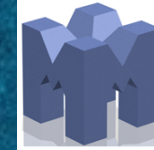




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**MANUFACTURING
METROLOGY TEAM**

On development of a fast wireless focus variation probe for in-process surface measurement

Wahyudin P. Syam,
University of Nottingham

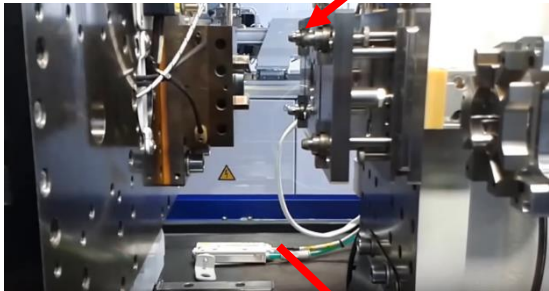
aliconna
imaging



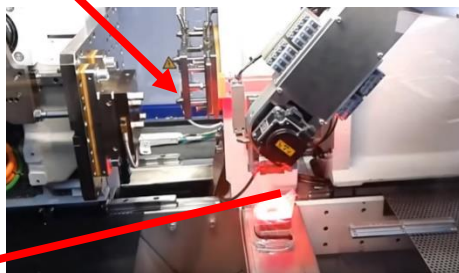


- The need of a small and compact surface measurement sensor to be easily integrated into various production machines

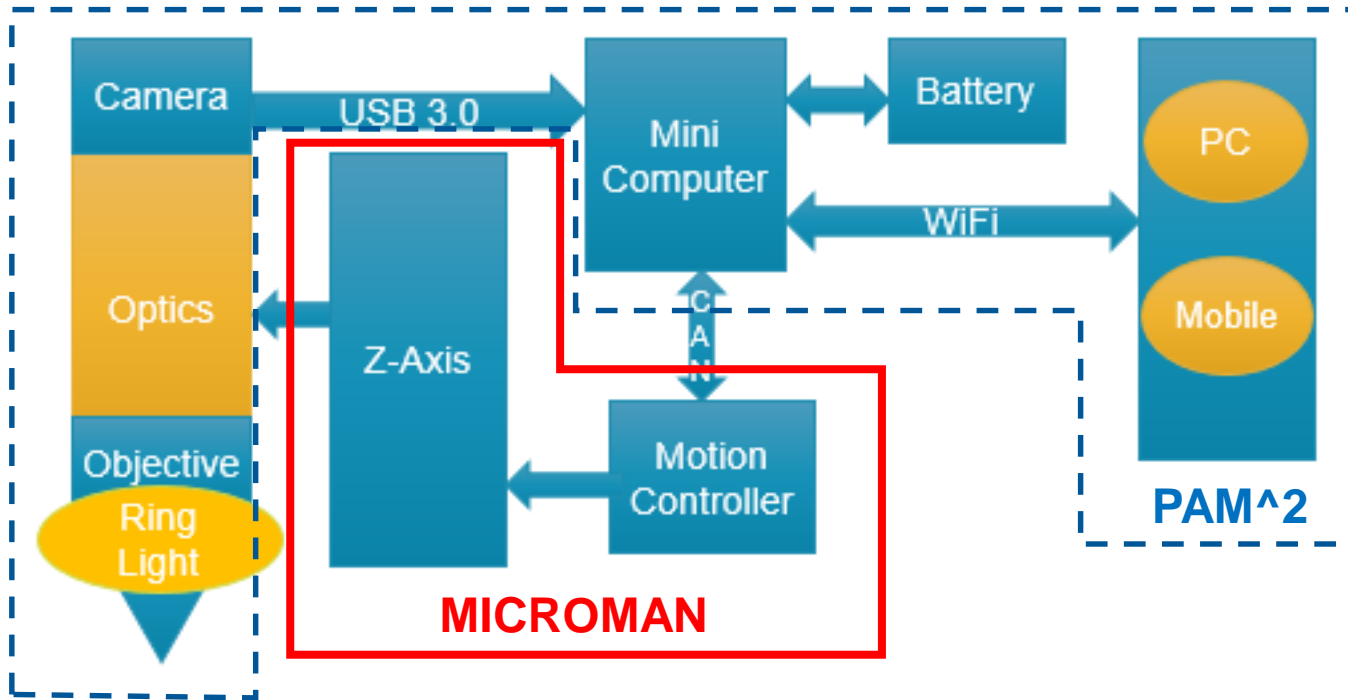
Micro injection moulding and CNC machine



measuring



General project scope:



MICROMAN project

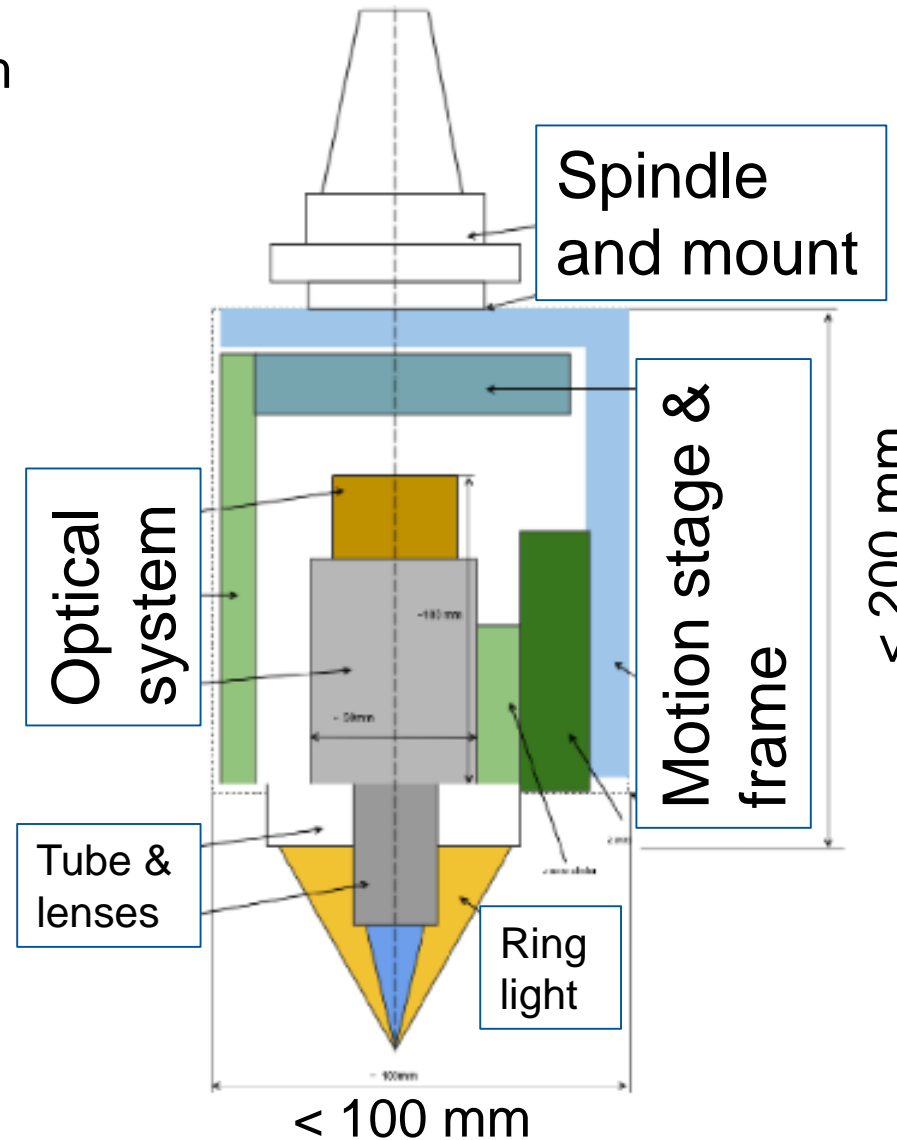
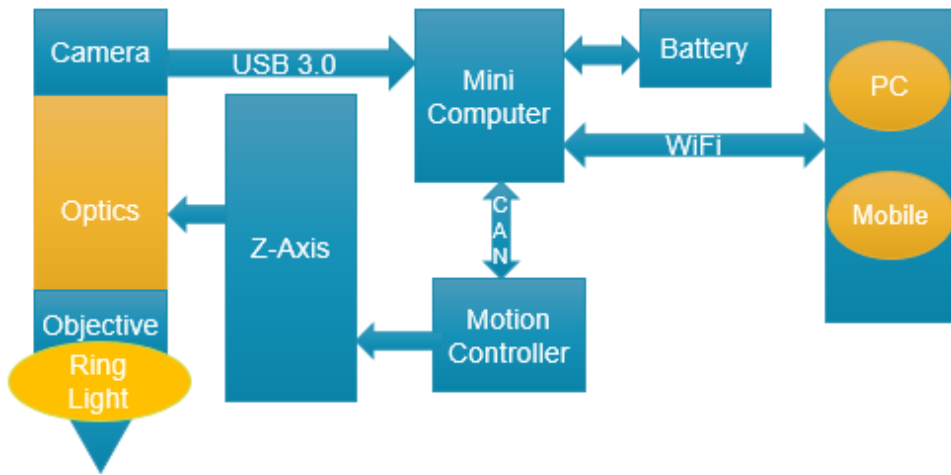
- Title: Process Fingerprint for Zero-defect Net-shape **MICROMAN**ufacturing
- Period: 2015-2019
- Covering major micro-scale manufacturing processes (injection moulding, EDM, ECM, etc)
- 13 PhDs, 8 Universities, 1 RTC
- 5 EU countries: DK, DE, UK, IT, BE

Company partner:
Alicona GmbH

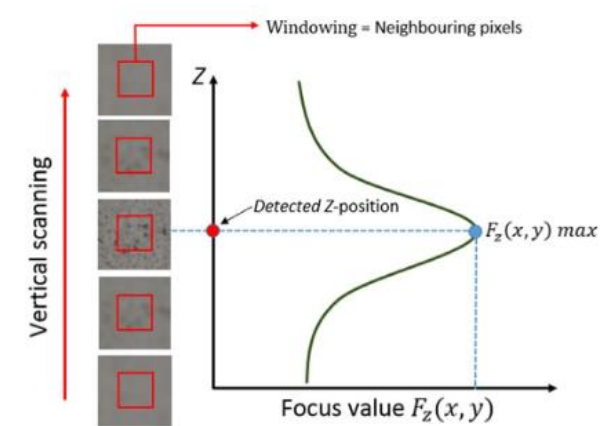
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imaging

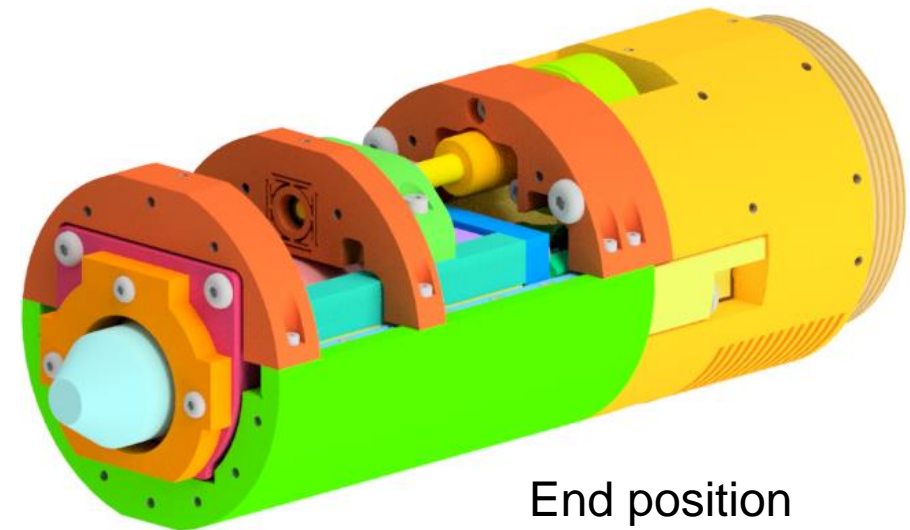
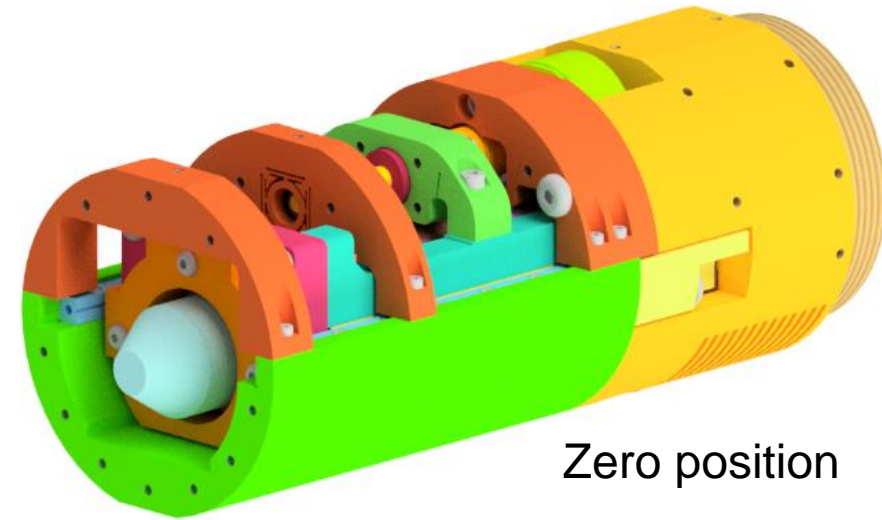
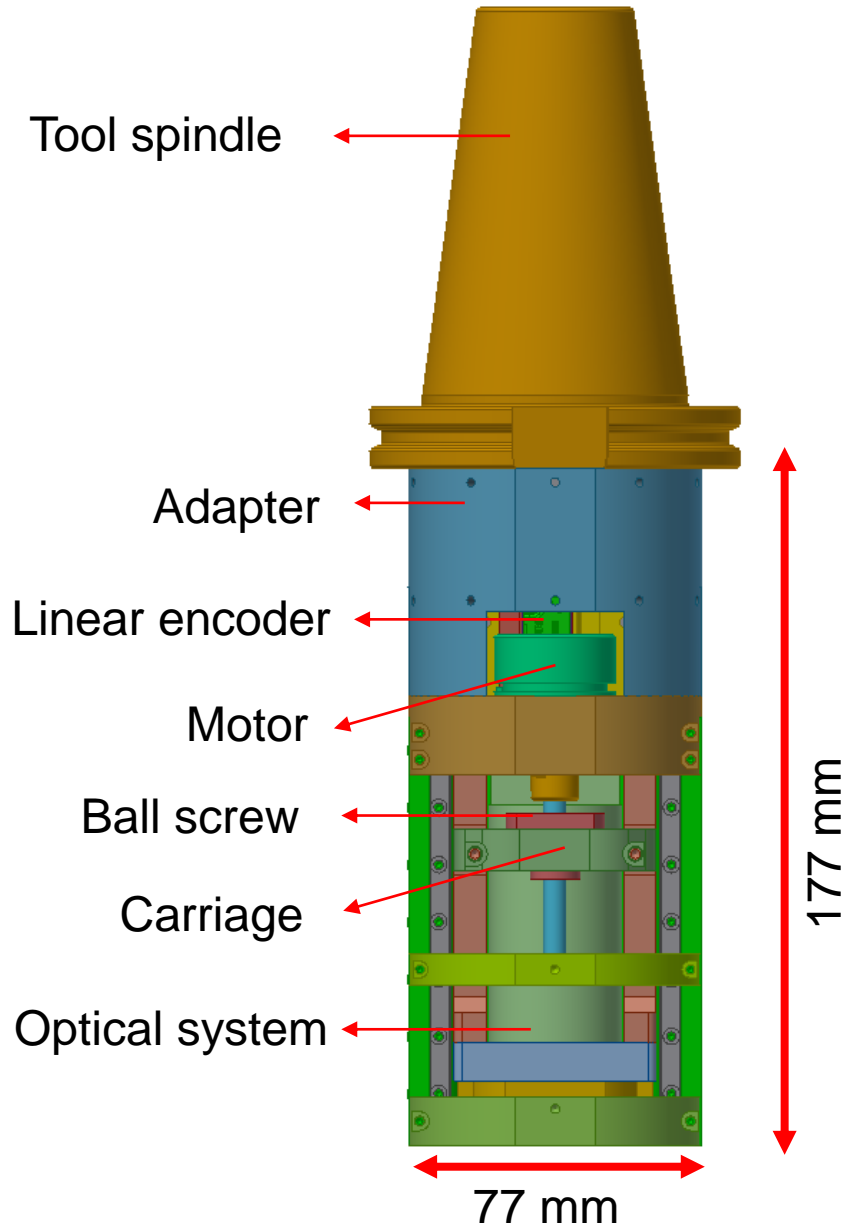


- Absolute position accuracy: $< 1 \mu\text{m}$
- Resolution: $< 25 \text{ nm}$
- Repeatability: $< 250 \text{ nm}$
- Pitch: $< 20 \mu\text{rad}$
- Yaw: $< 20 \mu\text{rad}$
- Straightness: $< 1 \mu\text{m}$



Based on focus variation method

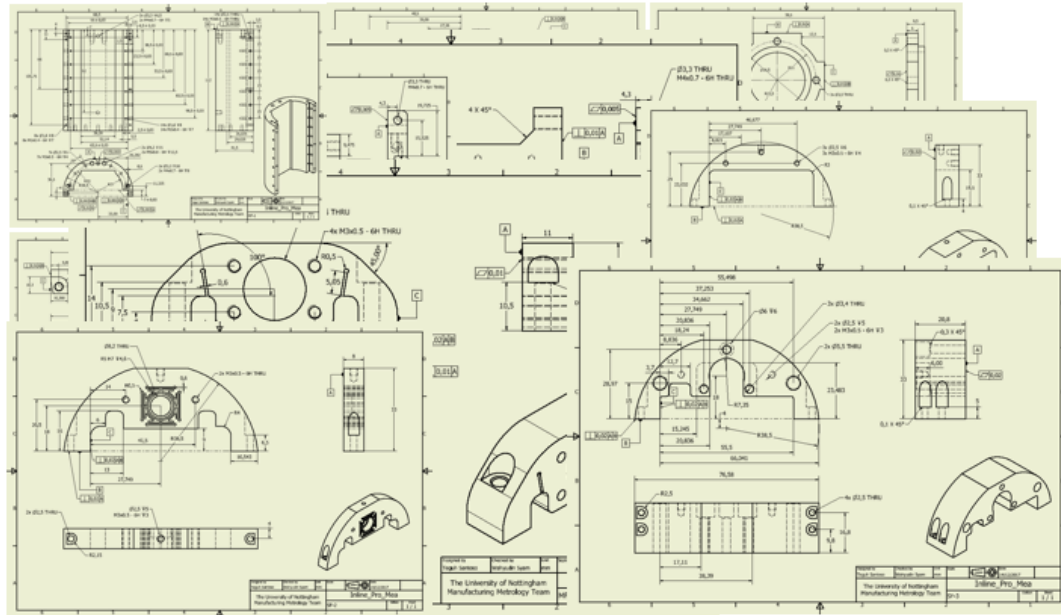




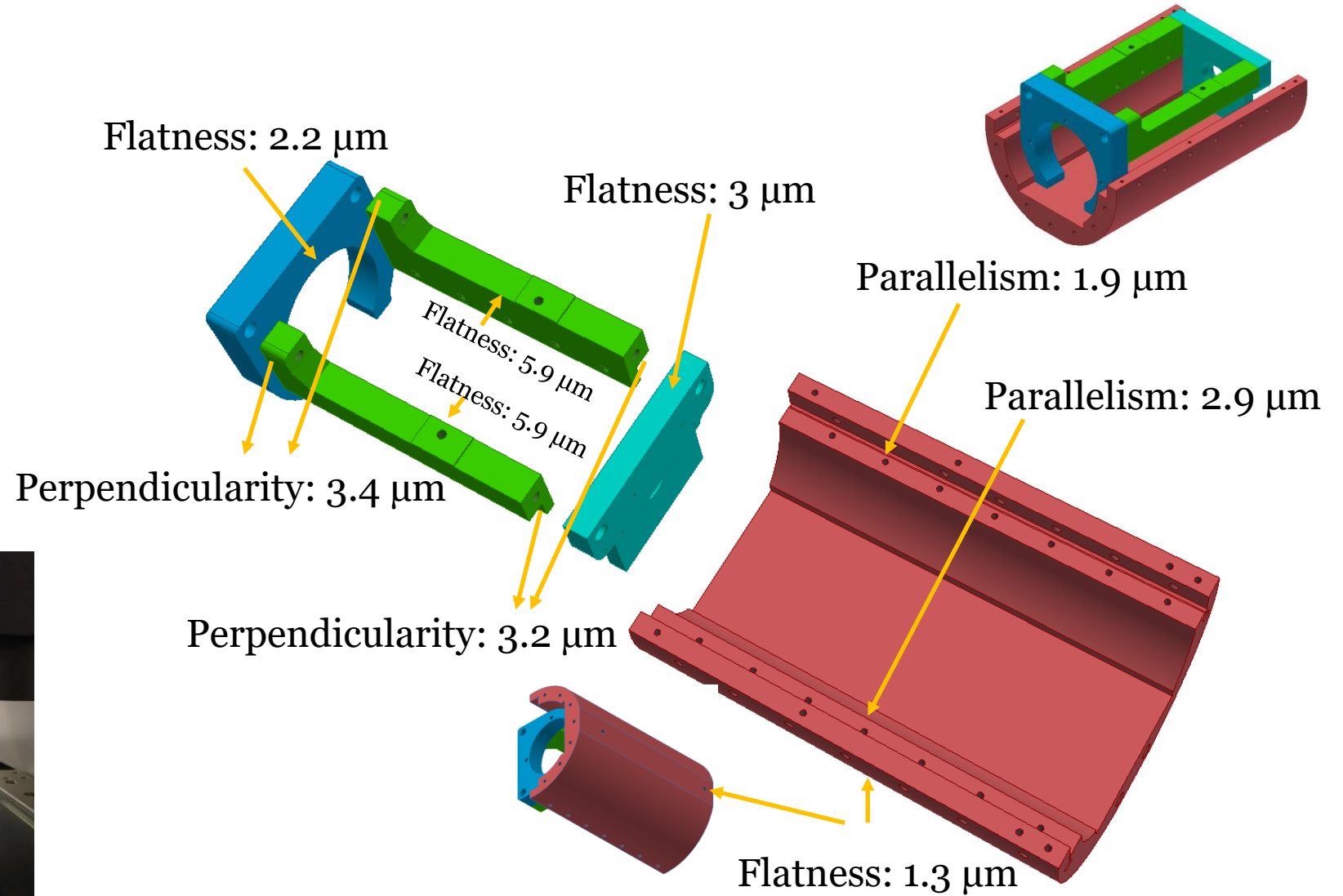
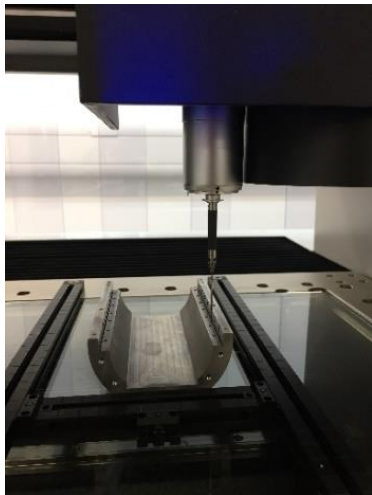
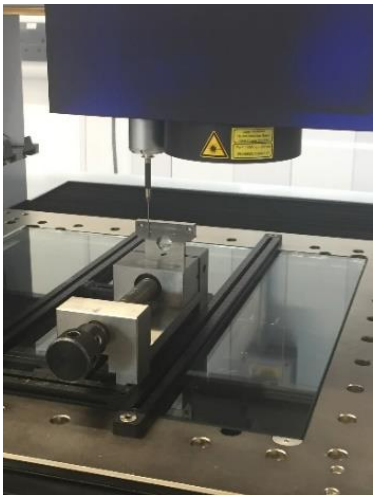
Acknowledgement:

Precision Manufacturing Center (IfAM, University of Nottingham)

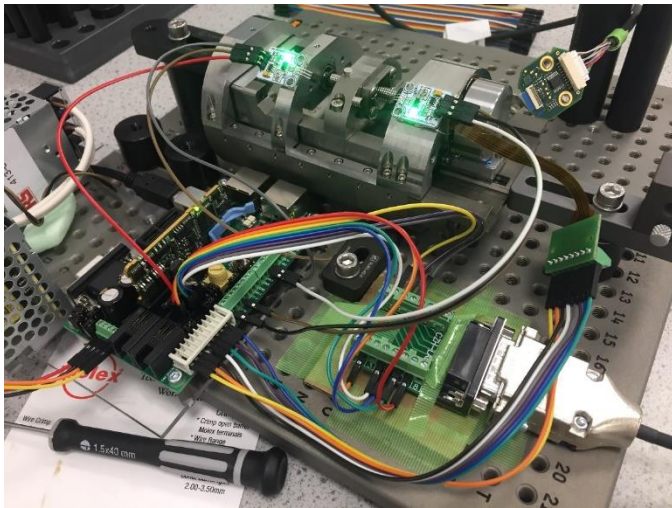
- Wire-EDM
- Precision milling
- Grinding
- Material SS416



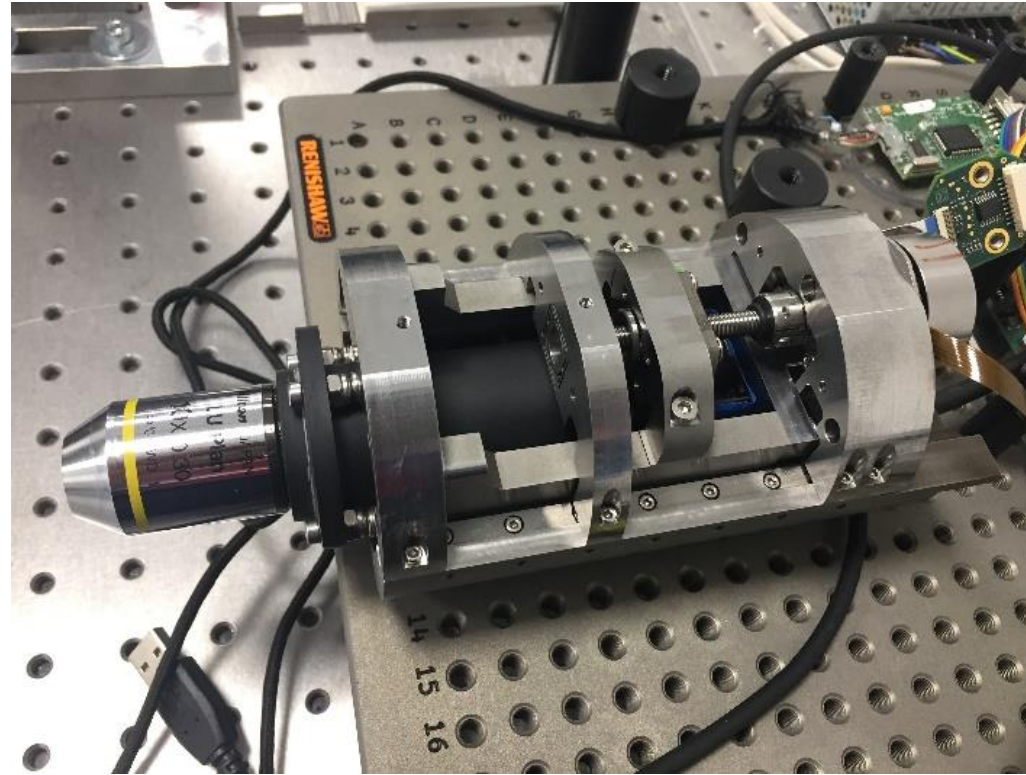
- Using tactile CMM



Motion controller and driver



Optical system + motion stage

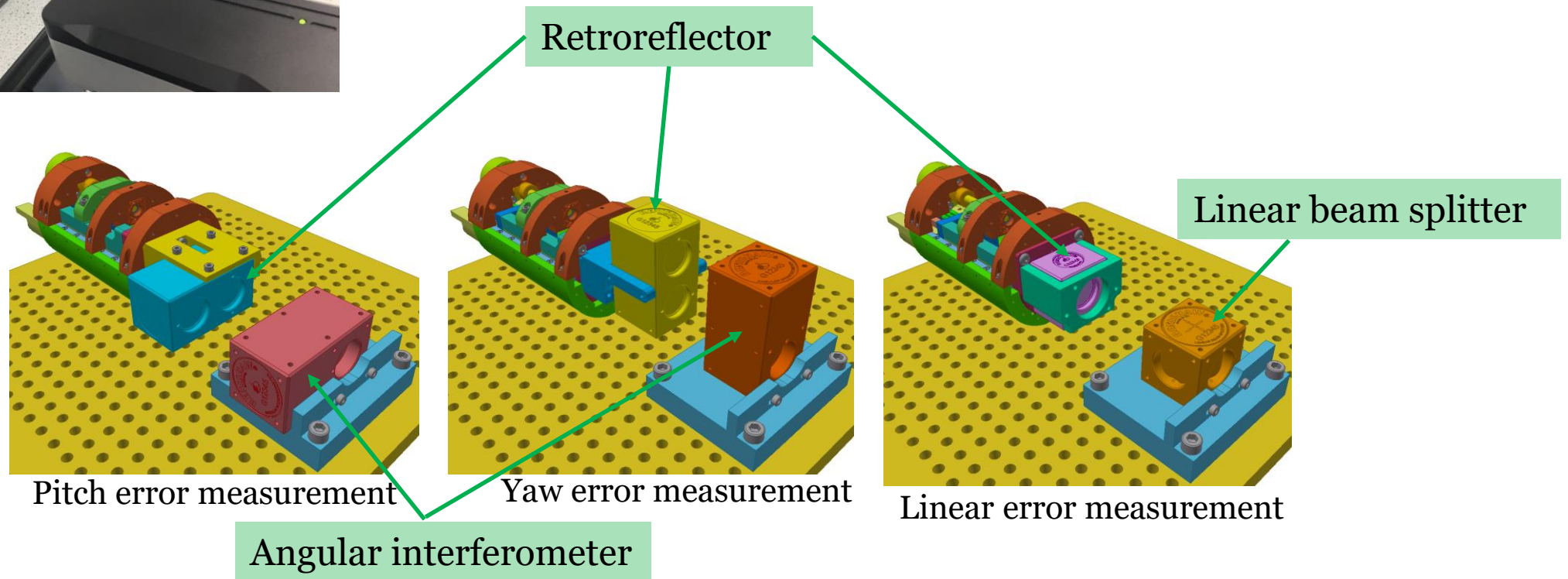


The optical system



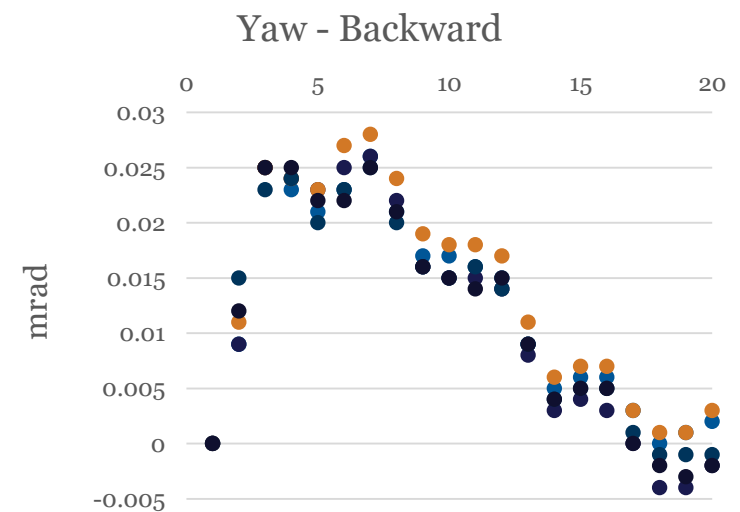
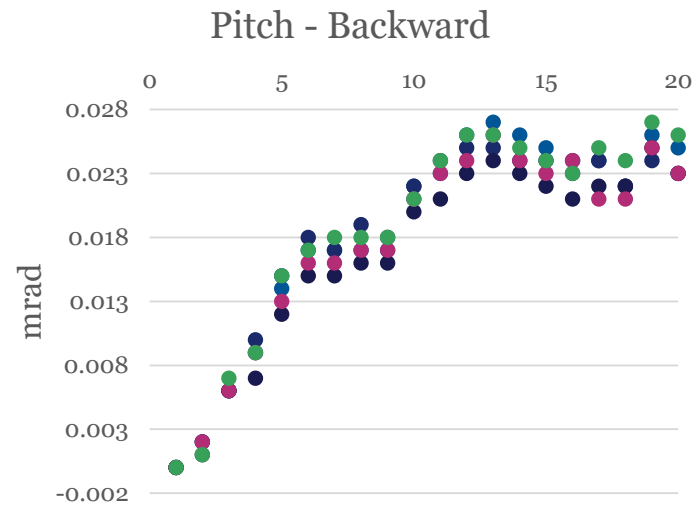
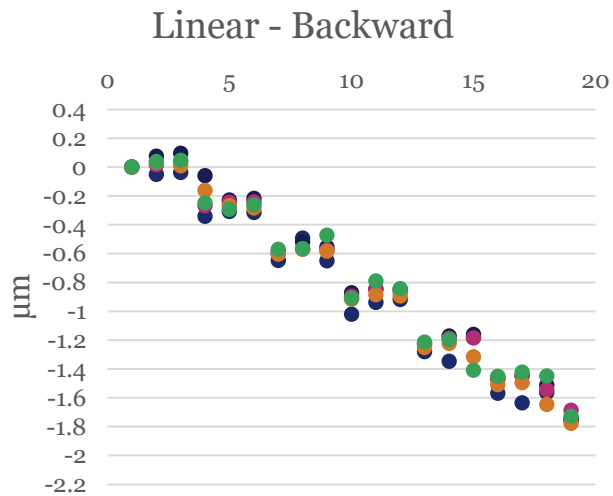
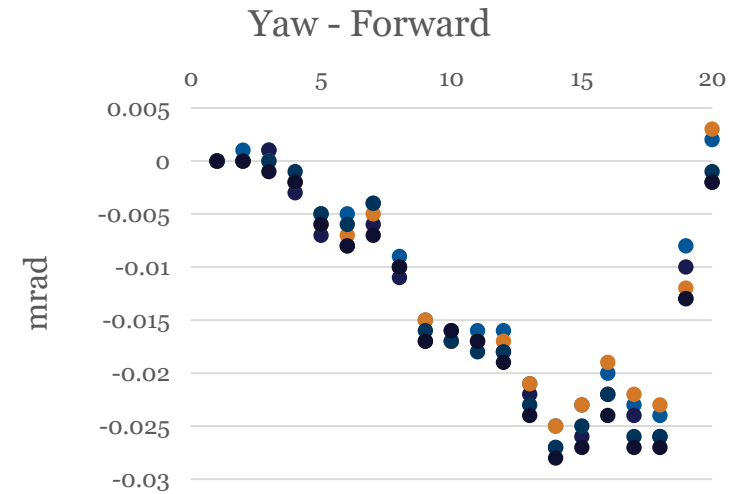
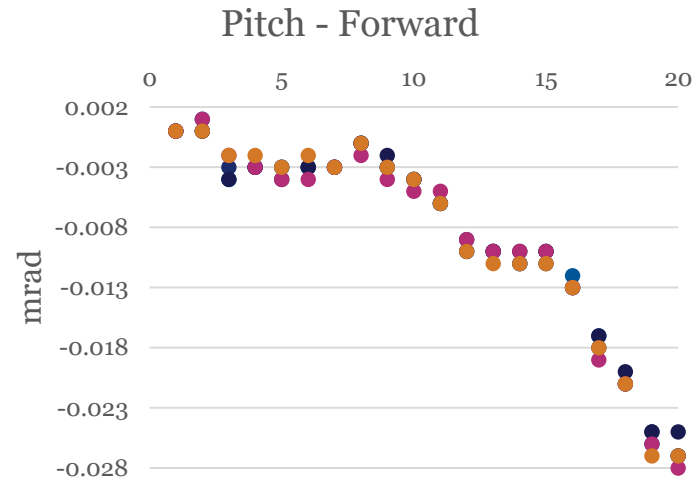
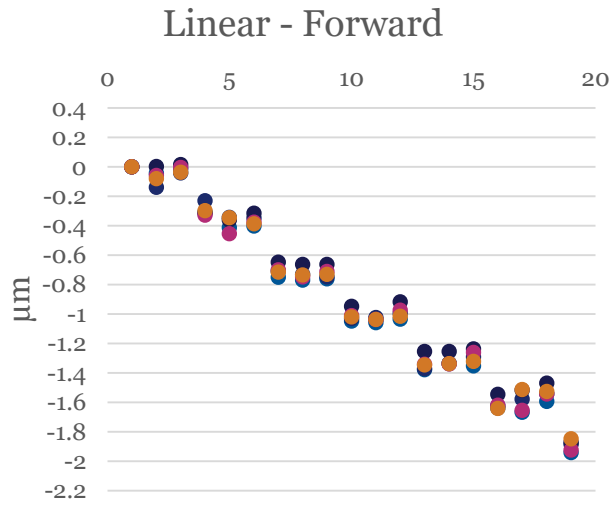
10x objective lens

- Using a laser interferometer
- The largest standard uncertainty ($k = 1$) = $0.1 \mu\text{m}$ for 20 mm (max. travel length)



Linear travelling range: 0 – 20 mm

5 repetitions for each length

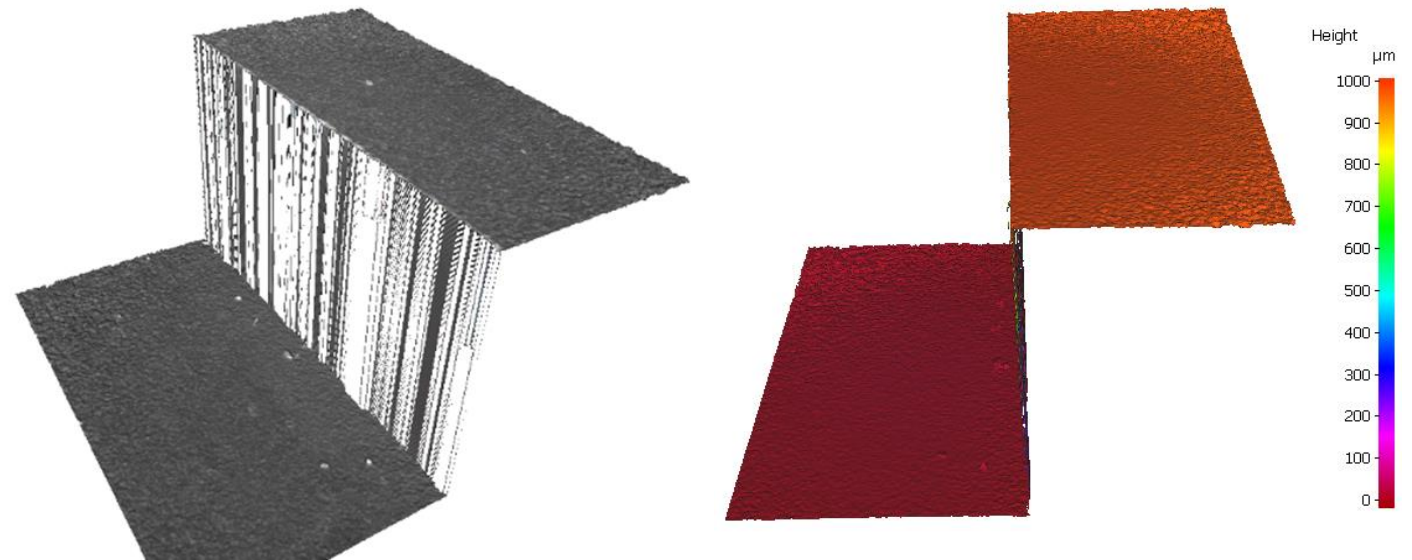


Alicona calibrated artefact:



Measurement tests:

- Step height measurement = 1001 μm
Calibration value = 999.99 \pm 0.1 μm
- Measurement noise with 10 \times lens \sim 90 nm



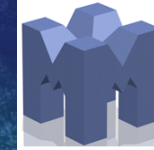
Future works:

- Optical aberration and distortion correction
- Motion control optimisation
- Full system integration: Precision optics + motion stage + mini PC + wifi system
- Metrological characterisation determination based on ISO 25178 series
- Testing on real case studies: micro-scale milling, micro-scale laser milling, etc



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MANUFACTURING METROLOGY TEAM

Manufacturing Metrology Team at Nottingham



Thank you!



Horizon 2020



EPSRC Centre for Doctoral Training in Ultra Precision Engineering

EPSRC

Engineering and Physical Sciences Research Council



EPSRC Centre for Doctoral Training in Additive Manufacturing

EMPIR



The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States