Physikalisch-Technische Bundesanstalt
Nationales Metrologieinstitut

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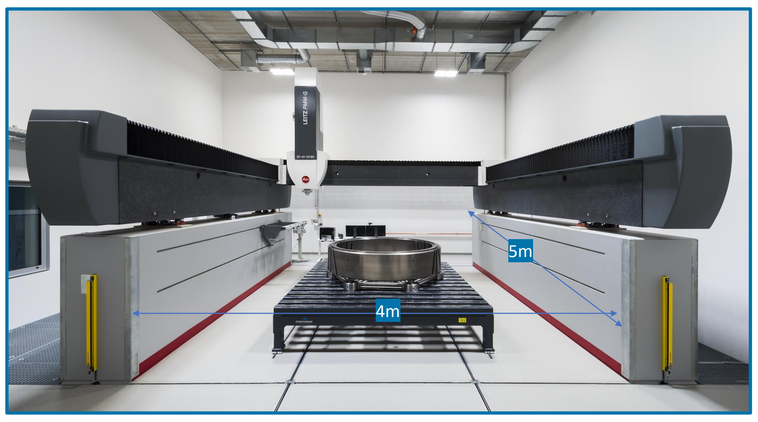
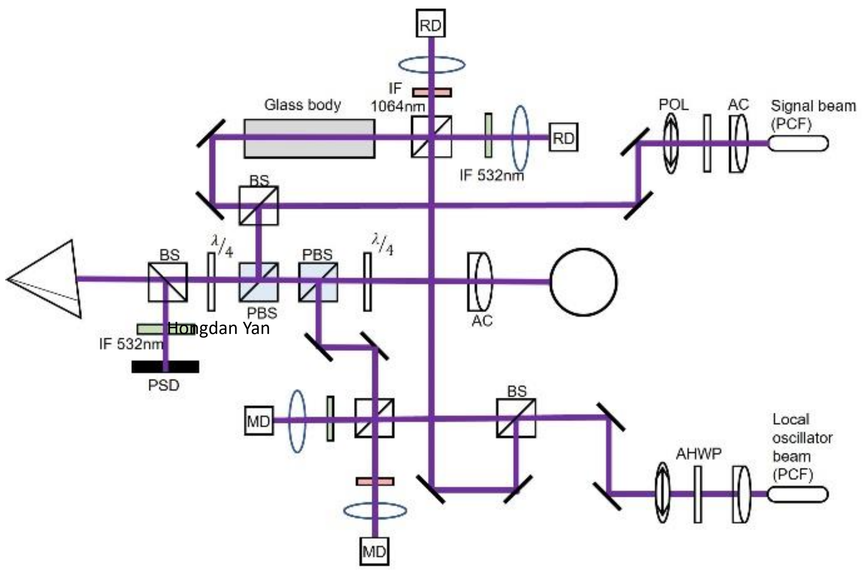
Two-colour self-tracking interferometer for large volume calibrations

Introduction



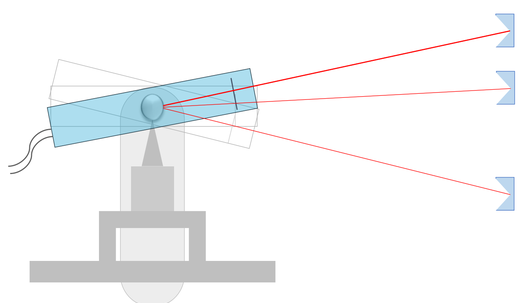
- CMM calibration by multilateration algorithms in large space (5 m^3 - 50 m^3)
- Absolute distance interferometer with two colour laser system (532 nm and 1064 nm)

Design of 3D Lasermeter 2.0

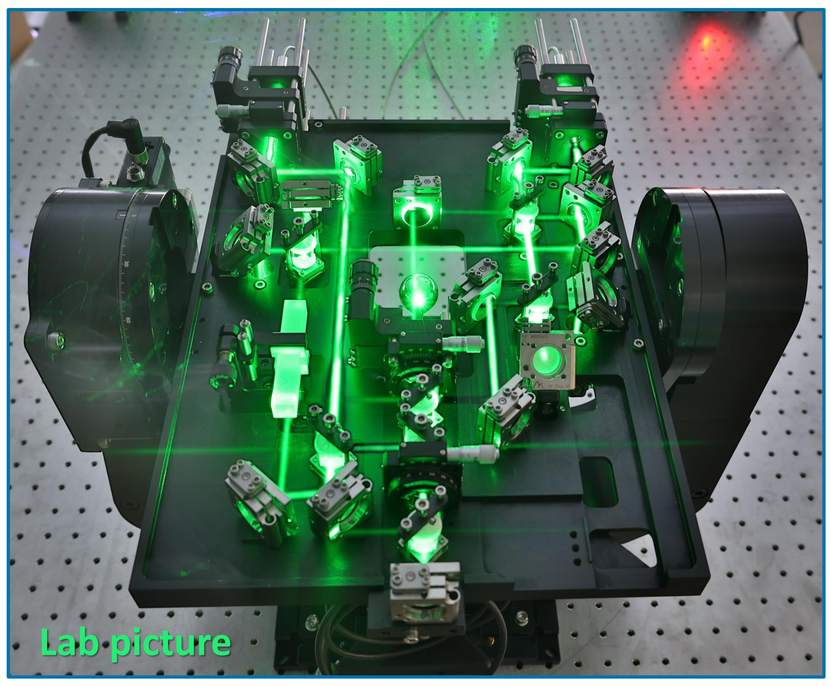


- Heterodyne interferometer principle
- Superposition of VIS and IR beams through a photonic crystal fibre (PCF) represents novel procedure
- Refractive compensation of two colour interferometer with stainless sphere as reference

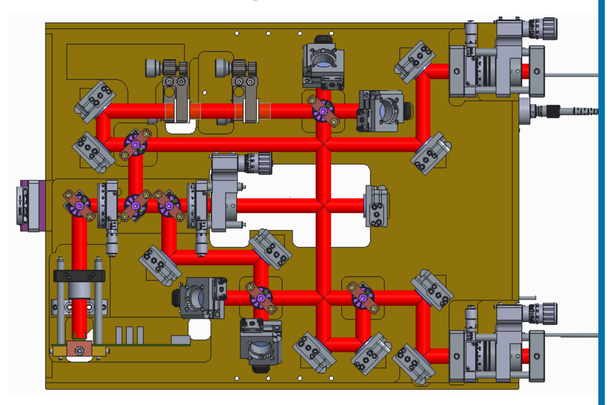
Self Tracking System based on FPGA



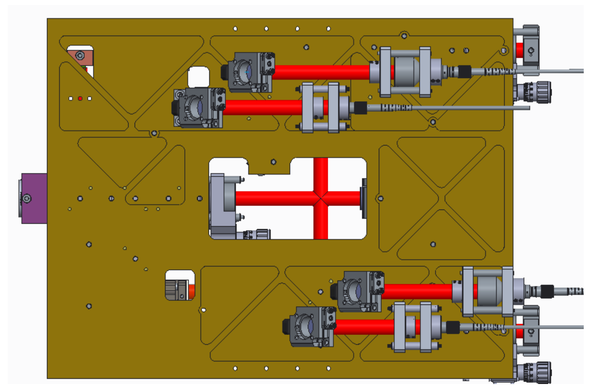
3D Design for Laboratory Prototype

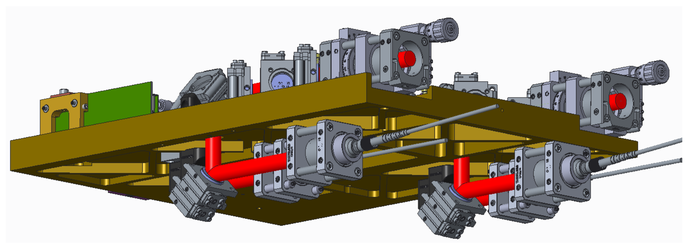


Top view



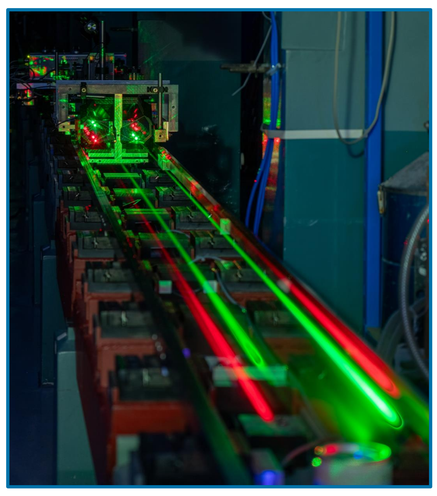
Back view

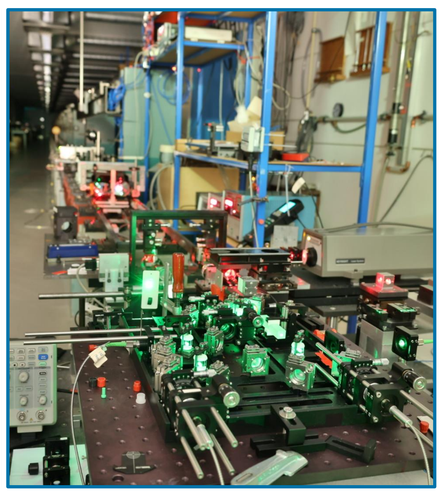


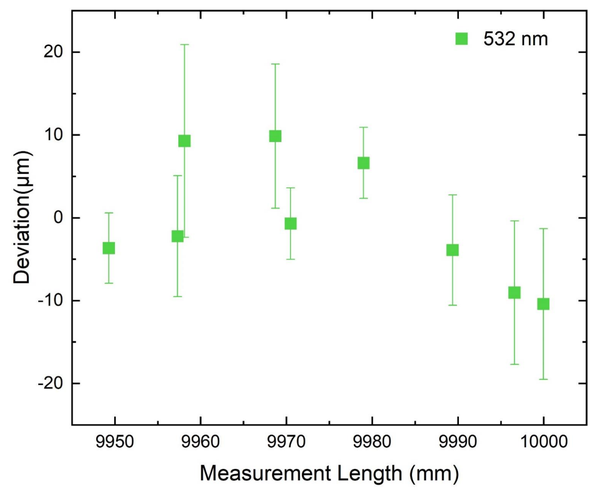


- Two-layer construction of an interferometer with adjustable mountings for optical components
- Thermally and mechanically stable platform with high rigidity
- Commercial Gimbal system (Zaber, Model: XG-RST300-DE50SR10) as mechanical plattform to guide measurement beams
- Reference sphere independently mounted & located on crossing point of three axes (Abbe point) of gimbal system

Preliminarily Results on Geodetic Base System

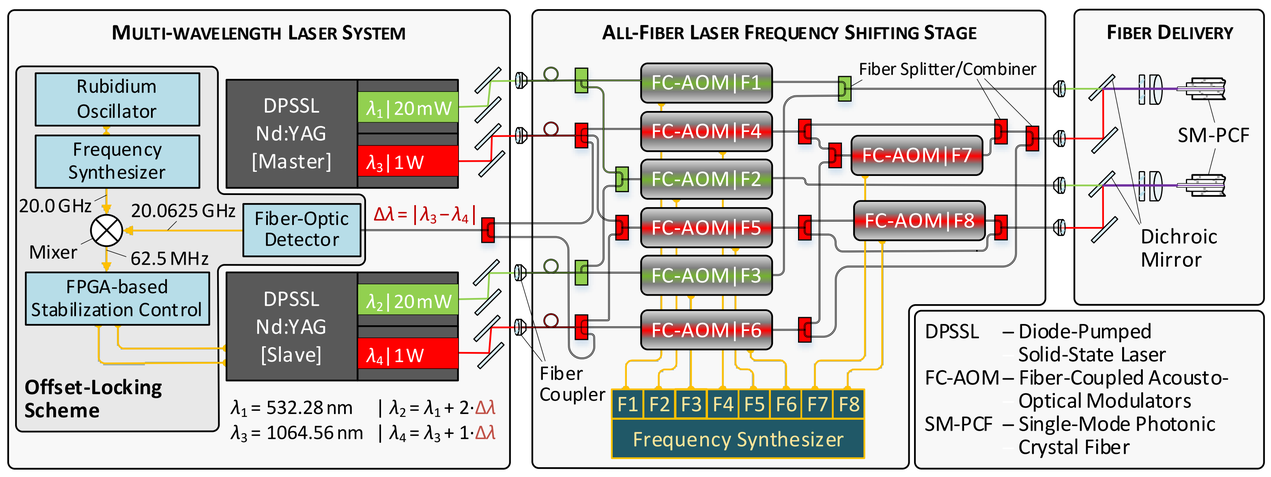






- Comparison of the 3D lasermeter to a commercial laser interferometer at maximum distances up to 10 m
- Measurement modes:
  - Absolute → Frequency sweeping mode
  - Incremental → Fringe counting mode
- Results:
  - Absolute ranging mode using only λ_{VIS}= 532 nm
  - Deviation to linear fit better than 12 µm

Optical Source Plattform



- Nd:YAG based multi-wavelength laser system
  - Optical phase-locked loop (OPLL) system
- Acousto-optical modulator (AOM) based frequency shifting:
  - Heterodyne displacement interferometry
  - Lock-in beam detection for colour separation
- 532/1064-nm superposition by photonic crystal fibres (PCF)

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