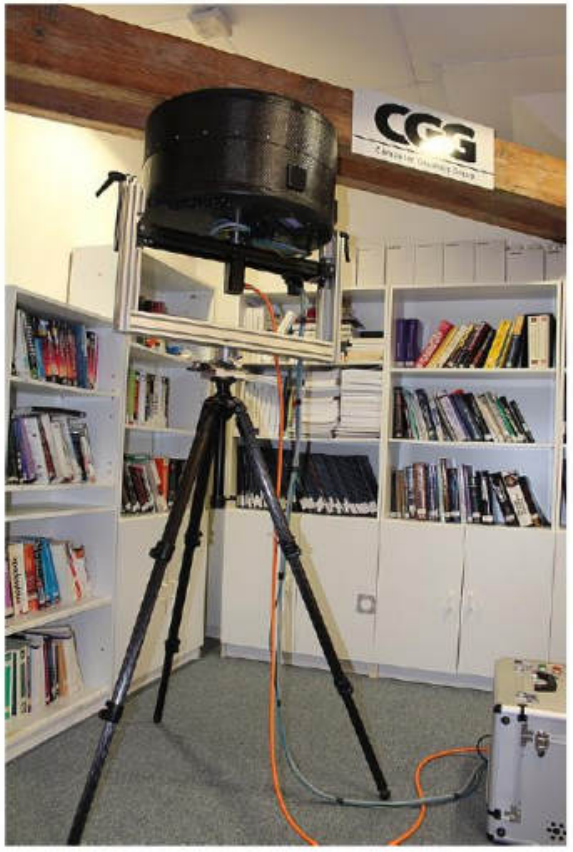


Center of gravity 170mm from the robot head flange

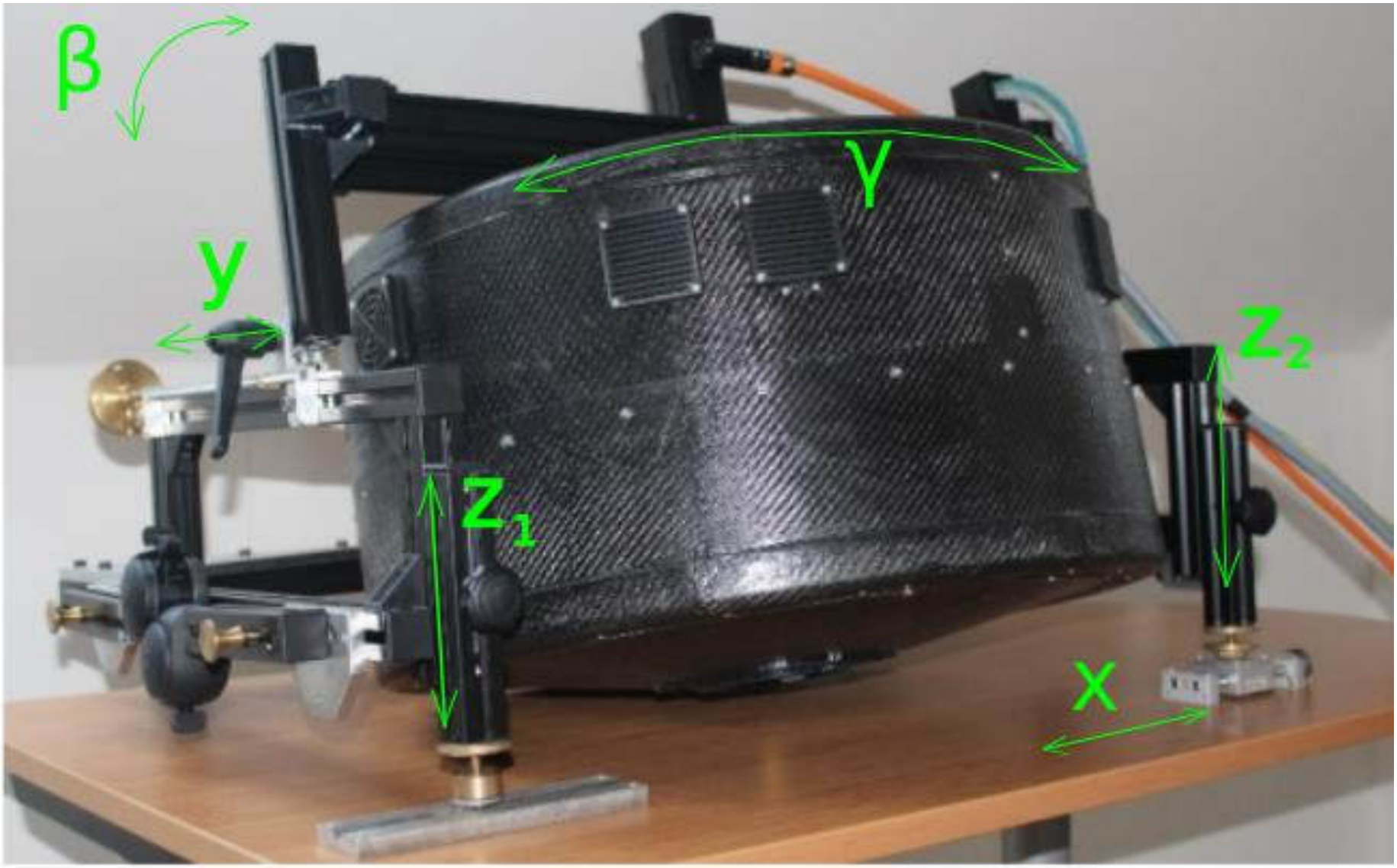
Payload 13.95kg

Four On-Site Measurement Configurations

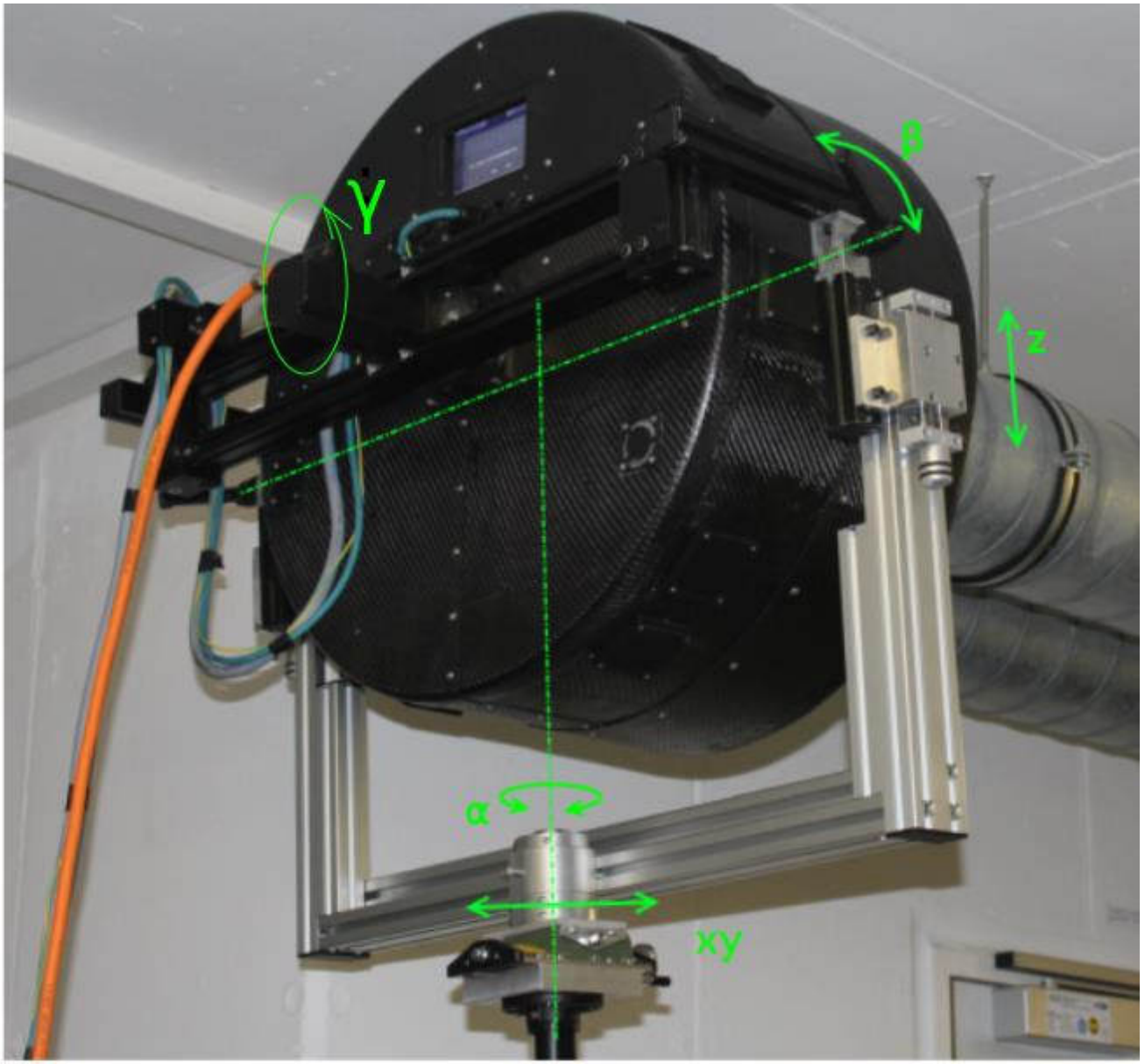
- Without robot, using manual holders
- Two different instrument holders, 5 degrees of freedom adjustable, 6th degree by servo rotation in the lightdrum



Revision of Table-Top Instrument Holder

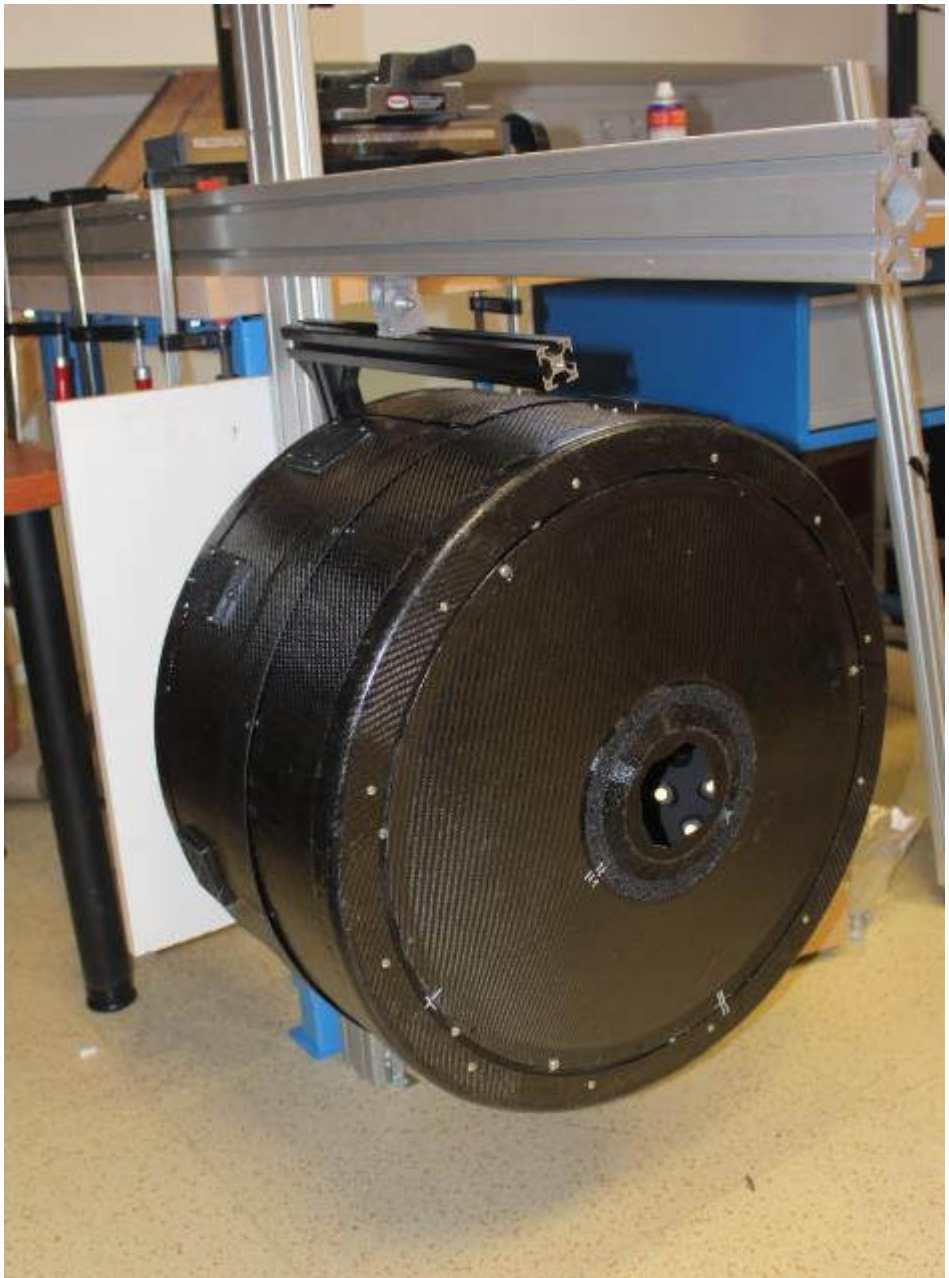


Revision of Tripod Based Instrument Holder



Lightdrum Properties (Drum only)

- Diameter 600mm
- Length 356mm
- Weight 12.6kg up to 13.9kg
- Moment of inertia 0.67kgm^2 measured experimentally by pendulum



Proposal – 4 chair wheel + 6D robot + lifting column + accumulator + lightdrum cabinet + lightdrum

Universal Robots UR16E - Operating Space Study

- Reach 900 [mm]
- Payload 16 [kg]
- Accuracy/repeatability 0.05 [mm]
- Weight 33.1 [kg]
- Power 585 [W]
- Cabinet size 480x420x270 [mm]
- Cabinet weight 12 [kg]

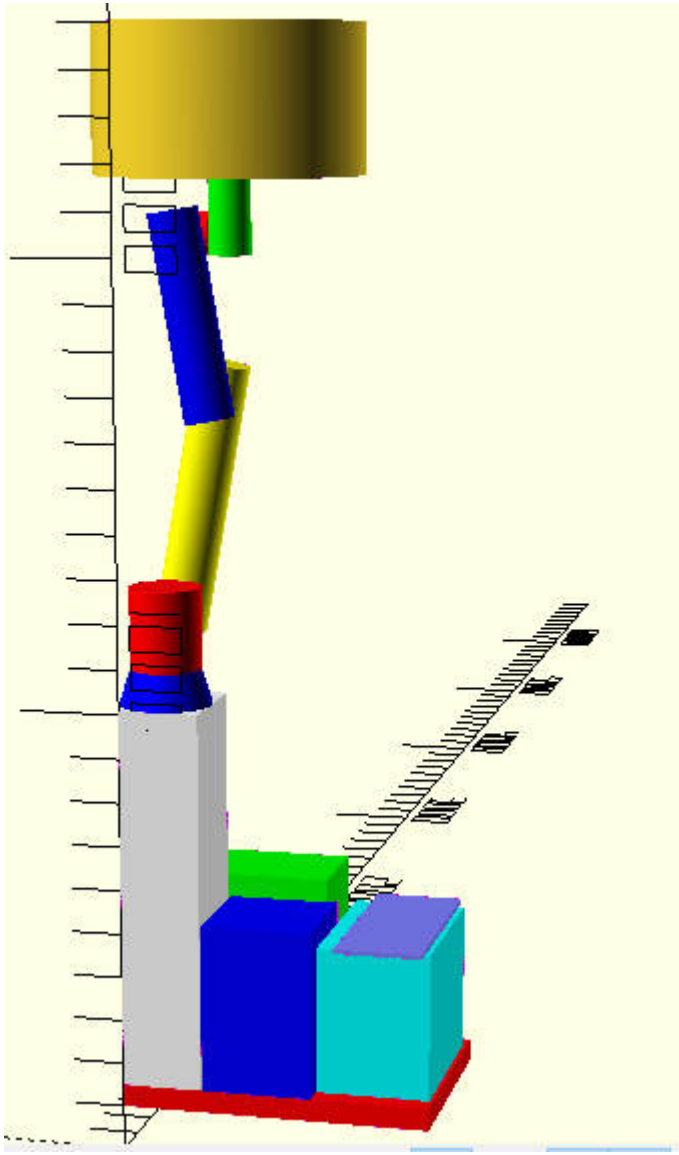
- Lifting column LINAK LP3 460-860mm, stroke 400mm

Experiment Objectives (Date 13 February 2020)

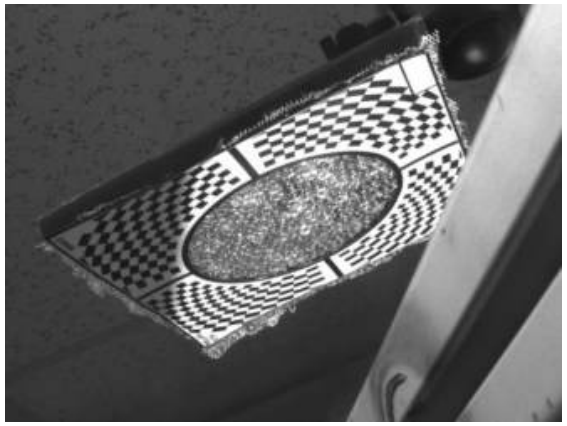
- Conditions: robot arm operates a camera that views independent stationary sample
- To make sure that a position of a robot does not change its position (vibration, tremble, shaking) under the payload of 14kg.
- To measure the power needed as reported by device and on the power socket. E.g. 140W, 86W means that power socket meter measured 140W and software shows 86W.
- The test was run at some positions that simulate the real expected use of a robot in proposed application.

Example Situation

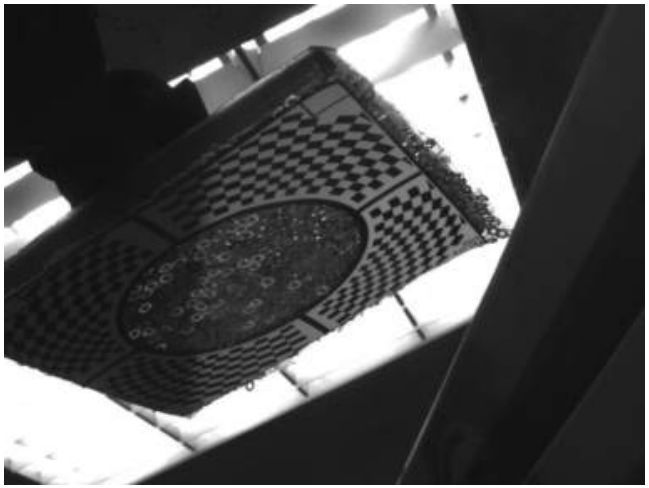
- Measurement on ceiling



Measurement 000 – 140W, 86W

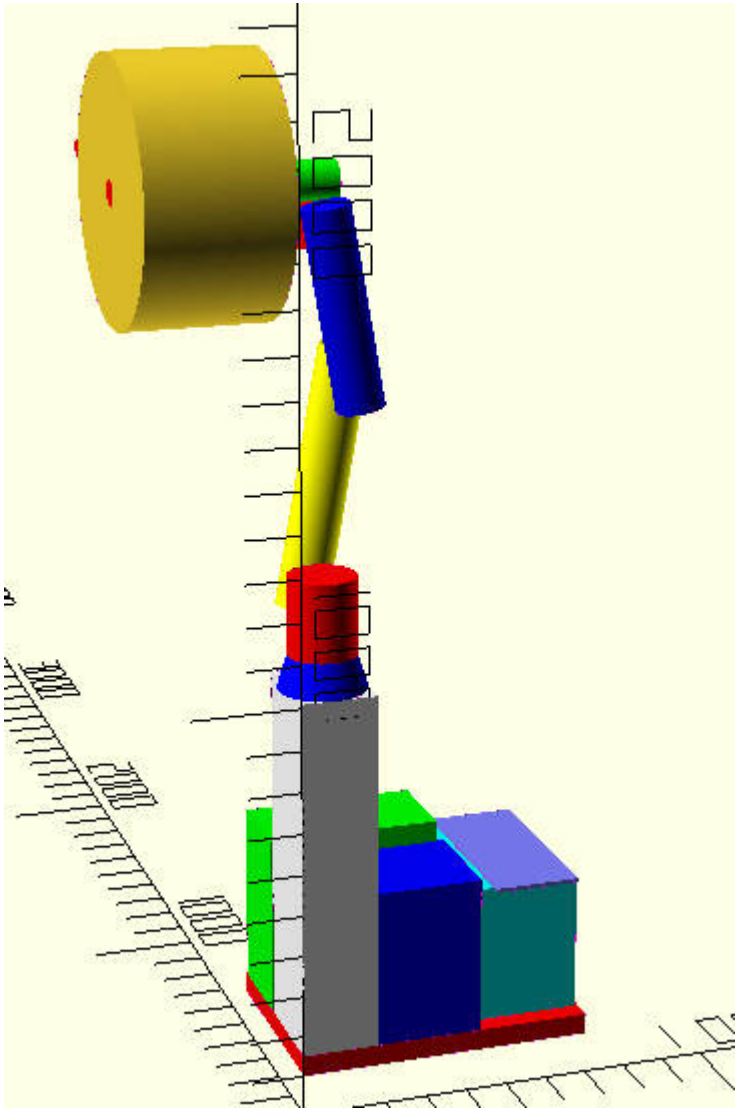


Measurement 010 – 140W, 86W

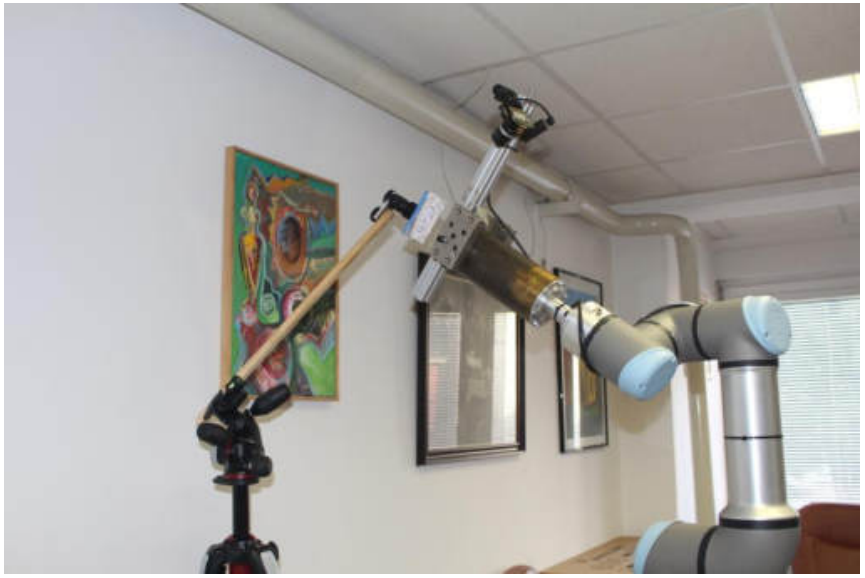


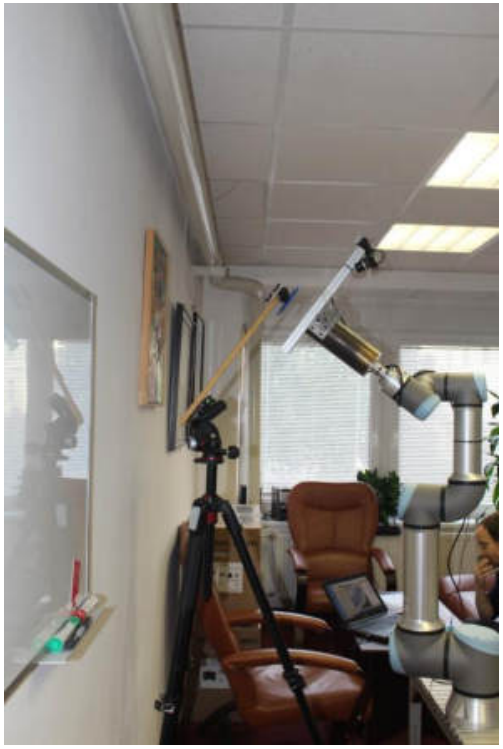
Example Situation

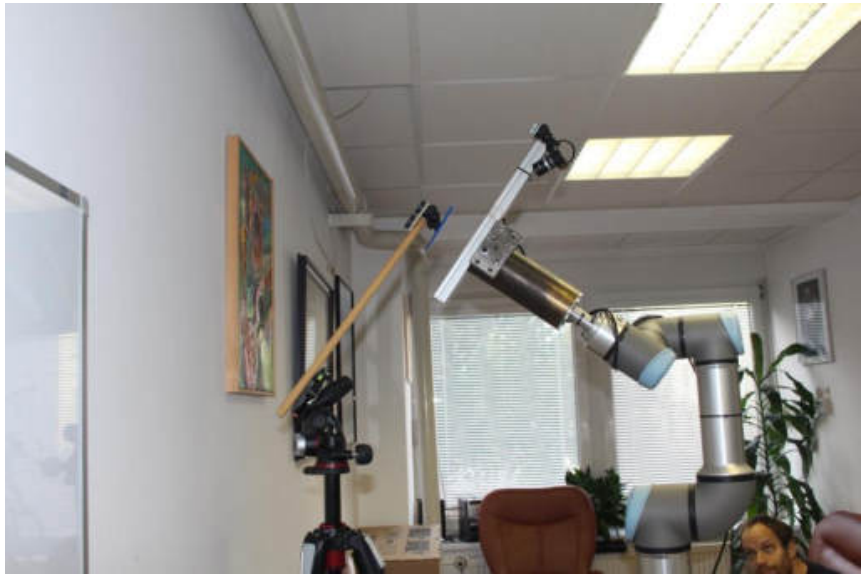
- Measurement on the wall close to ceiling



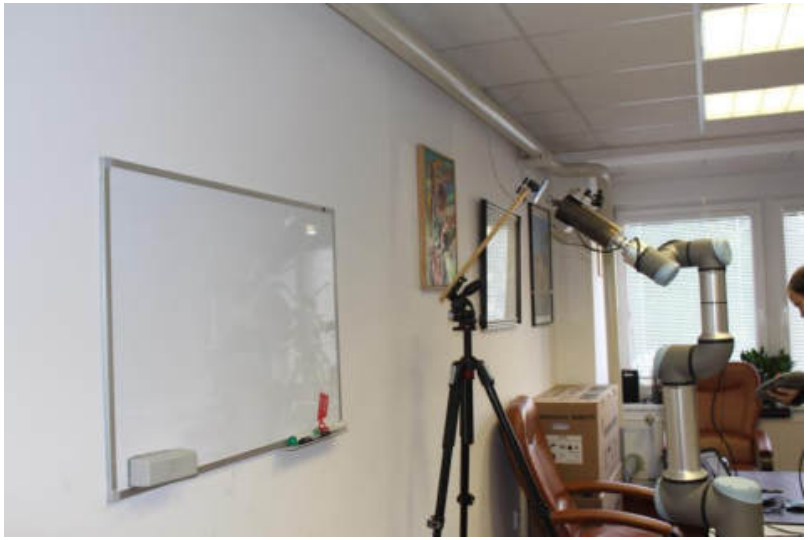
Measurement 020 – 96W, 46W

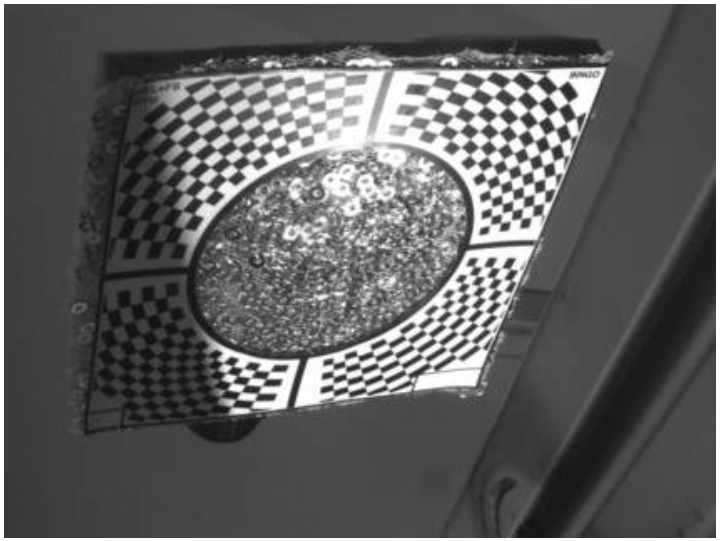




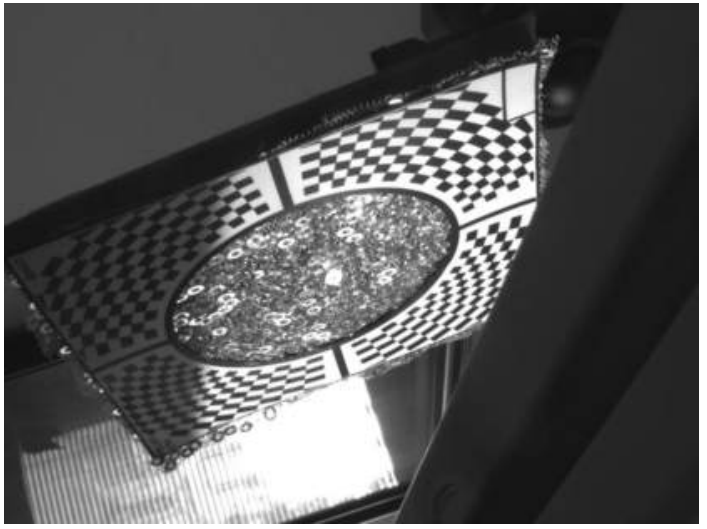


Measurement 030 – 96W, 46W

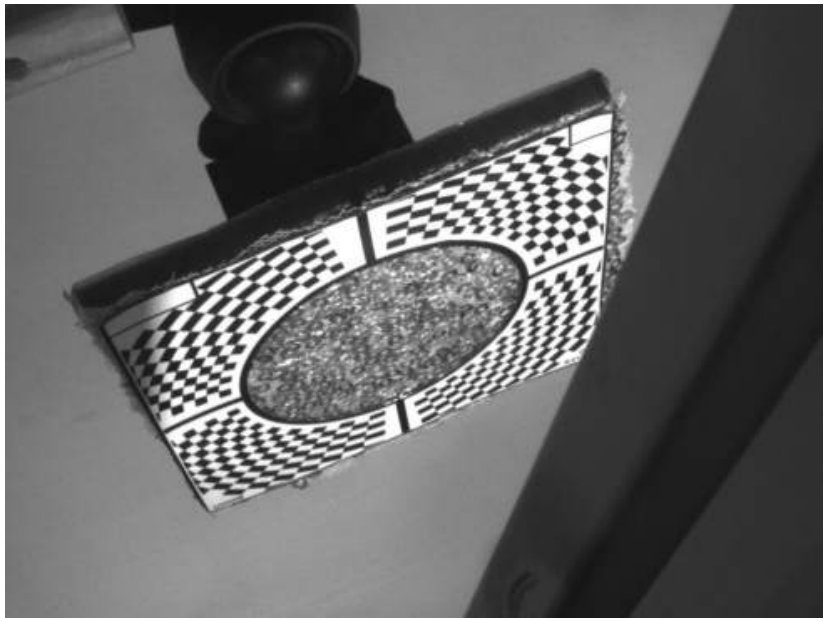




Measurement 040 – 82W, 37W



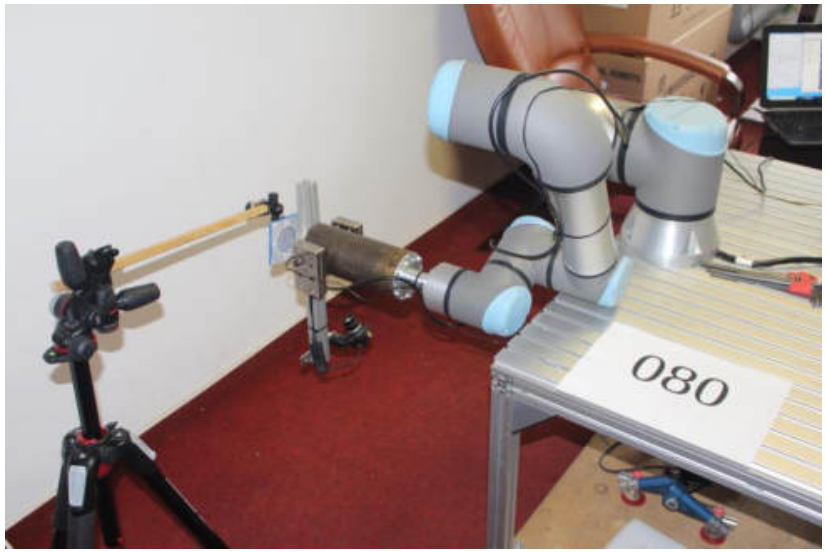
Measurement 050 – 82W,37W

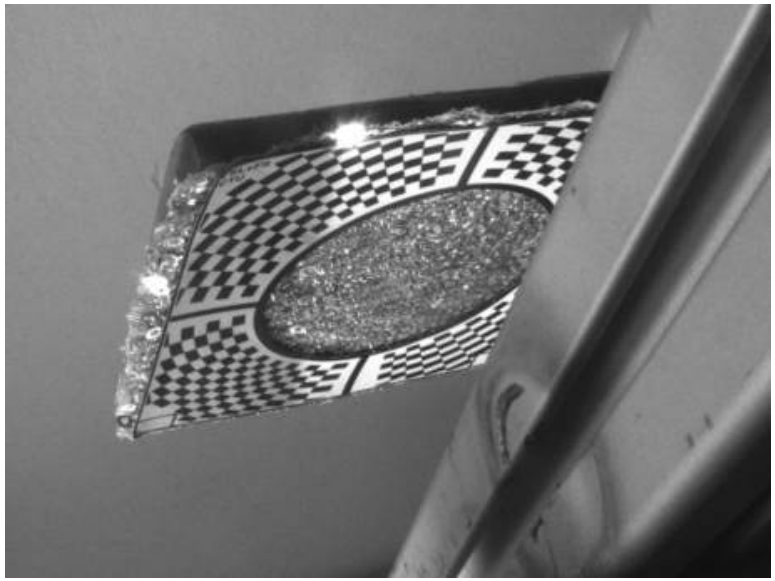


Measurement 060 - 103W, 52W

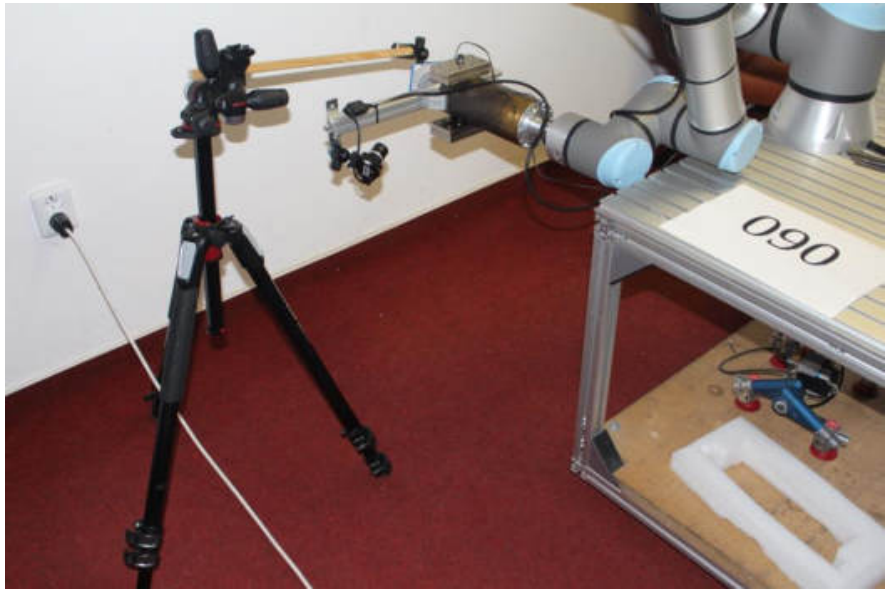
Measurement 070 - 103W, 52W

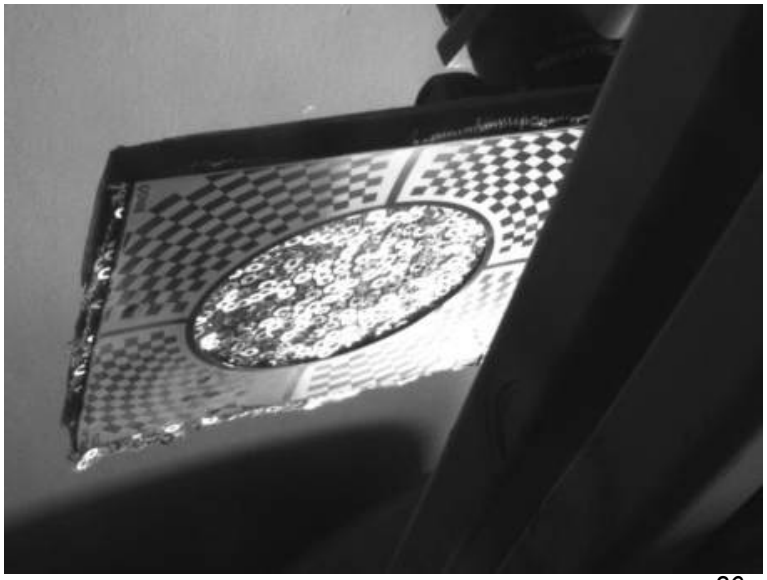
Measurement 080 - 100W, 50W





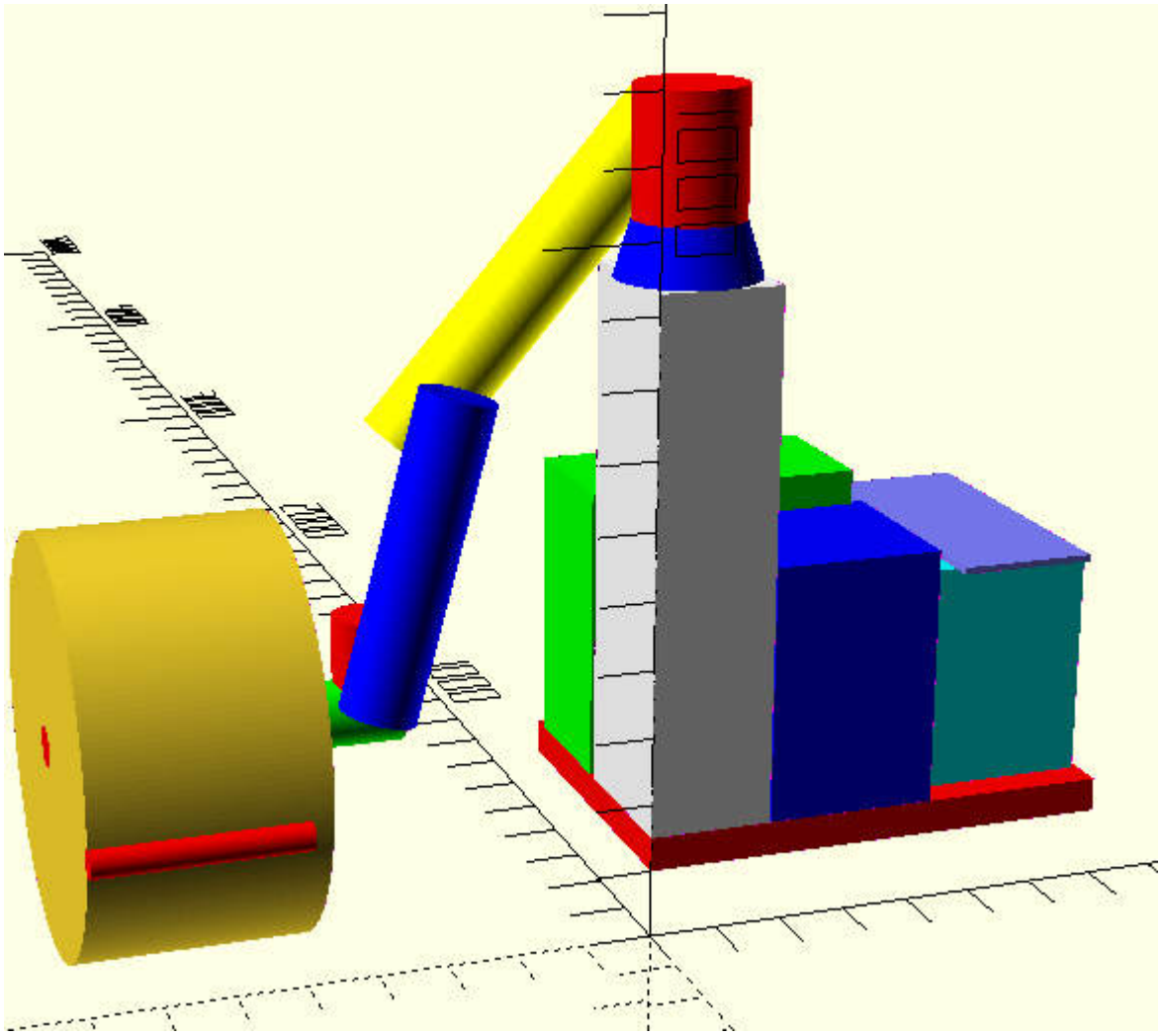
Measurement 090 - 100W, 50W



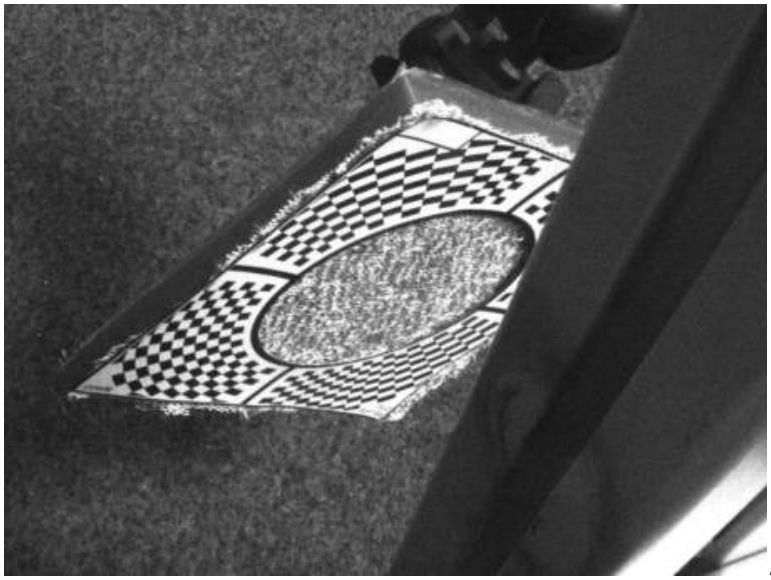


Example Situation

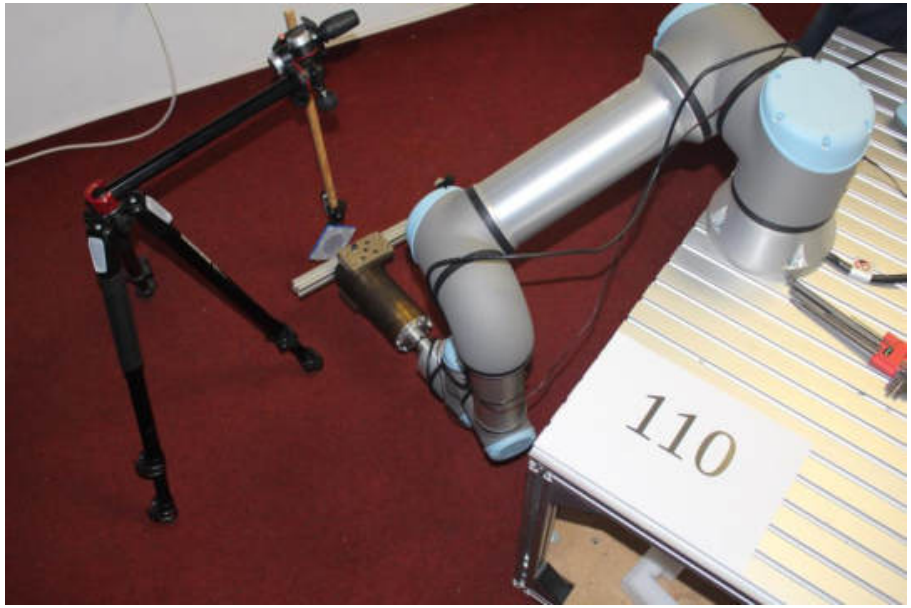
- Measurement on the wall above the floor

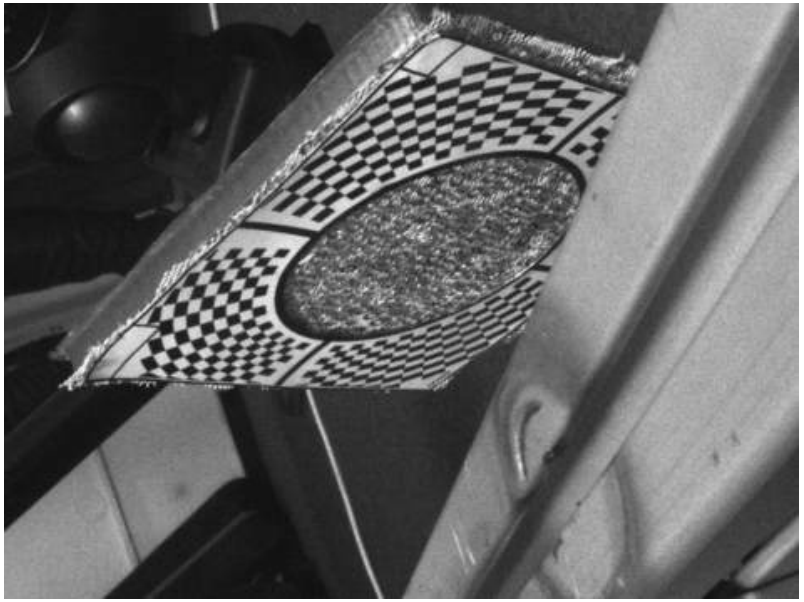


Measurement 100 - 91W, 44W

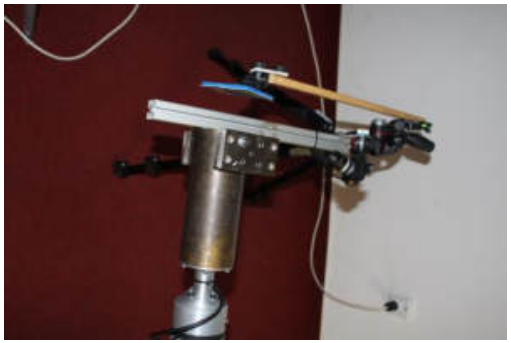


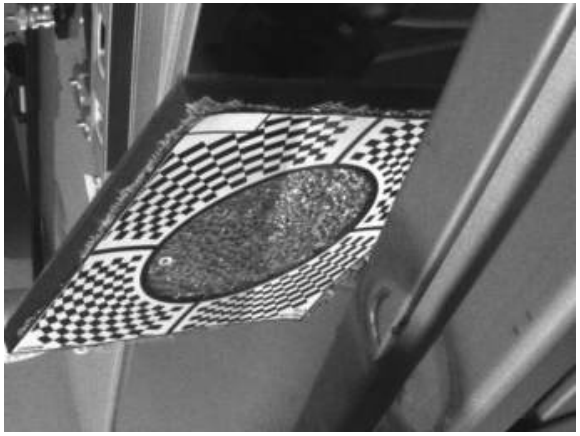
Measurement 110 - 91W, 44W

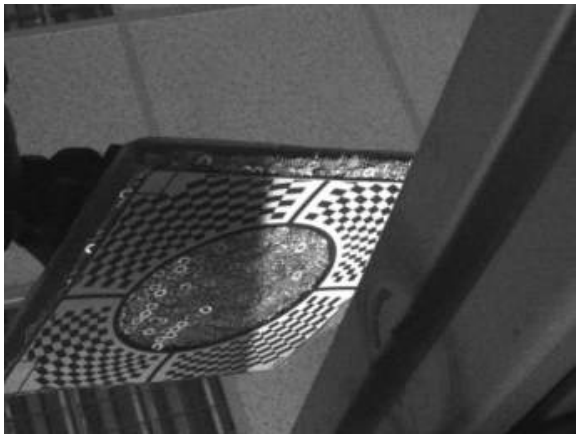




Measurement 120/130 - 160W, 100W and 148, 89W

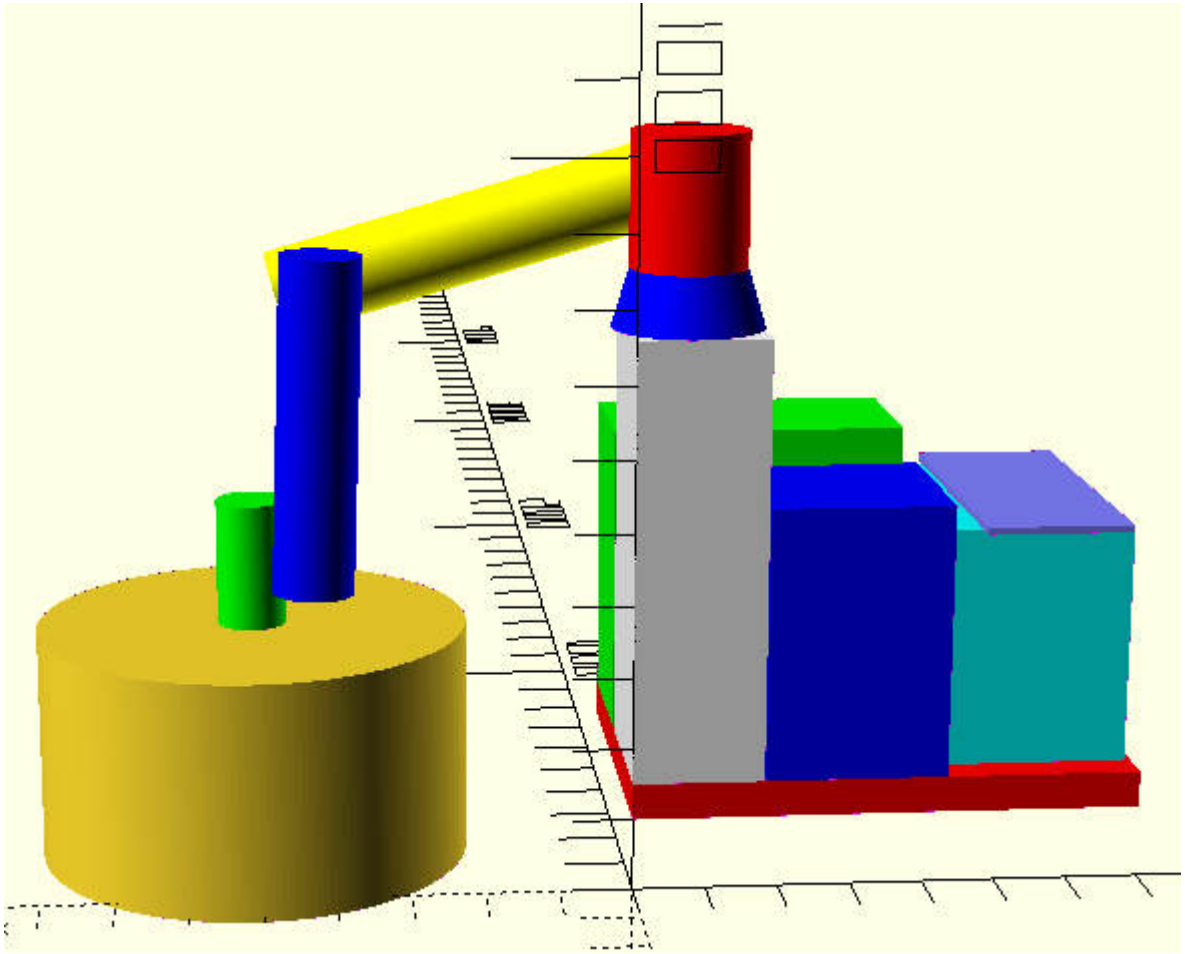




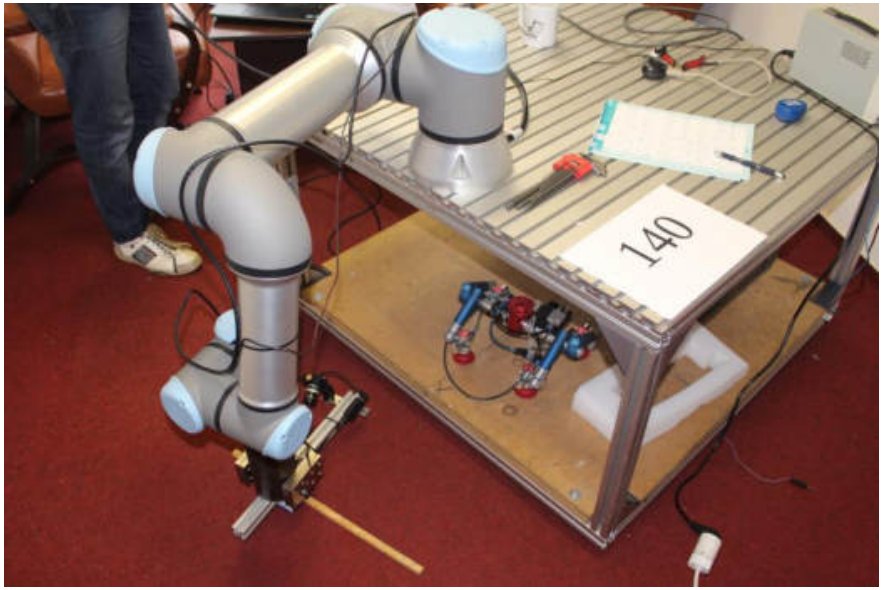


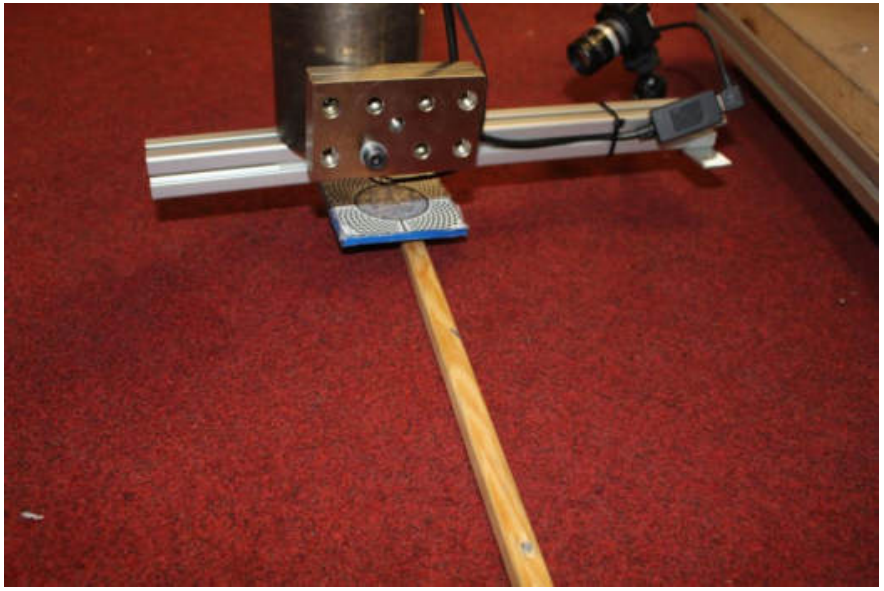
Example Situation

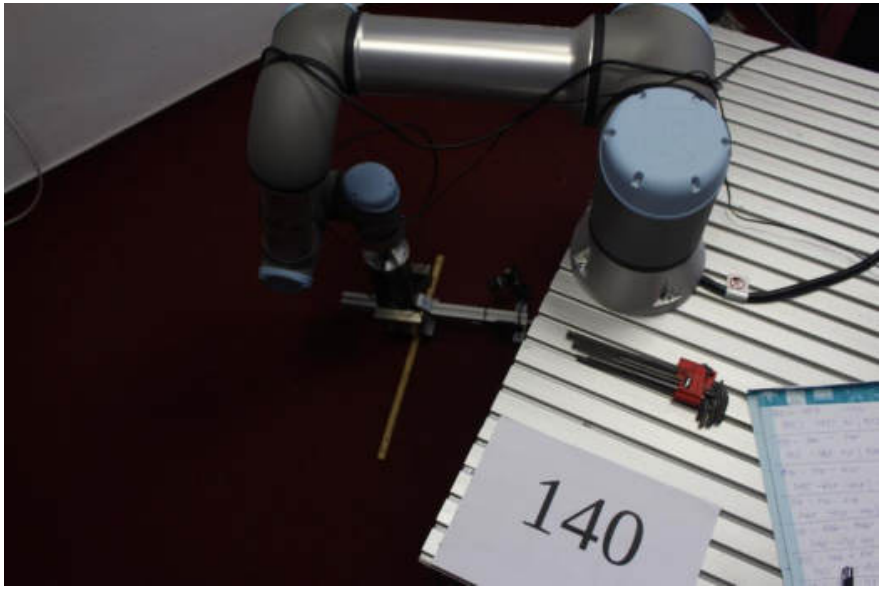
- Measurement on the floor

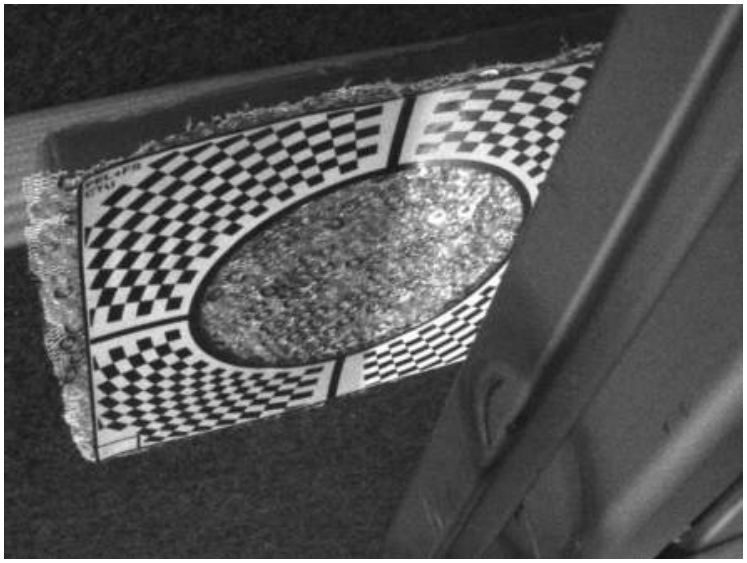


Measurement 140 - 94W, 47W

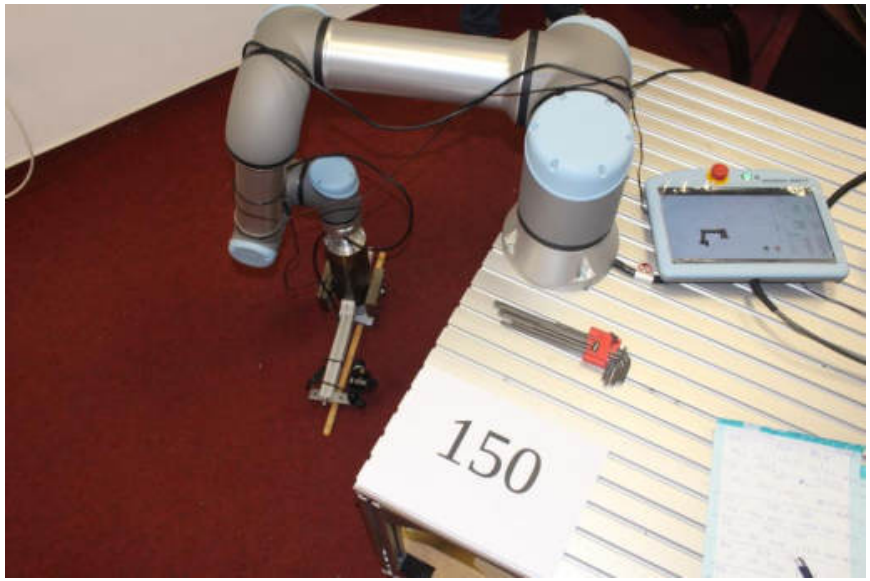


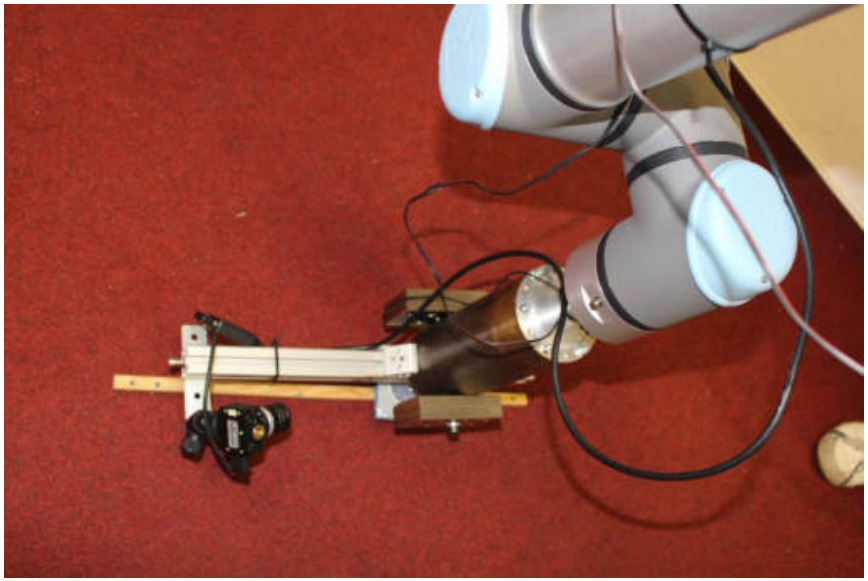


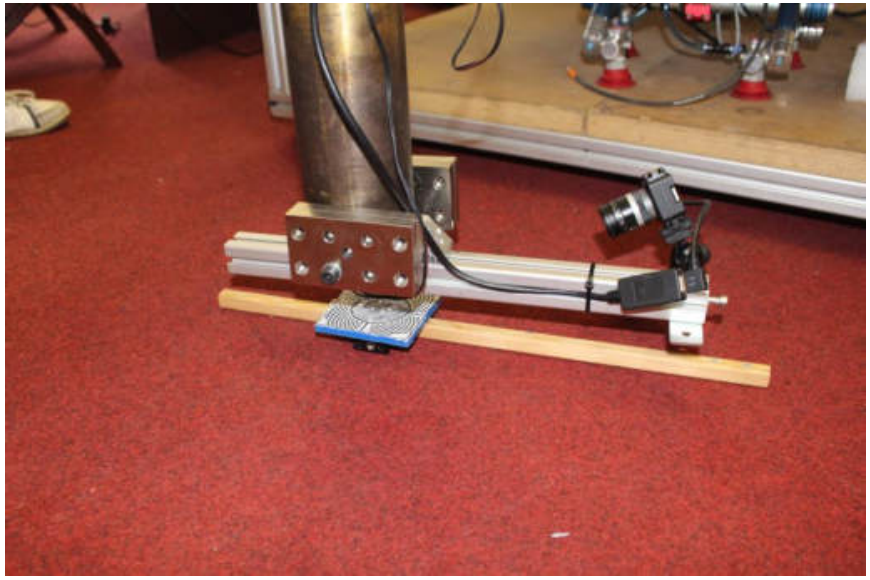


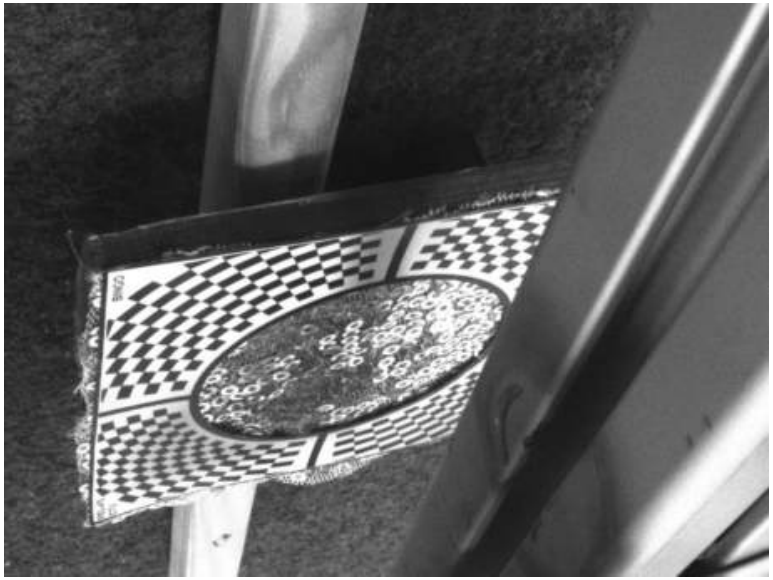


Measurement 150 - 94W, 47W









Conclusions

- 200 images were taken for each robot setup
- Random 1000 pairs from 200 images were subtracted. Only noise in difference images was detected. i.e. – no shaking!
- Total power consumption including cabinet: 94 to 160 Watts
- The robot arm does not shake during the time interval so that it could be detected on the images taken by camera on a robotic arm when images of an independent stationary object are taken: