Integrating Magnetic Field Mapping Crack Detection and Coordinate Measurement

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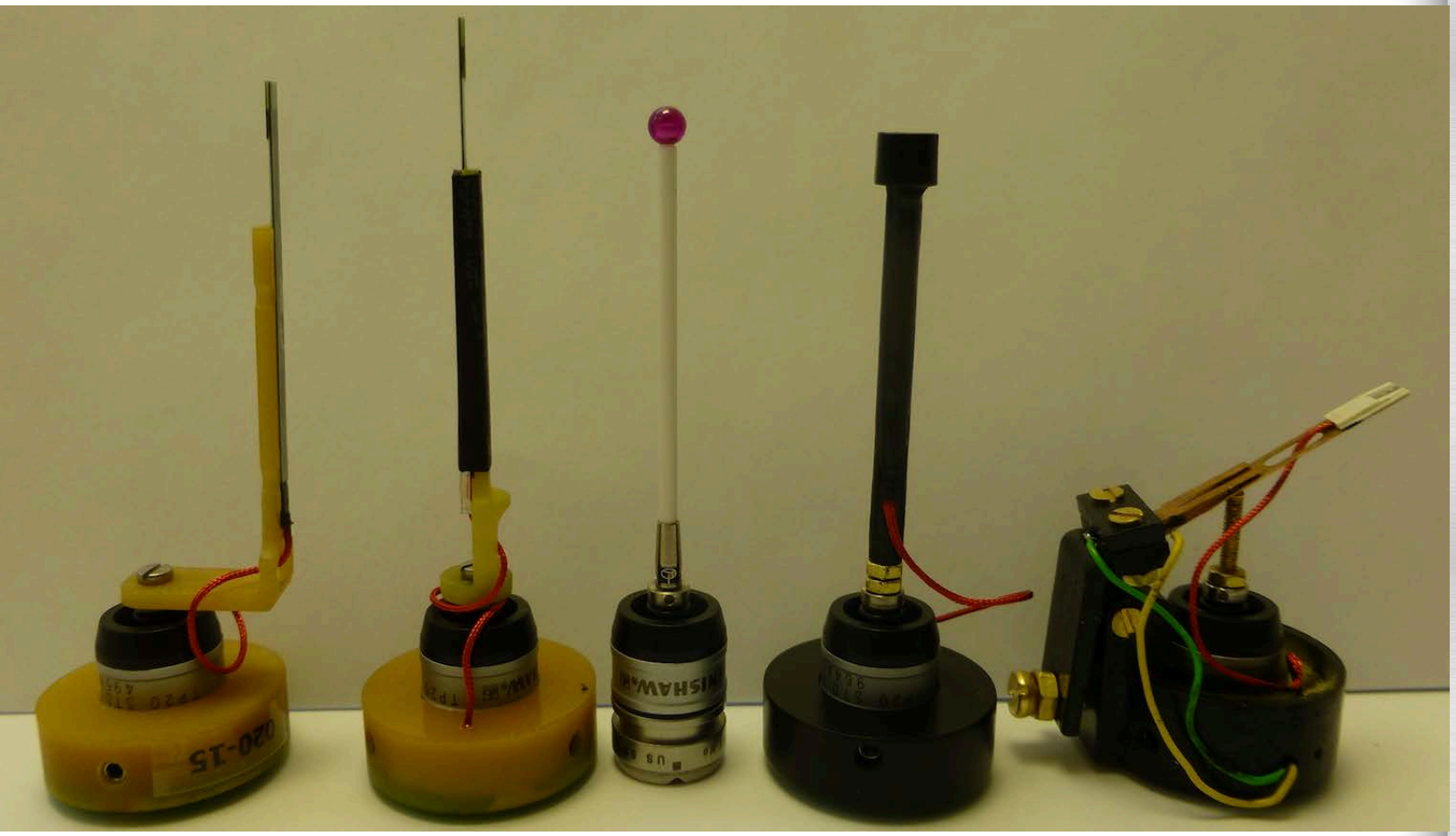
State-of-the-art Hall-based Magnetic Field Mapper

- 4 Axis capability: X,Y, Z and θ
- Scanning volume: up to 500mm cubical volume
- Scanning speed: up to 100mm/s
- Probe positioning resolution: ±2µm (X,Y,Z) / ±0.02° (θ)
- Standard magnetic resolution: < 10µT (rms)
- Measurement accuracy: 0.1% of measurement range
- Angular error (calibrated): 0.1°
- Measuring sensitive volume: <150 x 10 x 150 µm
- Magnetic field range: selectable ± 100µT to ±2T
- Magnetic field bandwidth: DC to 25 kHz (-3 db)

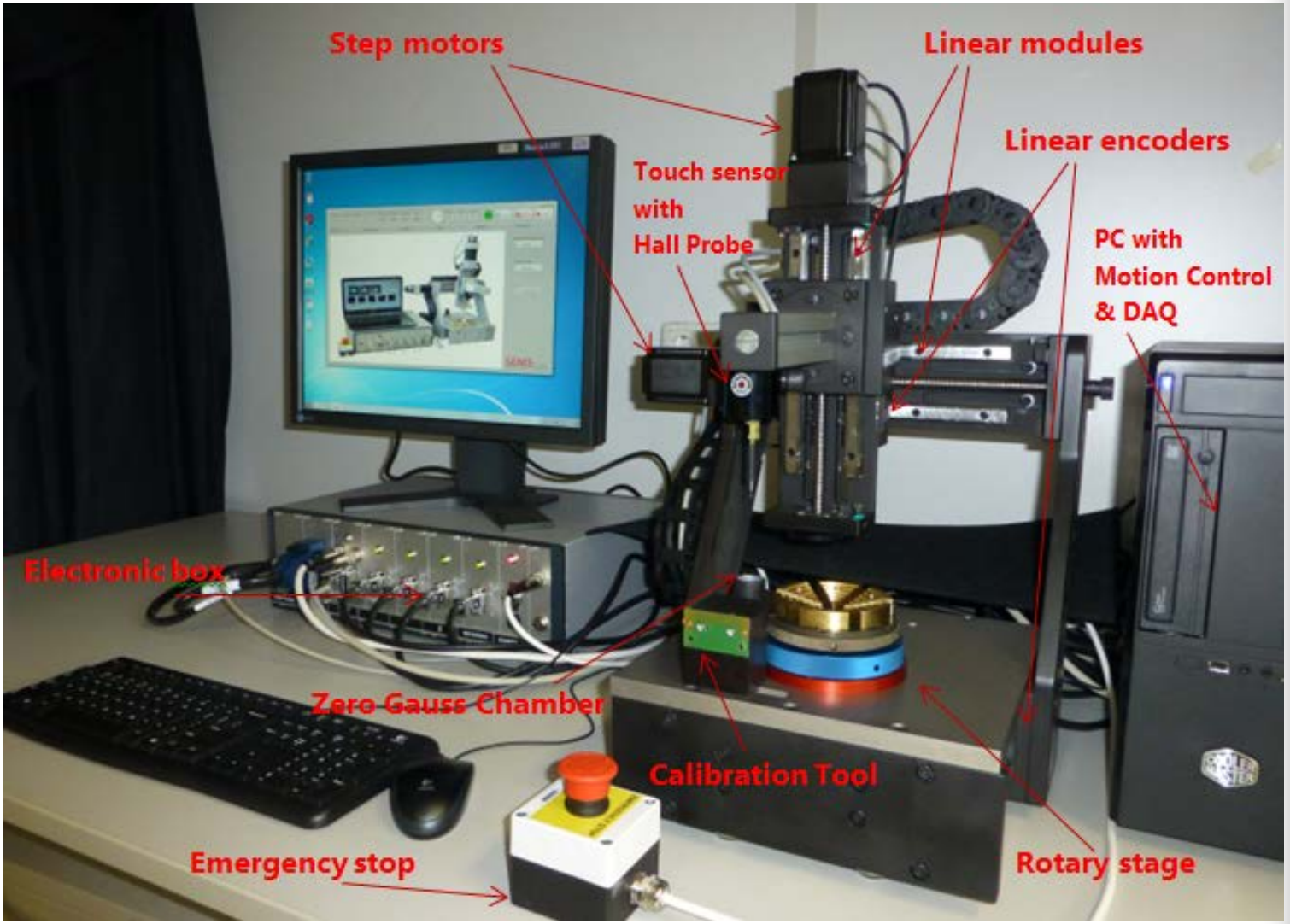
Increasing requirements for Magnetic Field Mapper

- Measurement of all three components of the magnetic field at the same spot
- Small overall dimensions of the probe
- Well calibrated mechanics (Cartesian Moving platform)
- Accurate positioning of the probe with respect to a coordinate system of the mapper
- Accurate positioning of objects under test
- Cracks and material inhomogeneity detection
- Specialized measurements (e.g. rotor mapping)
- Performance - Price - Ratio

Increasing Requirements for Magnetic Field Mapper



All-in-One Magnetic Field Mapper



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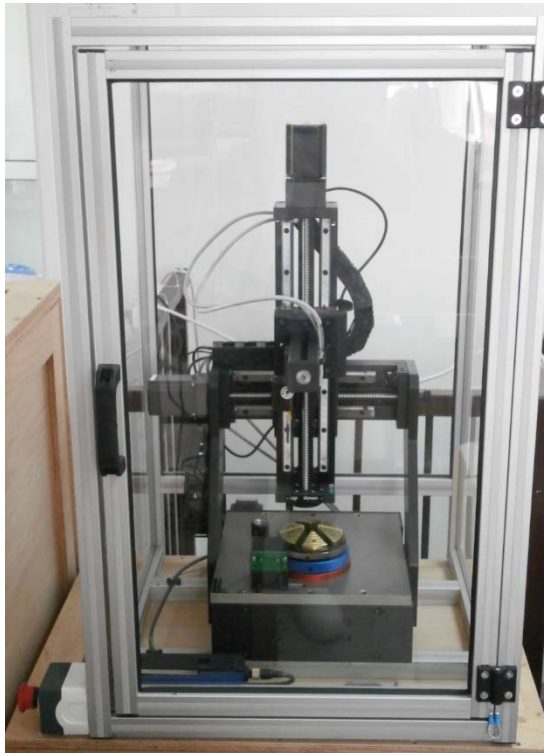
Mapper Size

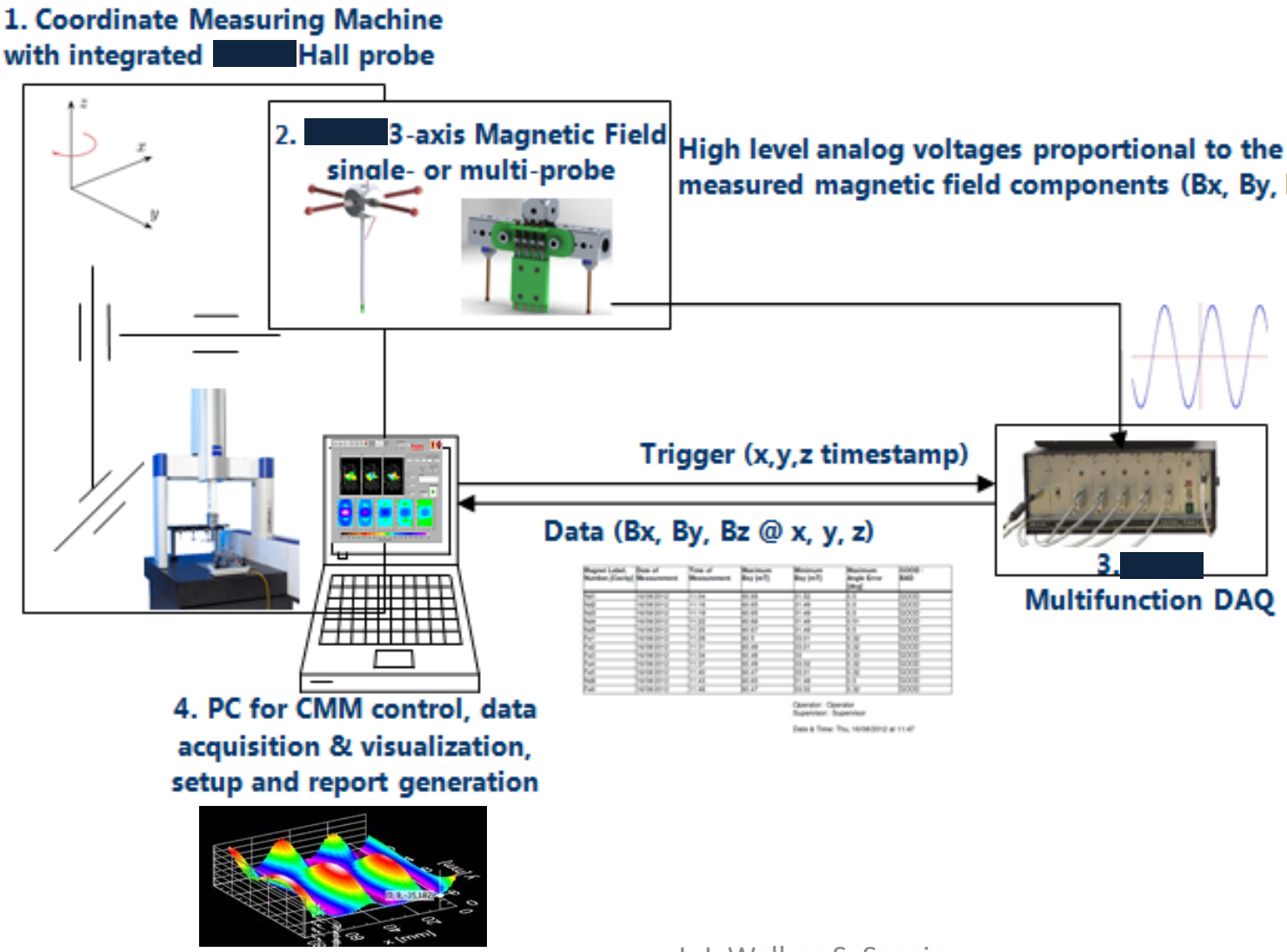
- Standard: scanning volume 135mm x 135mm x 135mm
- Extended: scanning volume 500mm x 500mm x 500mm

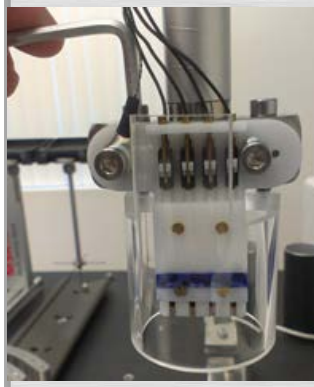


Applications of Mappers

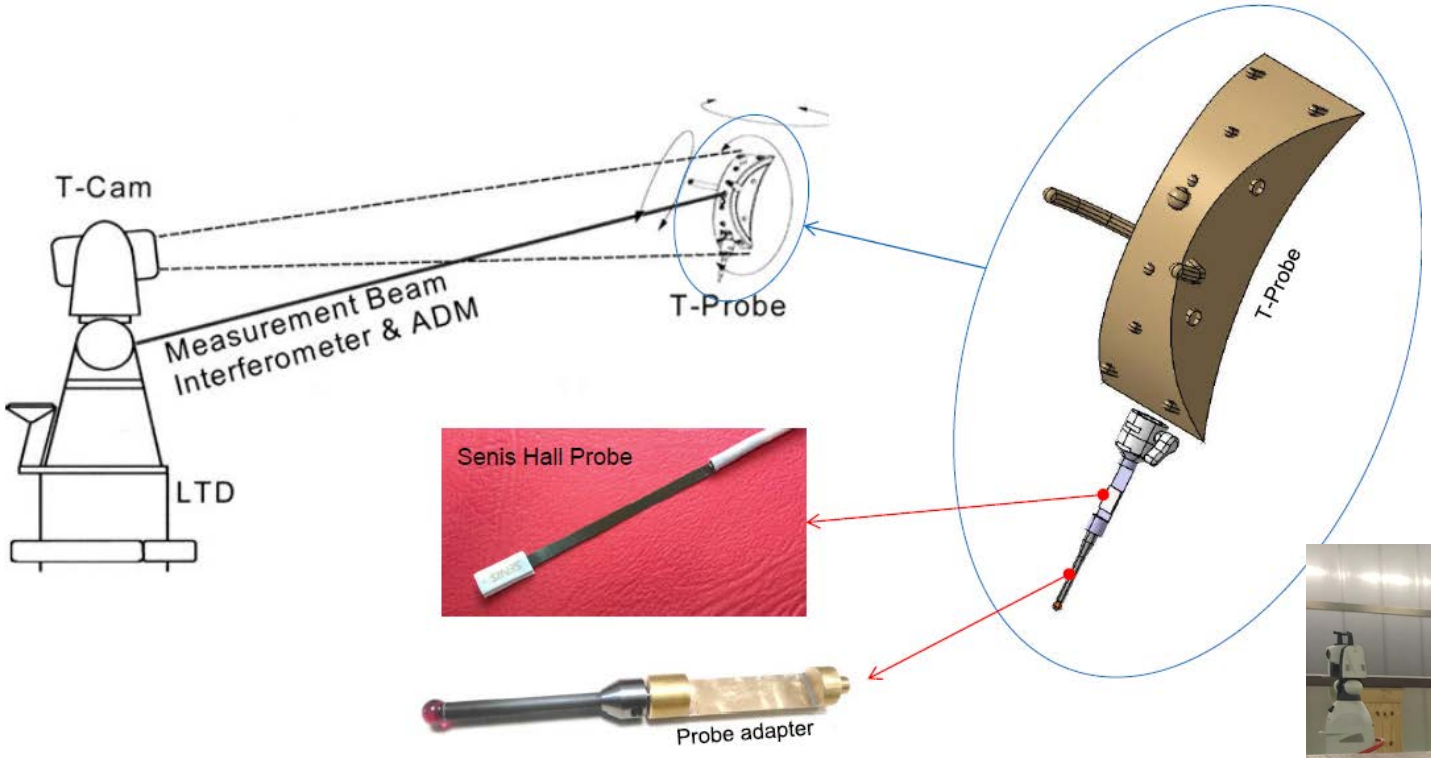
- DC and AC magnetic flux densities (25kHz and higher)
- Homogeneous and highly inhomogeneous fields
- Permanent magnet mapping (disc, ring, block, segment)
- Magnetic moment, polarization angle determination
- Mapping of Rotors and Stators (small motors, turbines)
- Mapping of quadrupoles
- Cracks and inhomogeneity detection (also non-magnetic)
- Mapping of micro structures (encoders, code-plates, etc.)
- Smartphones & PCB mapping
- Quality Control, Development, Testing
- Automotive, Energy, Consumer Industry
- Research Laboratories, Accelerators, Light Sources, Synchrotron Radiations…

Mapper Integration in Zeiss CMM

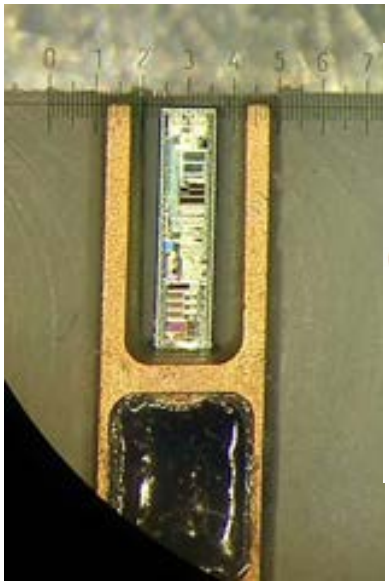


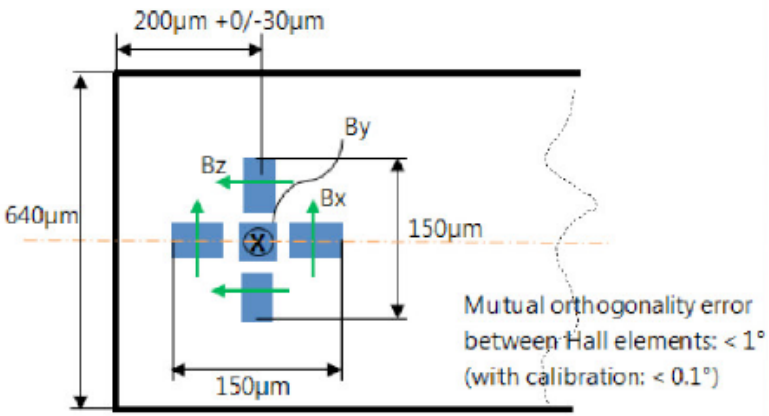


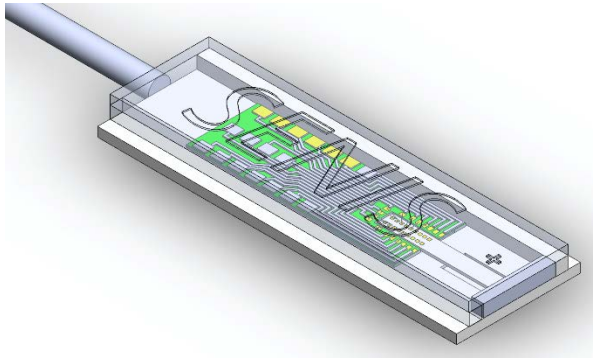
Leica Laser Tracker Integration

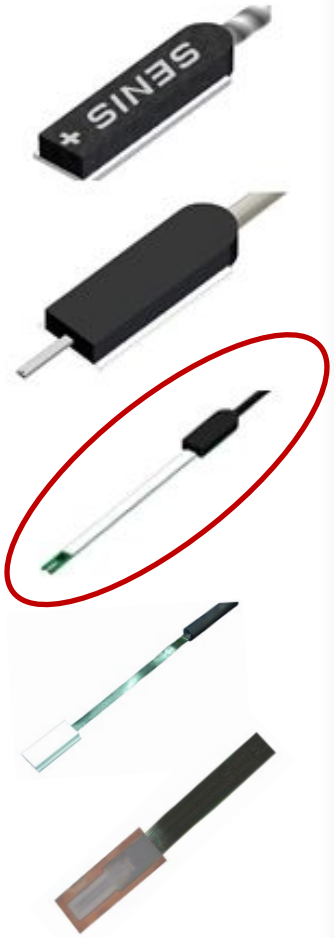


3-axis Hall Probe





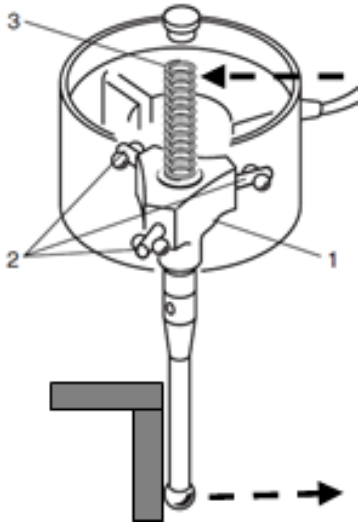


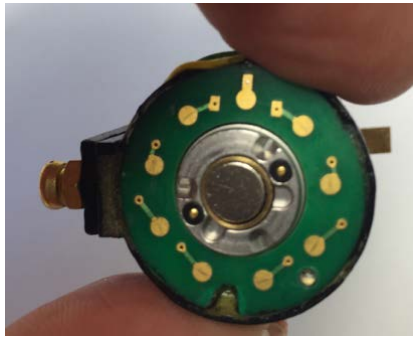


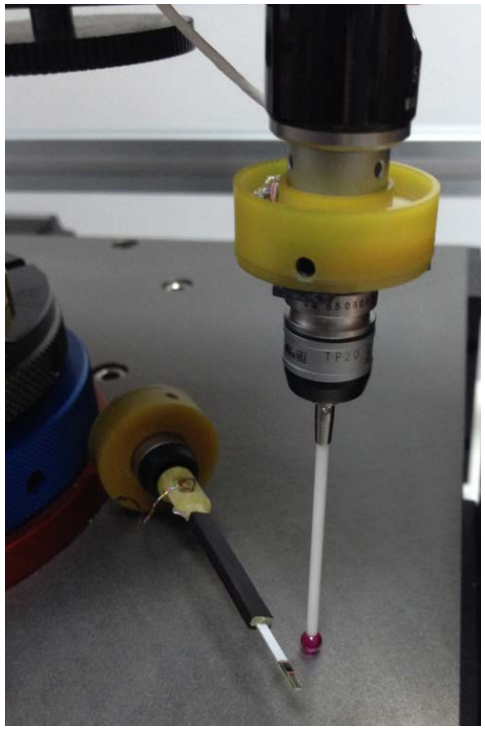
Standard dimensions of the mapper probe:
(LxWxH in mm): 42.0 x 2.0 x 0.5

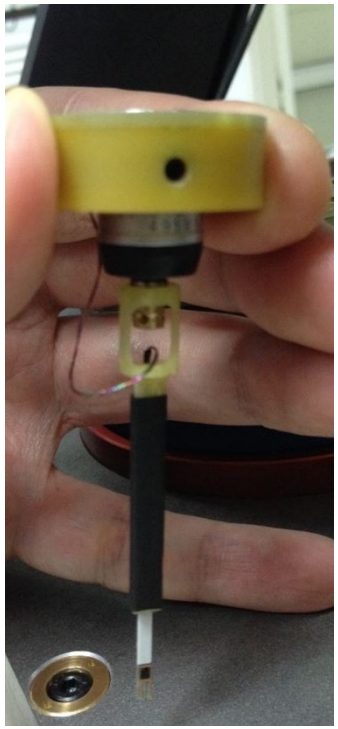
Touch Sensor Integration

- Touch-trigger sensor and stylus



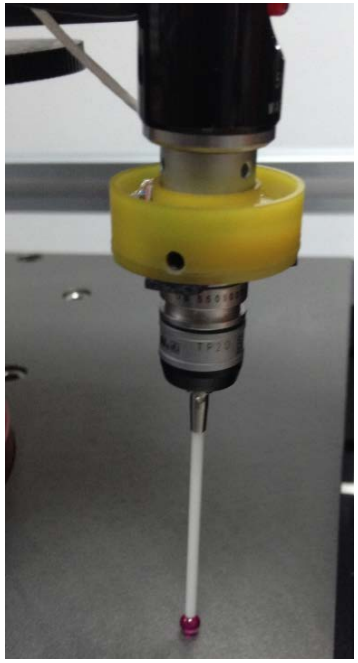


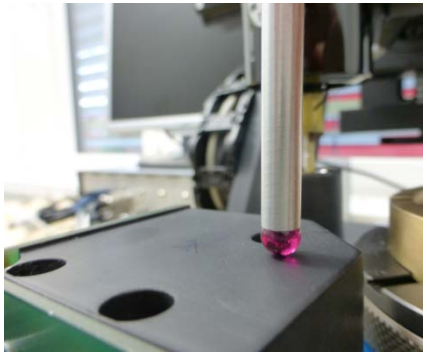




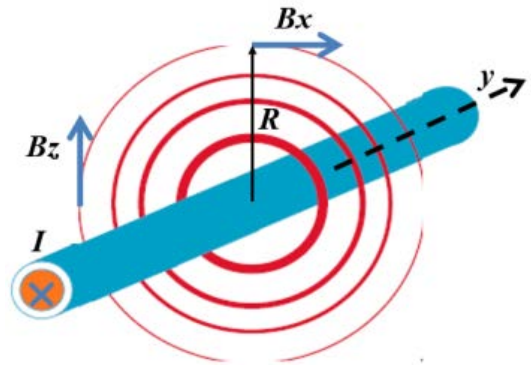
Dimensional Measurement

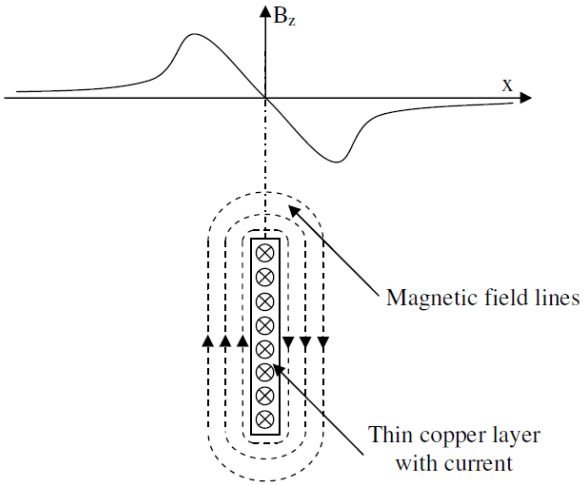
- Simple dimensional measurement
- Absolute magnet positioning
- Measurement distance definition
- Mapper calibration

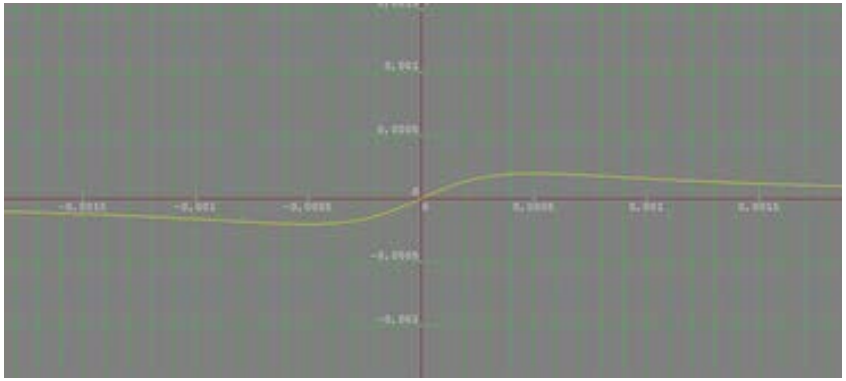




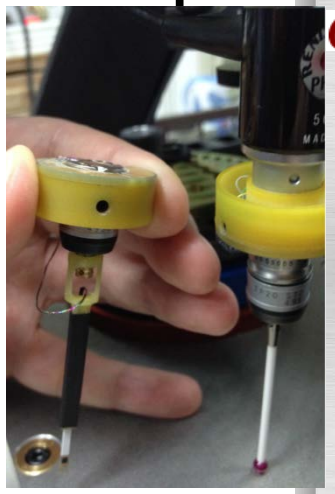
Determination of probe's Magnetic Field Sensitive Volume



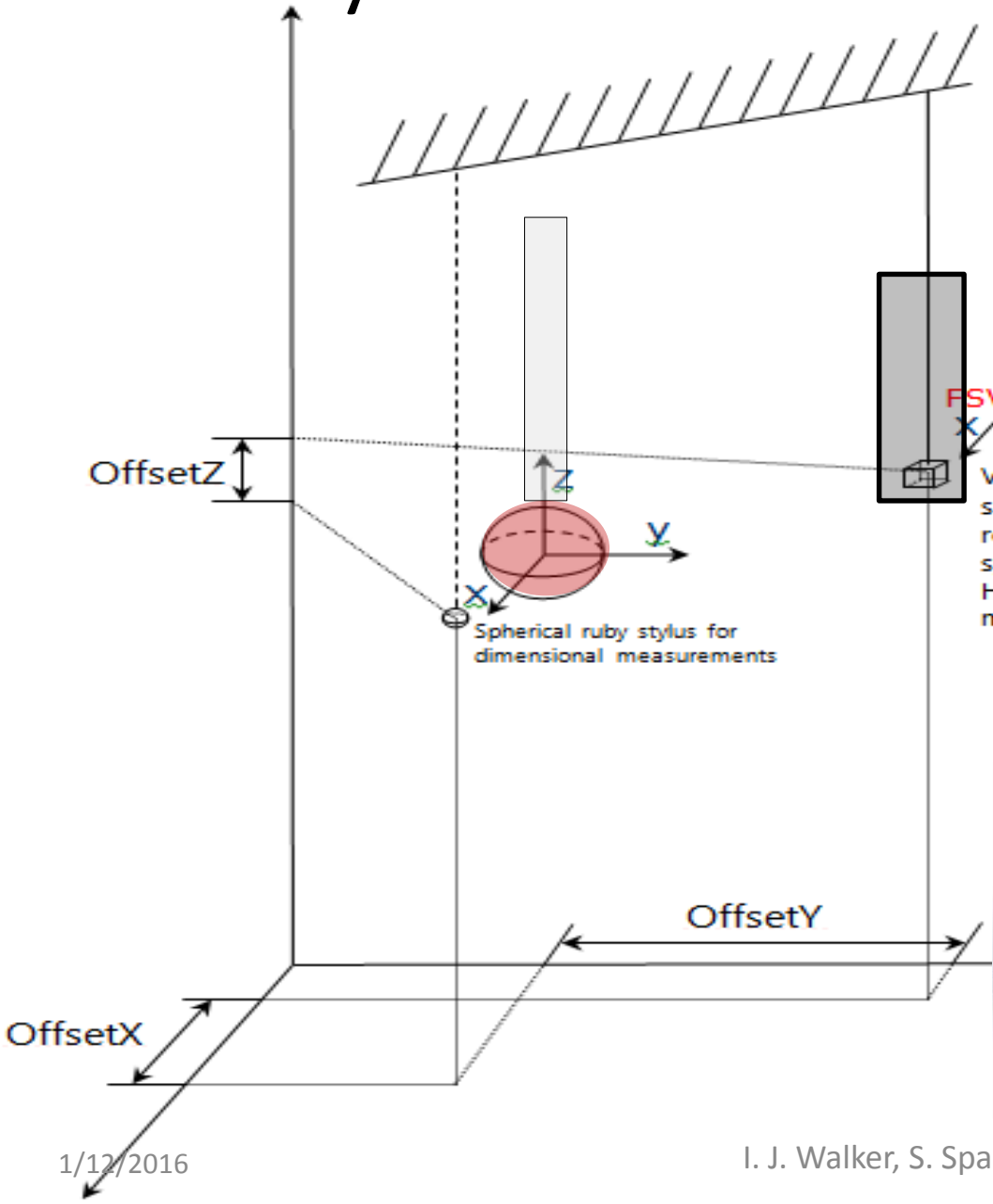


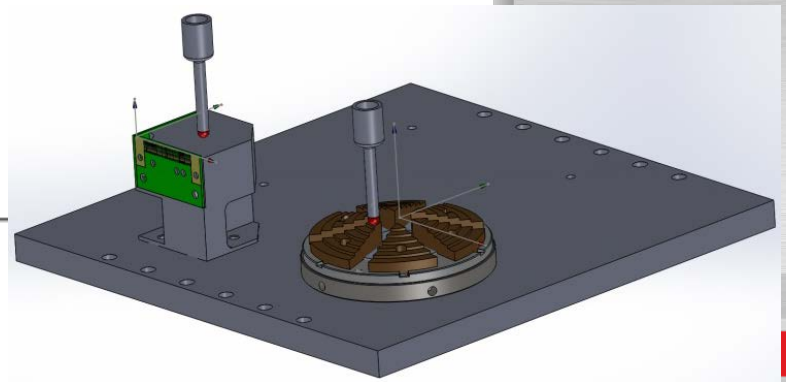


Touch-Stylus <–> Probe's Sensitive Spot

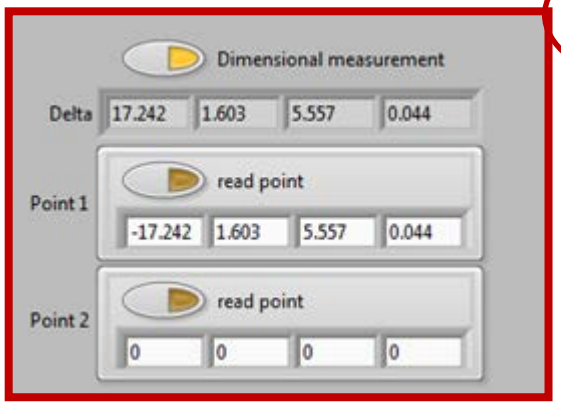


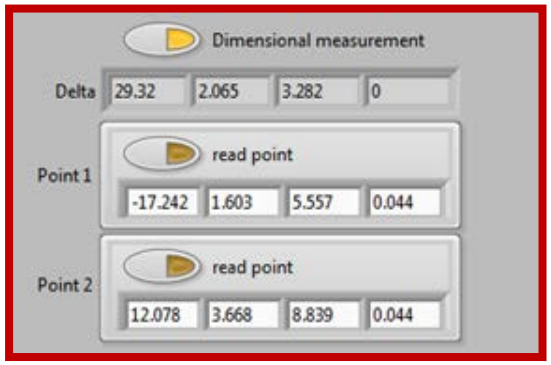
Virtual stylus with magnetic field sensitive point in position (0, 0, 0) in respect to the stylus's coordinate system (calibration alignment) => Hall probe for magnetic measurements

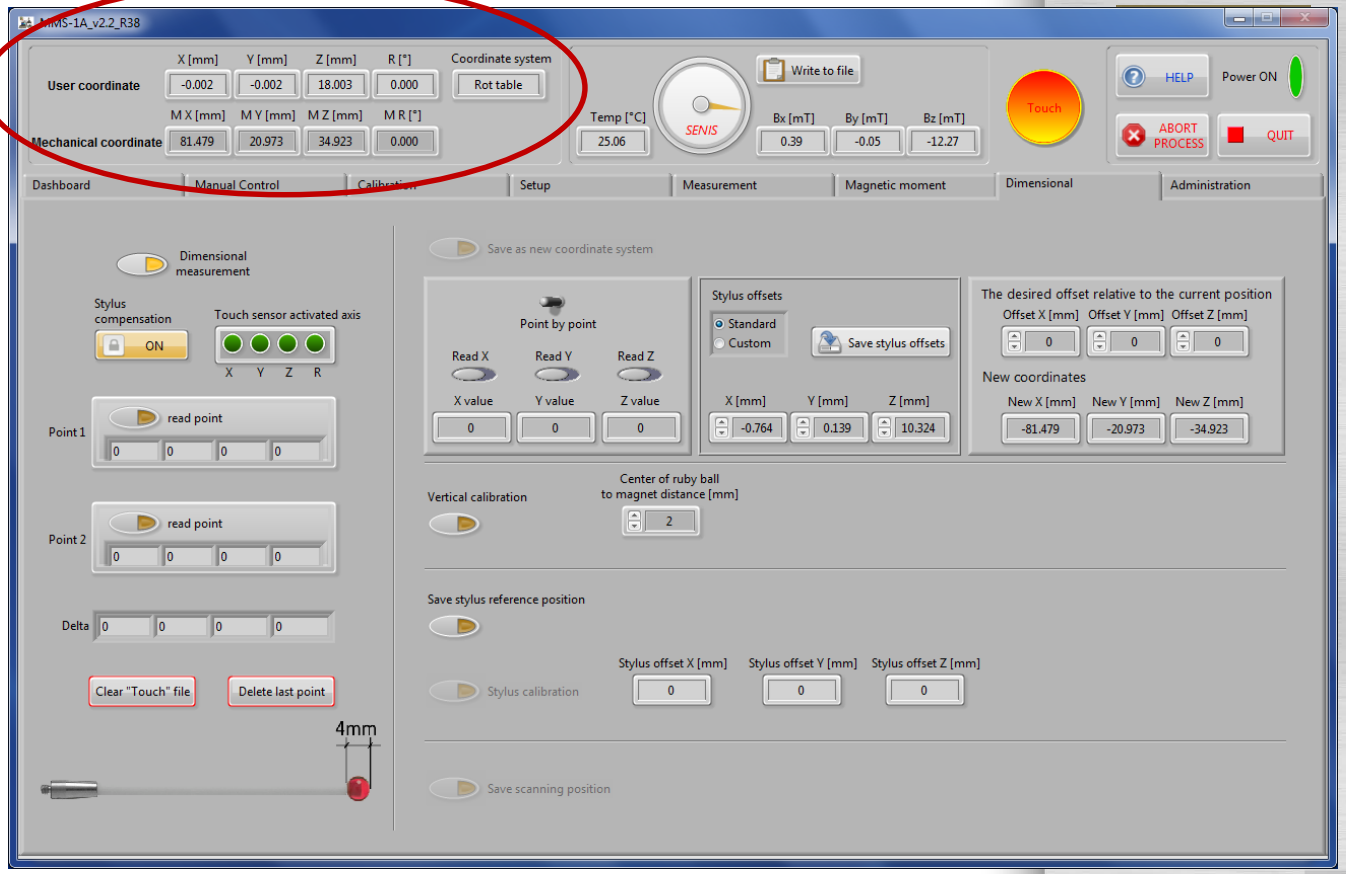




Dimensional Measurement



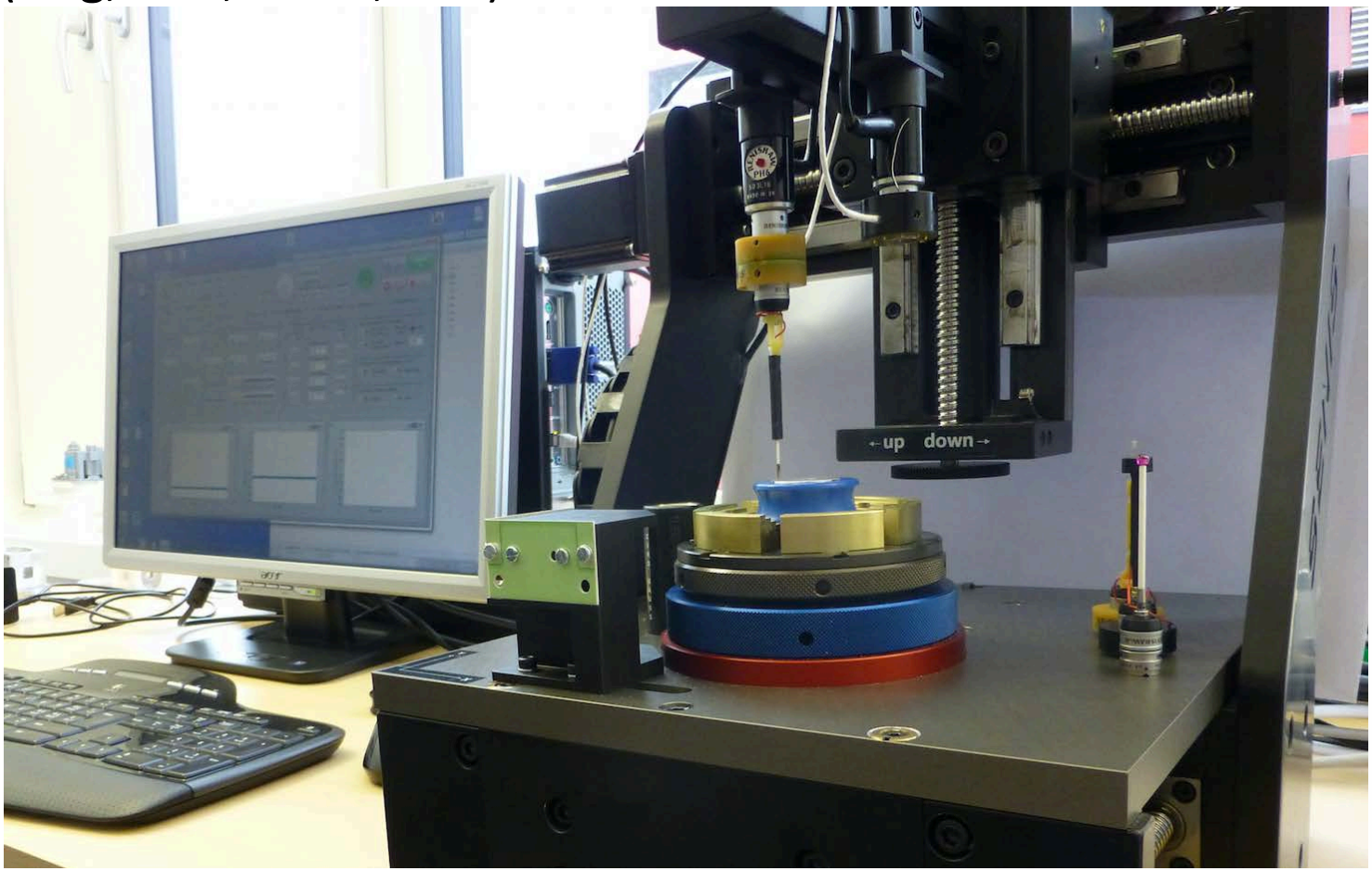




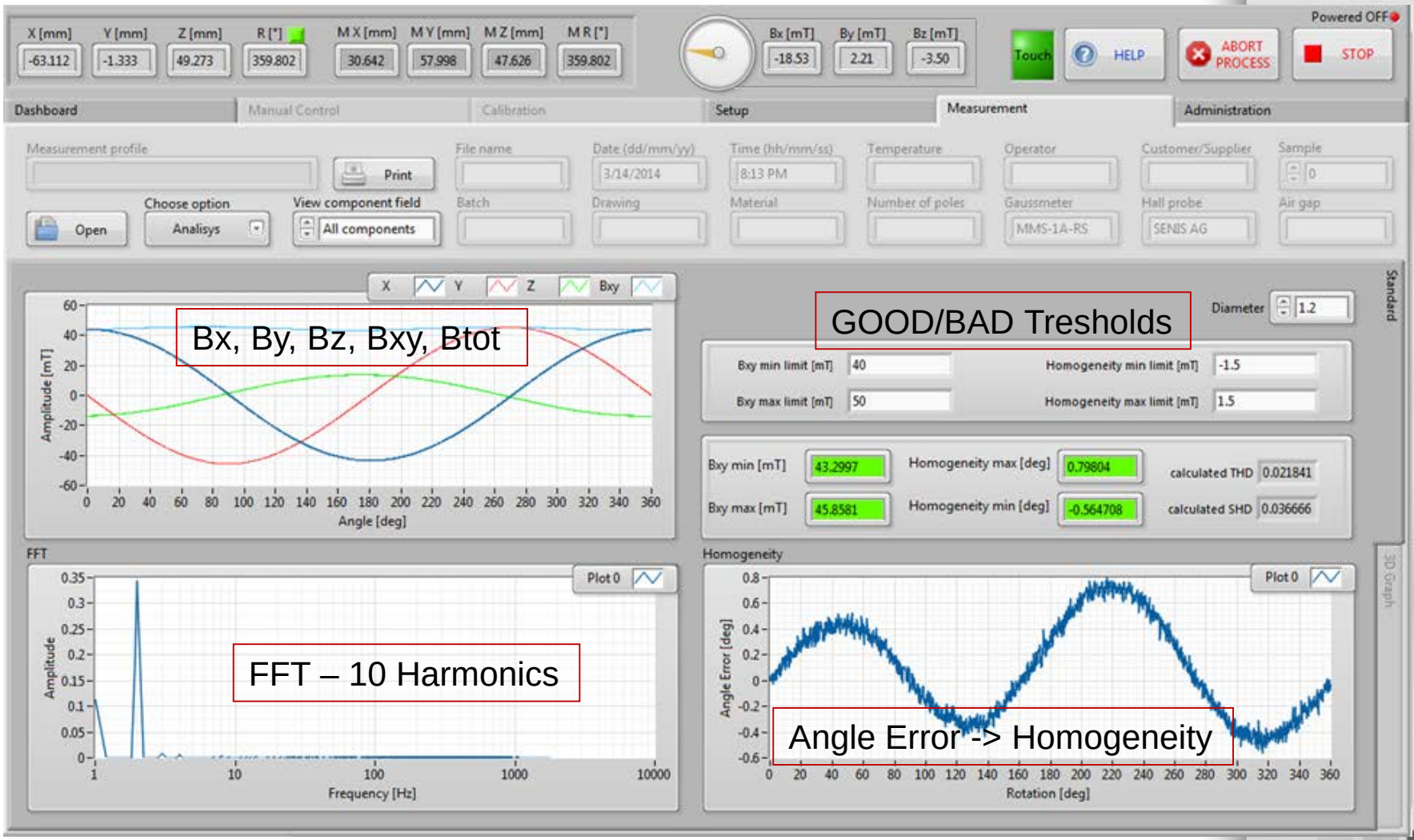
$$\Delta(x,y,z) = P2_{(x2,y2,z2)} - P1_{(x1,y1,z1)}$$

Magnetic Field Mapping

- Measurement (mapping) of the DC/AC 3-axis magnetic field around permanent magnets of all materials and geometries (ring, disc, block, etc.).

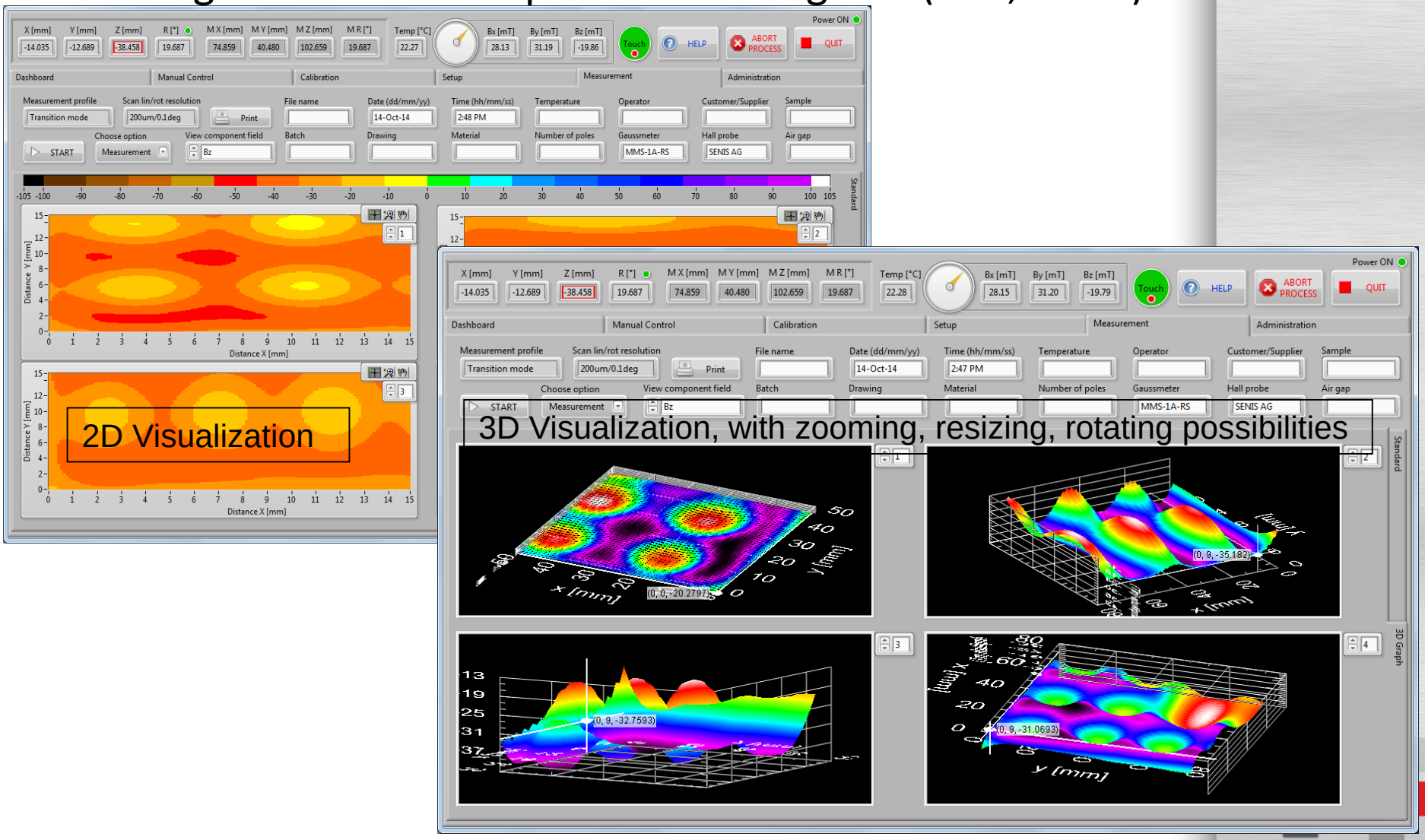


Magnetic Field Mapping



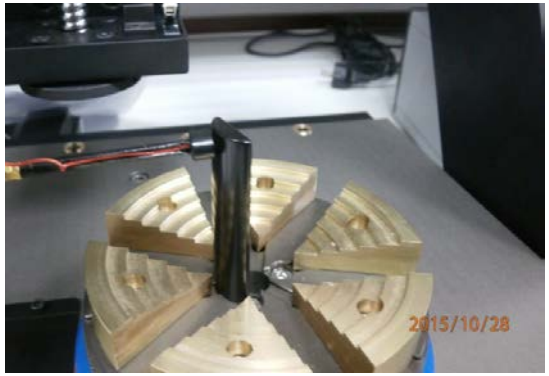
Magnetic Field Mapping

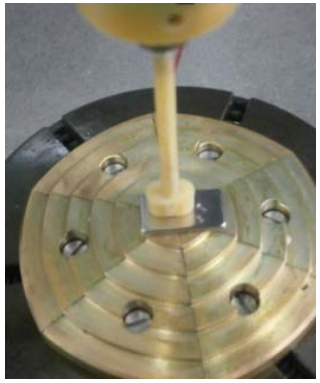
– Scanning an area around permanent magnets (disc, block)

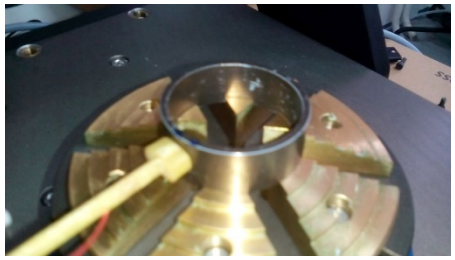


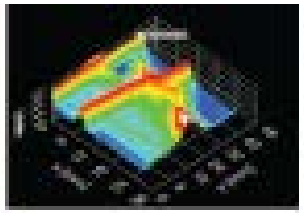
Crack & Inhomogeneity Detection

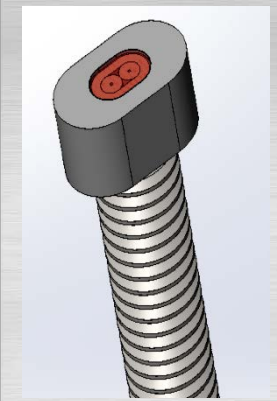
- Eddy-Current probe for cracks and inhomogeneity detection in magnetic materials and in non-magnetized parts.





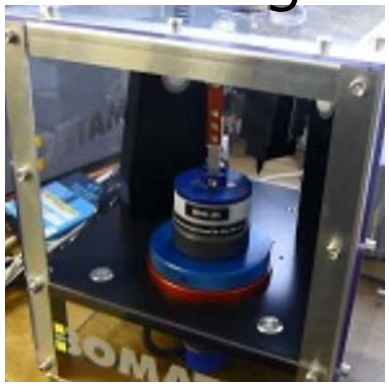


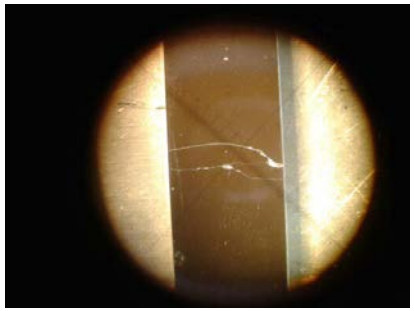


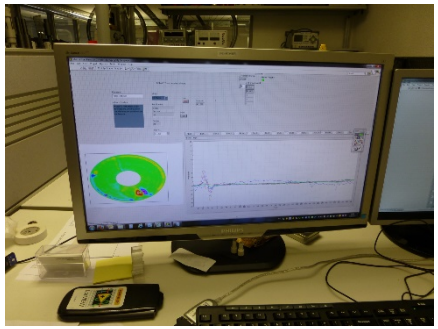


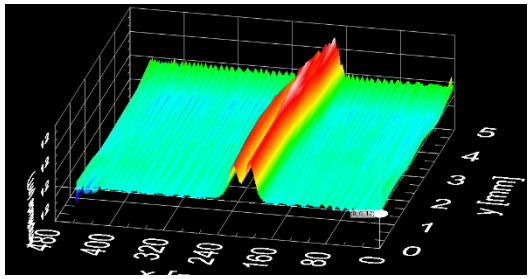
Crack & Inhomogeneity Detection

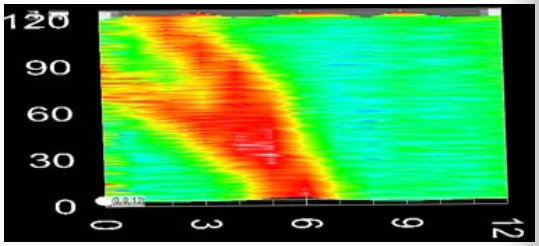
- Visible and invisible cracks (inside material or under coating)
- Inhomogeneity inside material (prior to magnetizing)

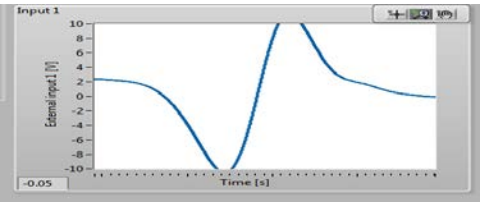


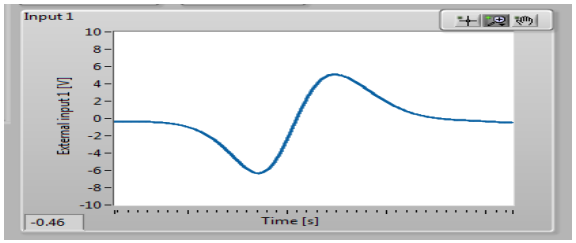


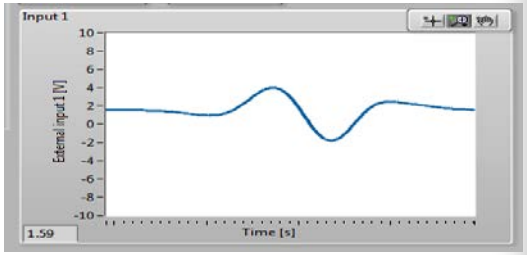












2D & 3D Visualization

Diff.-Voltage Visualization

Defectoscope for Crack Detection

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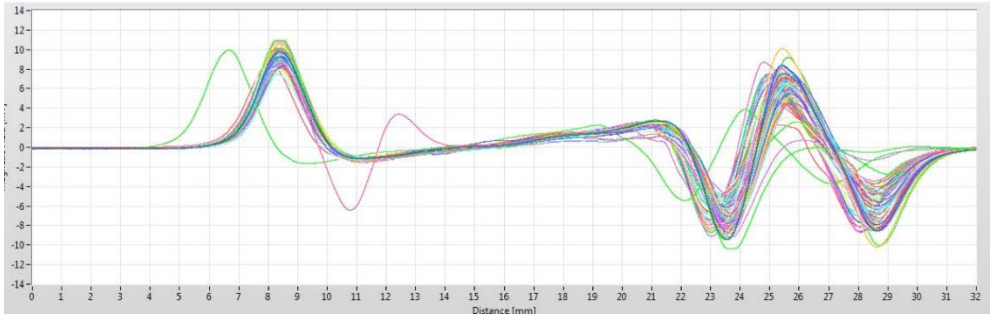
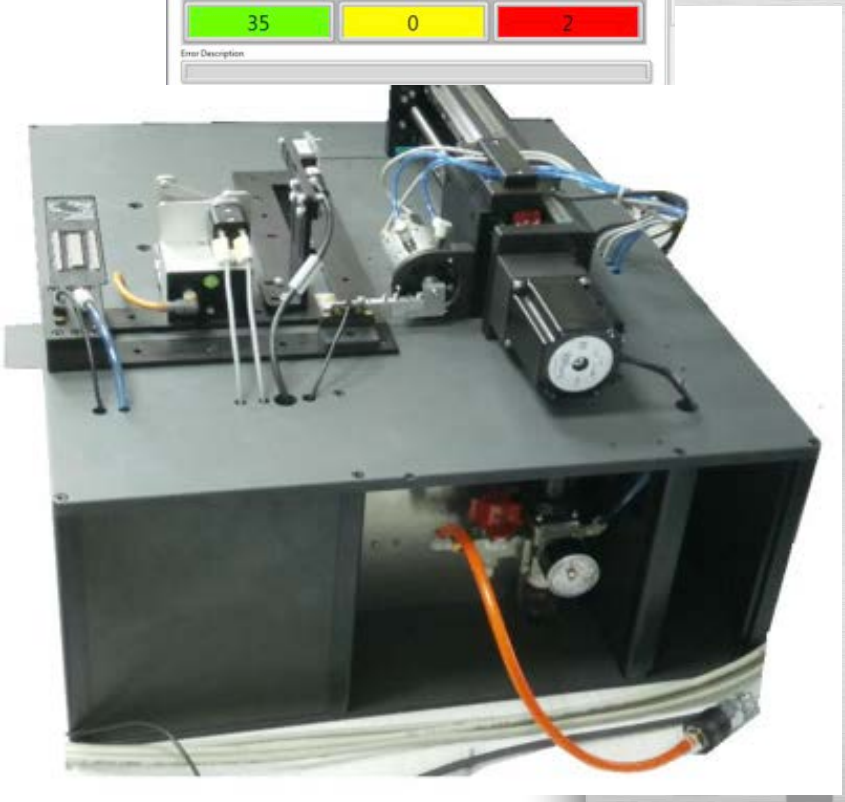
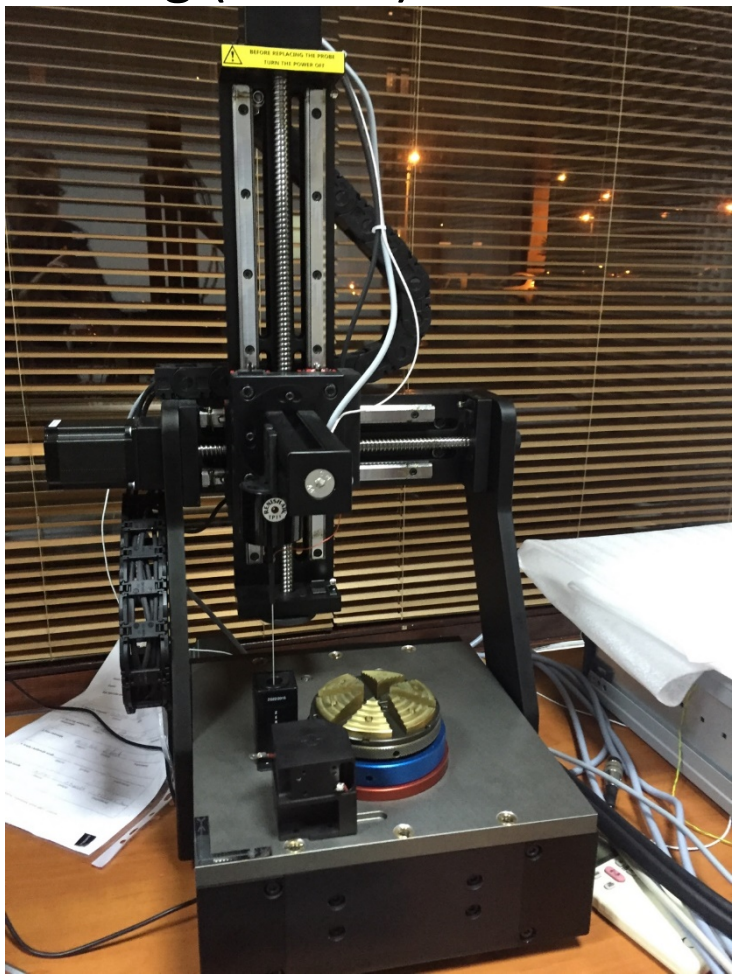
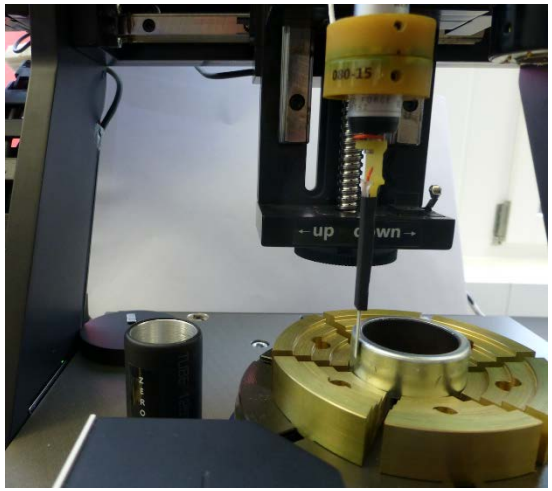




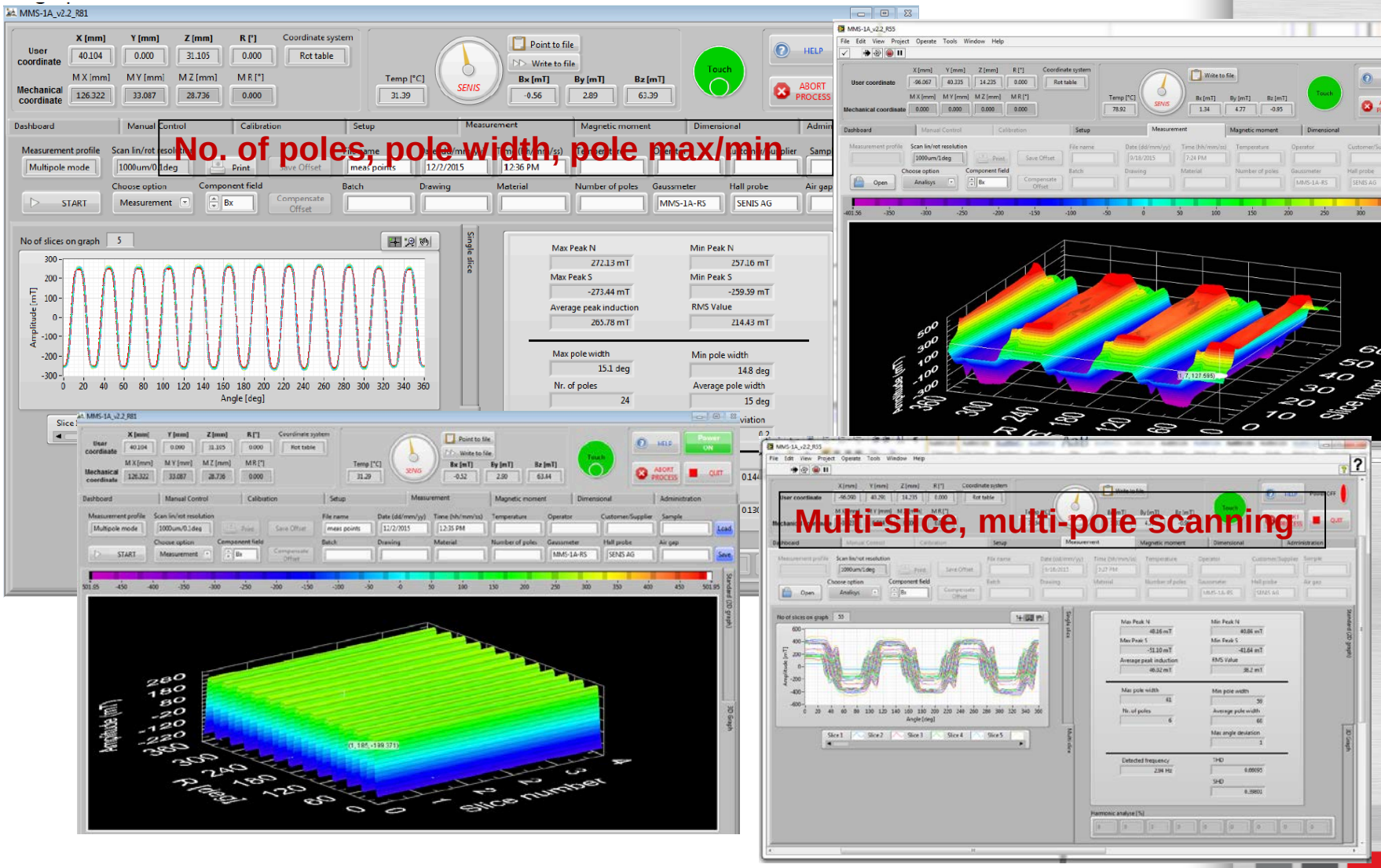
Rotor Measurements

- Specialized probes with a “knee” for higher rotors or very long (90mm) and thin for air gaps of large rotors-stators



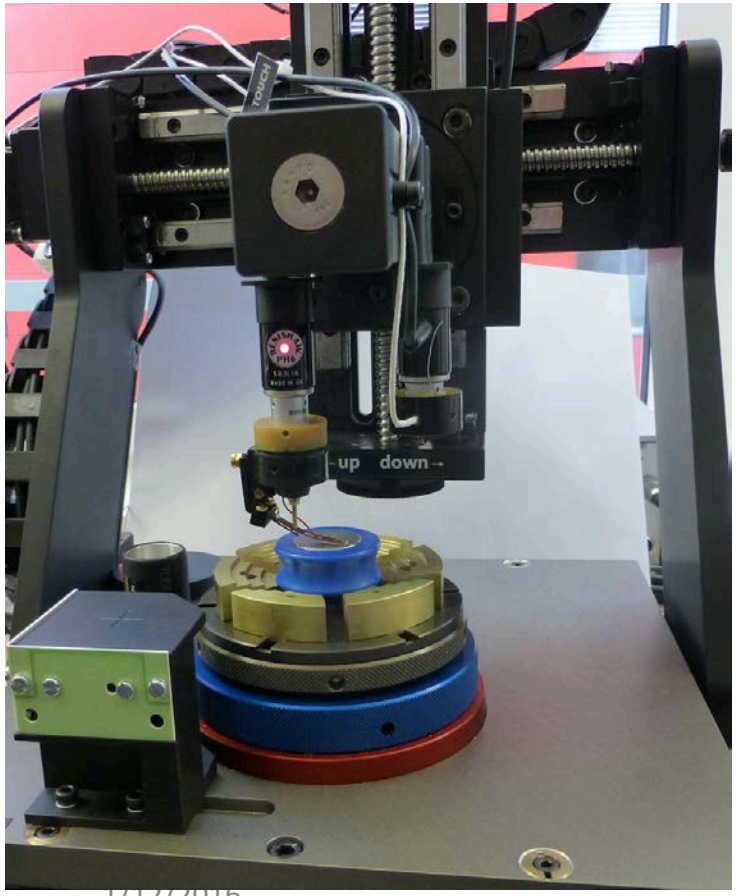


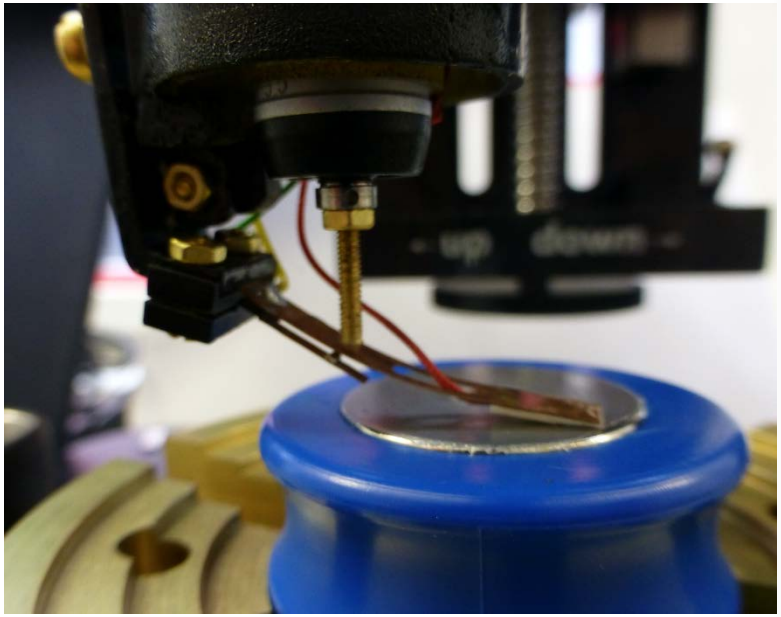
Rotor Measurements



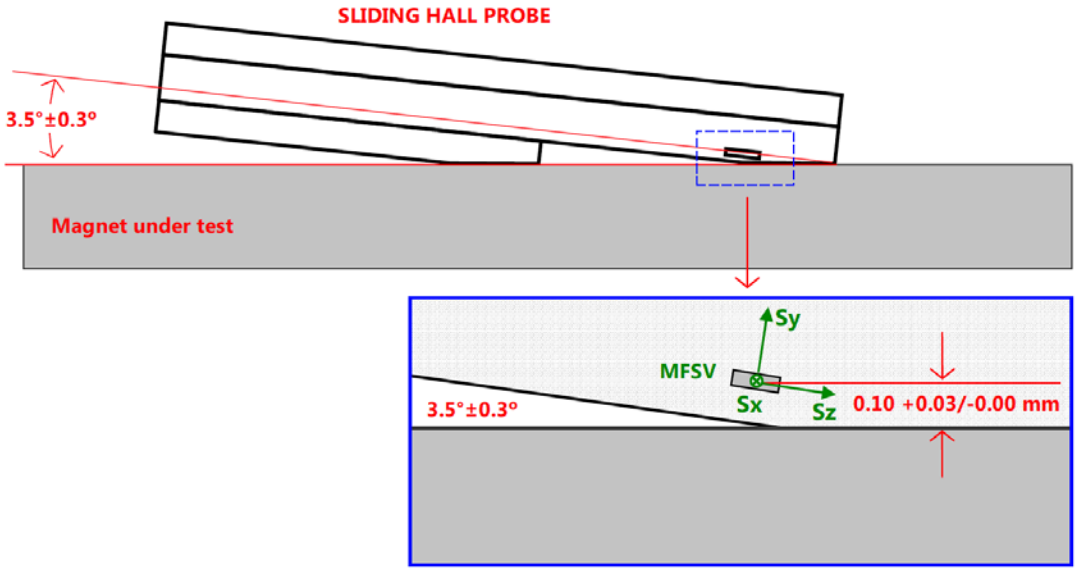
In-Contact Measurement

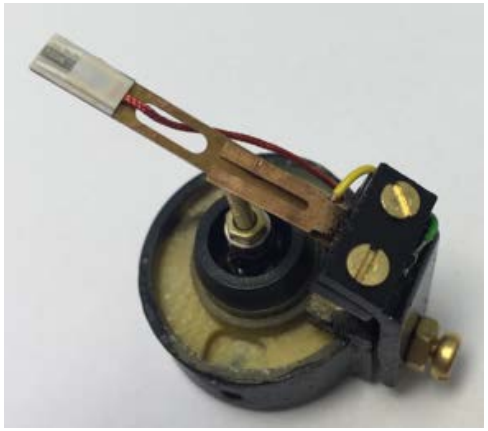
- Sliding Probe for In-Contact Measurement





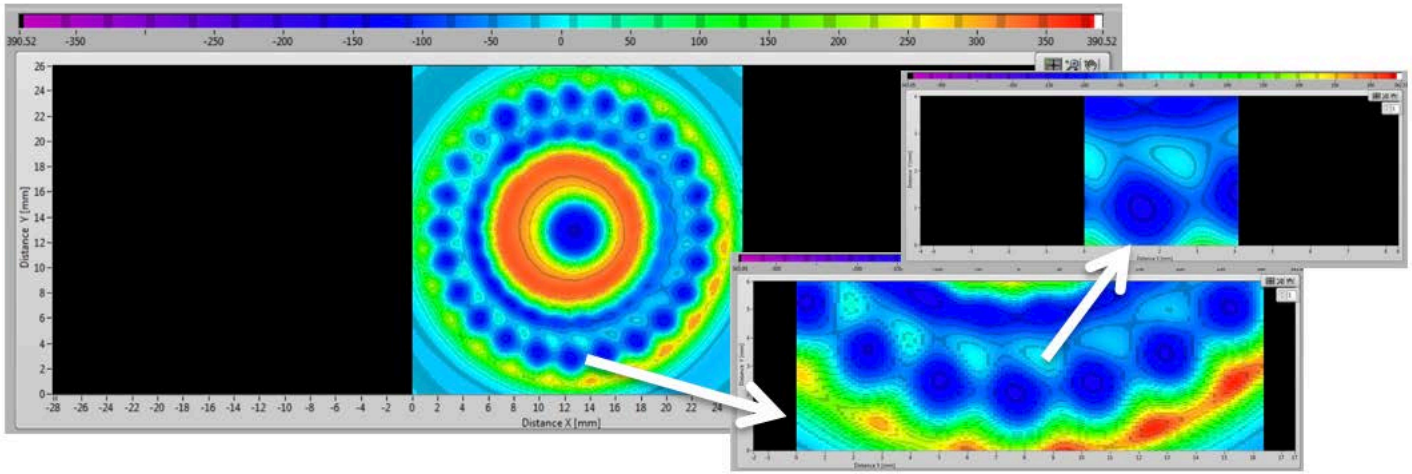
In-Contact Measurement

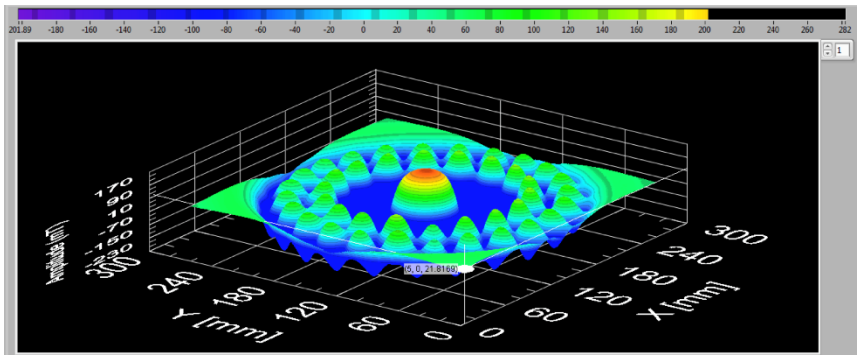


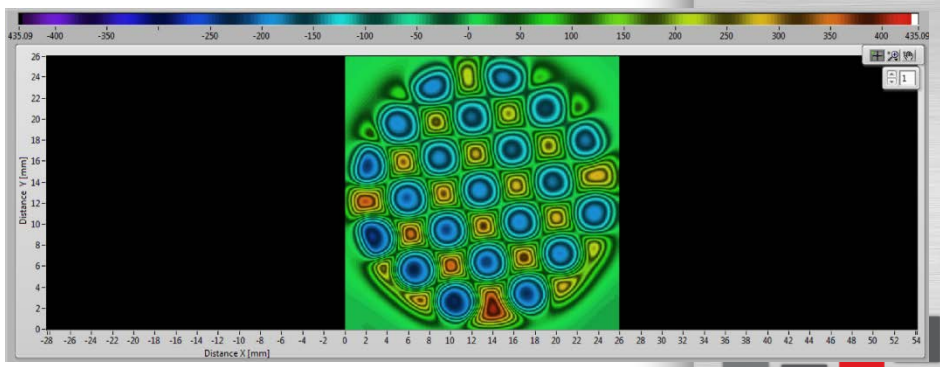


In-Contact Measurement

- Scanning of magnetic microstructures with the sliding probe

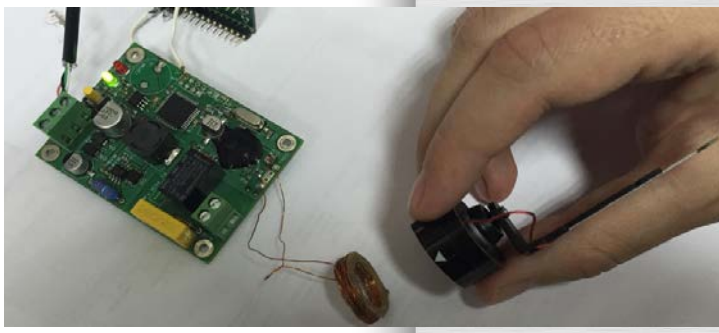






Further Developments

- RFID for automatic identification of the connected probe has already been implemented
- The mapper option “additional analog/digital inputs” allows integrating of customers own probes, such as Hall probes for comparative measurements
- Magneto-optical sensors can be integrated for quick tests and mapper for the detailed magnetic field measurement
- Magnetic arrays and cameras (probe matrix) for specialized measurements
- Integration of the manually indexing touch sensor for positioning the probe in any angle between 0° and 90° in respect to the mapper table (has been implemented)



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▶▶▶ Our World Records:

the only fully integrated 3-axis Hall Probe on the market

the smallest and thinnest 3-axis Hall Probe

magnetic field transducer & teslameter

with the highest resolution

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magnetic field measurements with the highest accuracy

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