CIRP Office : 9 rue Mayran - 75009 Paris - Tel. (33) 1 45 26 21 80
E-Mail: cirp@cirp.net Web : www.cirp.net

2025 GENERAL ASSEMBLY

Stockholm - Sweden

CIRP-2025-P-3

SCIENTIFIC TECHNICAL COMMITTEE "P"
(PRECISION ENGINEERING & METROLOGY)

Meeting to be held on Friday, August 22, 2025
8.30 - 12.30

You are kindly invited to participate in the next PRECISION ENGINEERING & METROLOGY Scientific Technical Committee meeting to be held in Stockholm.

Draft Agenda

1. Opening, welcome and introduction of invited guests

2. Modification/approval of the agenda

3. Approval of the 2025 Winter meeting minutes, matters arising

4. Keynote papers – status updates

4.1 Feedback on 2025 STC P Keynote
Dimensional metrology based on ultrashort pulse laser and optical frequency comb, (W. Gao)

4.2 2026 STC P Keynote (status update)
Machine learning in production metrology, (G. Lanza)

4.3 2027 STC P Keynote
Optical measurement in machines, (J. Mayr)

4.4 2028 STC P Keynote
Traceability and Measurement Uncertainty Assessment in Machine Tool Coordinate Measurements, (U. Mutilba)

4.5 2029 / Future keynotes

5. Special presentation

5.1 *The 150th Anniversary of the Metre Convention*, Harald Bosse (PTB)

Coffee Break [10:00 – 10:30]

6. Focused topic area of interest to STC P

6.1 Introduction (A. Archenti)
6.2 Presentation: *Engineering Micrometric Alignment Solutions for the LHC's Harsh Environment* (Mateusz Sosin, CERN)

7. Short technical presentations and reports on ongoing research work

7.1 *Towards accurate in-process monitoring and control in metal laser powder bed fusion: metrological solutions and open challenges*, Filippo Zanini, Department of Management and Engineering, University of Padua, Vicenza, Italy

Abstract: In-process monitoring and control are crucial to enhancing the reliability, quality, and industrial adoption of laser powder bed fusion (PBF-LB), especially in high value-added sectors such as aerospace, biomedical, and precision engineering. However, current in-process monitoring systems are still insufficient to fully guarantee part quality, making it essential to validate the layer-by-layer observations extracted from data gathered during fabrication through post-process measurements. This validation is key to identifying critical anomalies that lead to actual defects, as well as to developing and training artificial intelligence algorithms for active and automated process control. One of the main metrological challenges in establishing a robust spatial alignment between in-process and post-process data lies in part deformations occurring between the two acquisition stages, which undermine the reliability of comparisons between the two domains. This presentation introduces potential solutions to these issues, including strategies for effective perspective correction of optical in-process data and methodologies for aligning in-process monitoring and post-process tomographic data while accounting for part deformation. Finally, current limitations and open metrological challenges are highlighted.

Open questions and discussion points are addressed with the aim of initiating a discussion on possible developments and collaborative research opportunities.

7.2 *National guideline for the evaluation of area-related flank data in gear metrology*, Anke Guenther, TriMetrik-Hamburg

Abstract: More and more optical sensors are being developed to capture more or less area-wide measuring points on gear flanks. The optical systems provide significantly more measuring points within very short measuring times, but the individual measuring points are subject to greater measurement uncertainty than those recorded conventionally by tactile devices. In conventional gear metrology, individual scan lines are used to determine classic gear deviations, correct production processes or determine the production quality of the workpieces.

Since optically recorded, area-wide measuring points could provide additional information on manufacturing quality (e.g. due to disturbing vibrations in the manufacturing process or, conversely, intended waviness or other modifications that are advantageous for the function of the gears), there are many discussions about this. Evaluations of classic gear metrology were described in guidelines around 100 years ago and later manifested in standards. Within these standards, however, no area related deviation parameters are defined. Their calculation is also not clearly pre-defined. International publications on this subject have so far focused exclusively on determining the classic gear deviation parameters. The technical committee “Measurement on gears and gear systems” of the Association of German Engineers (VDI) has therefore been working with a group of interested measuring device manufacturers and gear producers for 2 ½ years on a new guideline that describes possible calculation methods in detail. The speaker is the chairperson of this working group and will briefly present the current status and the differentiation from classic gear metrology.

7.3 *Stacked Multilayer Scintillator for Reducing Measurement Duration in Multispectral Computed Tomography*, Robert Schmitt, WZL-IQS | RWTH Aachen University

Abstract: Multispectral X-ray computed tomography (MSP xCT) enables material differentiation in multi-material workpieces, which is highly relevant for industrial quality control. However, MSP typically require two sequential scans at different energy levels, increasing the measurement duration. One reason is that conventional detectors cannot distinguish different regions of the X-ray spectrum. However, different scintillator materials possess different X-ray absorption and emission spectra and might be exploited in a stacked setup. This would allow for spectral separation within a single scan. However, the idea of stacked scintillator introduces several challenges that must be considered. These include optical crosstalk between layers, variations in light yield and emission spectra, and potential overlap of visible-range signal reaching the detector. Additionally, layer-dependent absorption may introduce artefacts and distortions that affect image quality. Further challenges may arise depending on material combinations and system configuration. Our presentation will discuss the potentials and challenges of a stacked-scintillator detector for industrial MSP xCT undermined by early results of simulation model of the optical system. Preliminary results from the simulation might help identify suitable material combinations and support the development of a working multispectral detector.

7.4 *Application of Digital-Metrological Twins for emerging measurement technology in advanced manufacturing*, Daniel Heißelmann, Physikalisch-Technische Bundesanstalt, Braunschweig, Germany

Abstract: Advanced manufacturing enables novel design and production techniques for industrial products with complex freeform geometries. It also meets the increasing demand for fast and contactless measurements in industrial quality control using optical sensors. However, current simulation-based methods using Digital-Metrological Twins (D-MTs) to determine measurement uncertainty do not cover such developments in advanced manufacturing. To address this issue, the European Partnership on Metrology project 23IND12 ADAM will develop reliable model descriptions, accurate mathematical models for use in D-MTs, and traceable parametrization methods for measurement uncertainty evaluation in D-MTs. Furthermore, the project aims cover the optimization of the performance of the developed D-MTs for the cost-efficient and economic, yet reliable use in advanced manufacturing applications. The results are evaluated in case studies comparing optical and tactile measurements using complex freeform geometries and guidance for D-MT use in industrial applications will be derived.

The presentation will give an overview of the development of Digital-Metrological Twins for freeform geometry measurements and optical sensors. It will showcase the current approaches for uncertainty evaluation and the establishment of traceability, while identifying current challenges for developers and users alike.

7.5 *Indirect optical geometry measurements with optical tweezers*, Andreas Fischer, BIMAQ, University of Bremen, Bremen, Germany

Abstract: The idea of determining the geometry of a target object by optically investigating its footprint within the surrounding medium has been explored under the term Indirect Optical Geometry Measurement. While this technique remains an optical approach, it does not depend on the optical properties of the target object and operates independently of its material composition.

Indirect optical approaches often involve adding particles into the surrounding medium. To mitigate artifacts and uncertainties caused by the uncontrolled motion of these particles, the application of a well-controlled single particle by means of an optical tweezer is proposed. As a result of first theoretical studies and experiments, it was observed that studying the geometry using a single optically trapped particle could enable precise measurements with uncertainties below the resolution limit of the optical system. It is reported about the latest experimental findings, potential future fields of applications, and current promises and challenges of using optical tweezers for indirect optical geometry measurements with micrometer and sub-micrometer precision.

8. Update on terminology committee activities

8.1 Update, R. Schmitt

9. CNTPE updates

9.1 State-of-the-Art in Optical Gear Metrology, G. Goch

10. Announcements

10.1 Results of officer elections

11. Any other business

11.1 Proposal for 3rd CIRP School, F. Fang

12. Closure (12:30 pm)