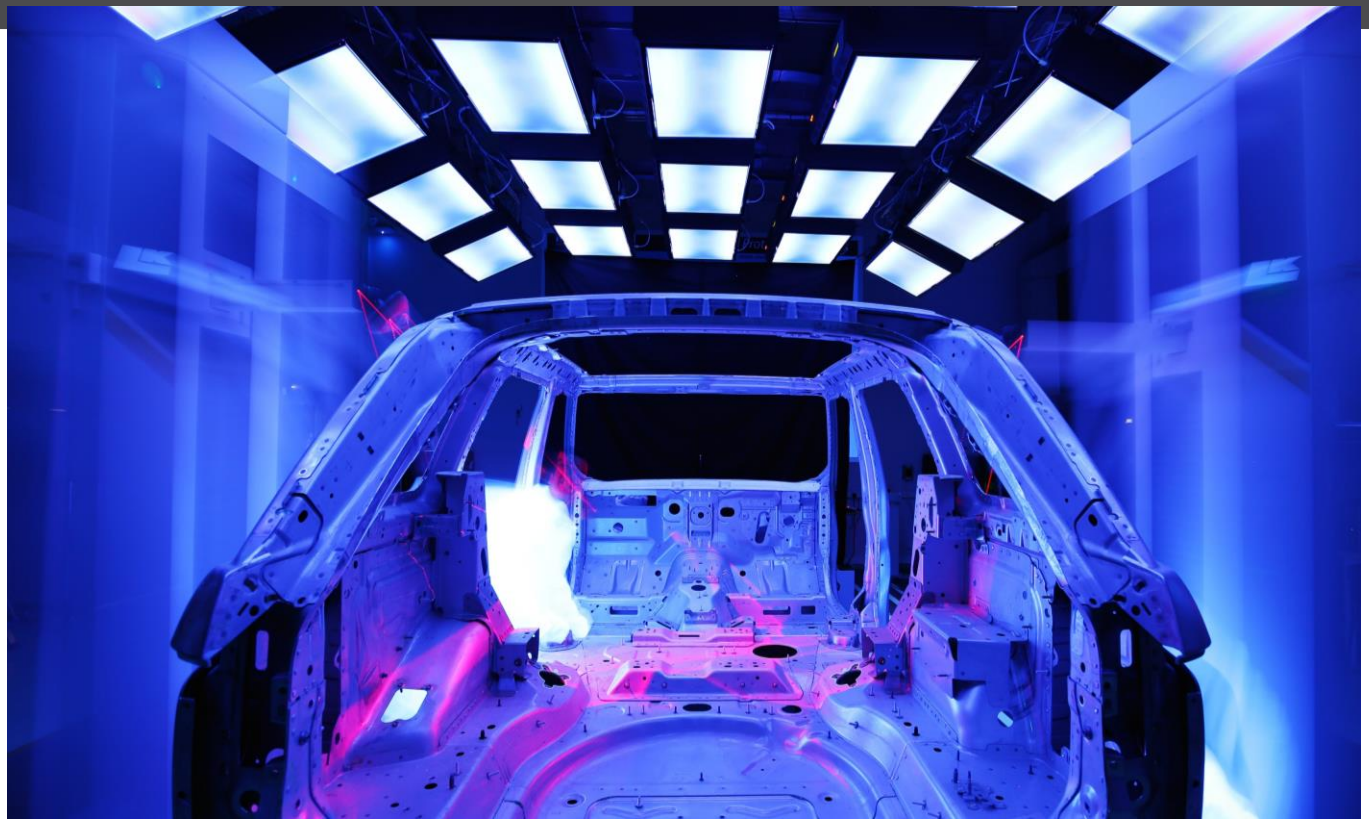

3DMC 3D METROLOGY CONFERENCE

Dr. Ercihan Kiraci

CATAPULT High Value Manufacturing

WMG THE UNIVERSITY OF WARWICK

Evaluating the impact of Inferred Probe Qualification on Automotive Inspection Process

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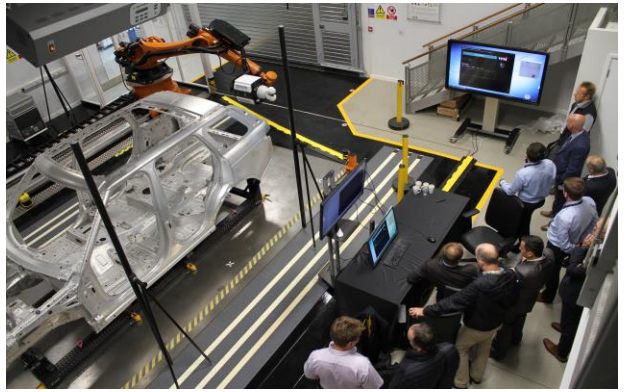
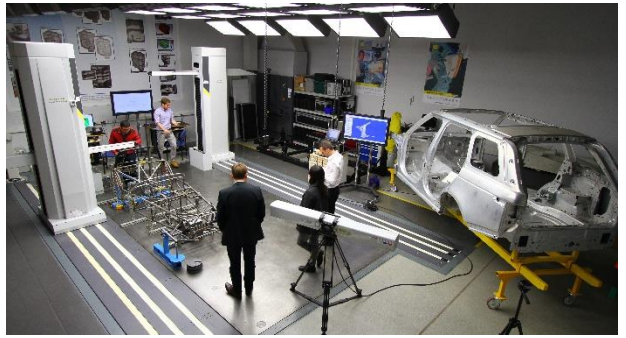
CiMAT – Centre for imaging Metrology and Additive Technologies

- Helping UK high-value manufacturing to deliver high quality products, in large volumes and short time-frames, through the effective use of metrology solutions coupled with fundamental research and innovation.
- Unique composition of mathematicians, computer scientists and engineers, with over a century of combined expertise.
- State-of-the-art CT and Metrology facilities, including industrial sized Twin Column CMM and Kuka robot and rail solution.





UK’s R&D One-Stop-Shop for E-Motor Metrology

- ***UK First*** – Hexagon 3D Hairpin Inspect (Tube inspect P8.2)

- ***Specialised Nikon HN-C3030*** – able to quickly capture details on any rotating components.

- A ***Leitz Reference Xi and Nikon iNEXIV VMA 4540*** completes the Aerospace a-grade metrology rooms capability.

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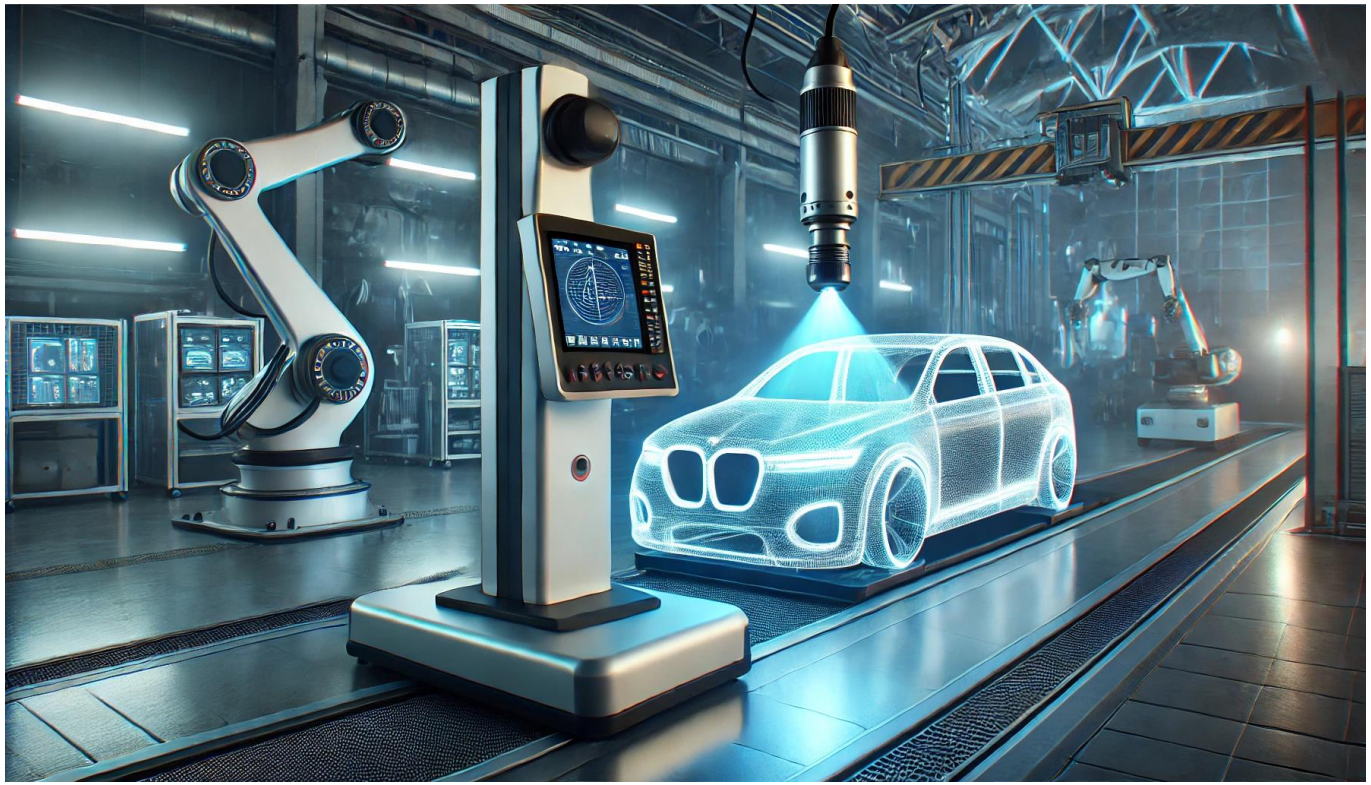
DALL-E- Futuristic Image of CMM

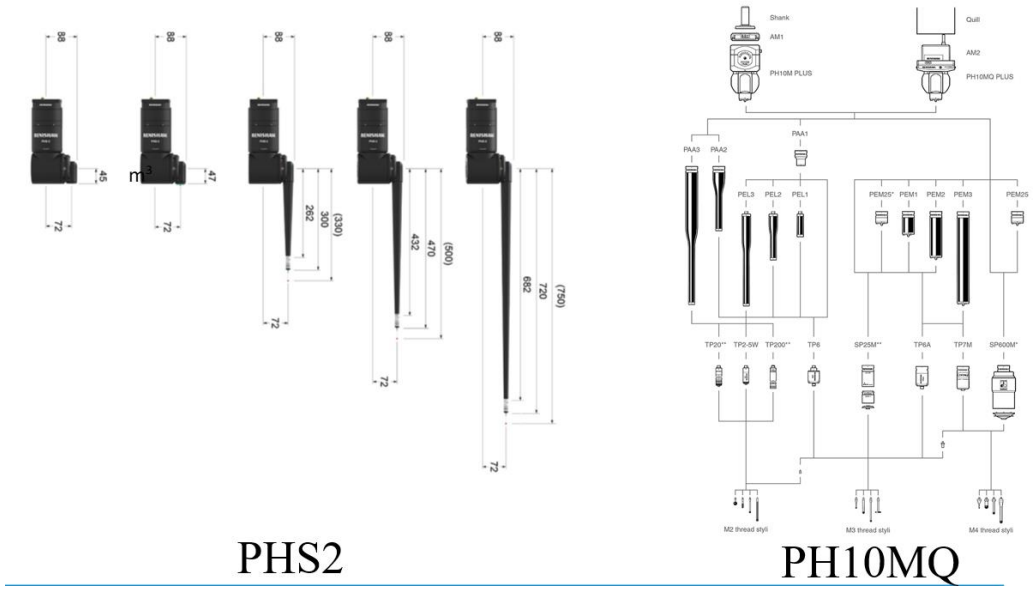


Objectives

- Investigate the effectiveness of inferred probe qualification in coordinate measuring machines (CMMs)
- Compare the performance of different probing methods
- Evaluate the impact of inferred probe qualification on dimensional results
- Assess the cost-effectiveness and efficiency of inferred probe qualification
- Identify challenges and potential limitations of inferred probe qualification

PHS2 Experience so far

- Long extension range
  - Measurement volume increases from 20.16m3 to 27,09m3 per arm



Up to 700 mm extension

225mm extended multiwire arm

PHS2 Experience so far

Ability to have an extension for the laser heads

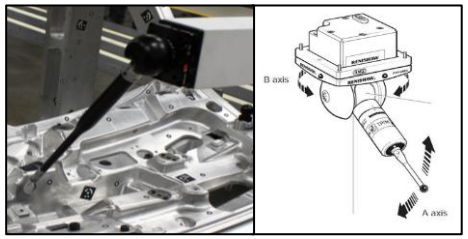
Roof Ditch Seal Area

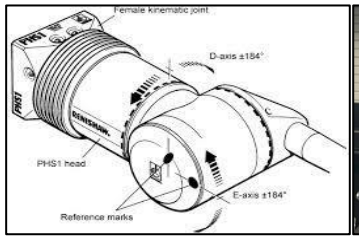
Cant Rail

Tailgate Aperture

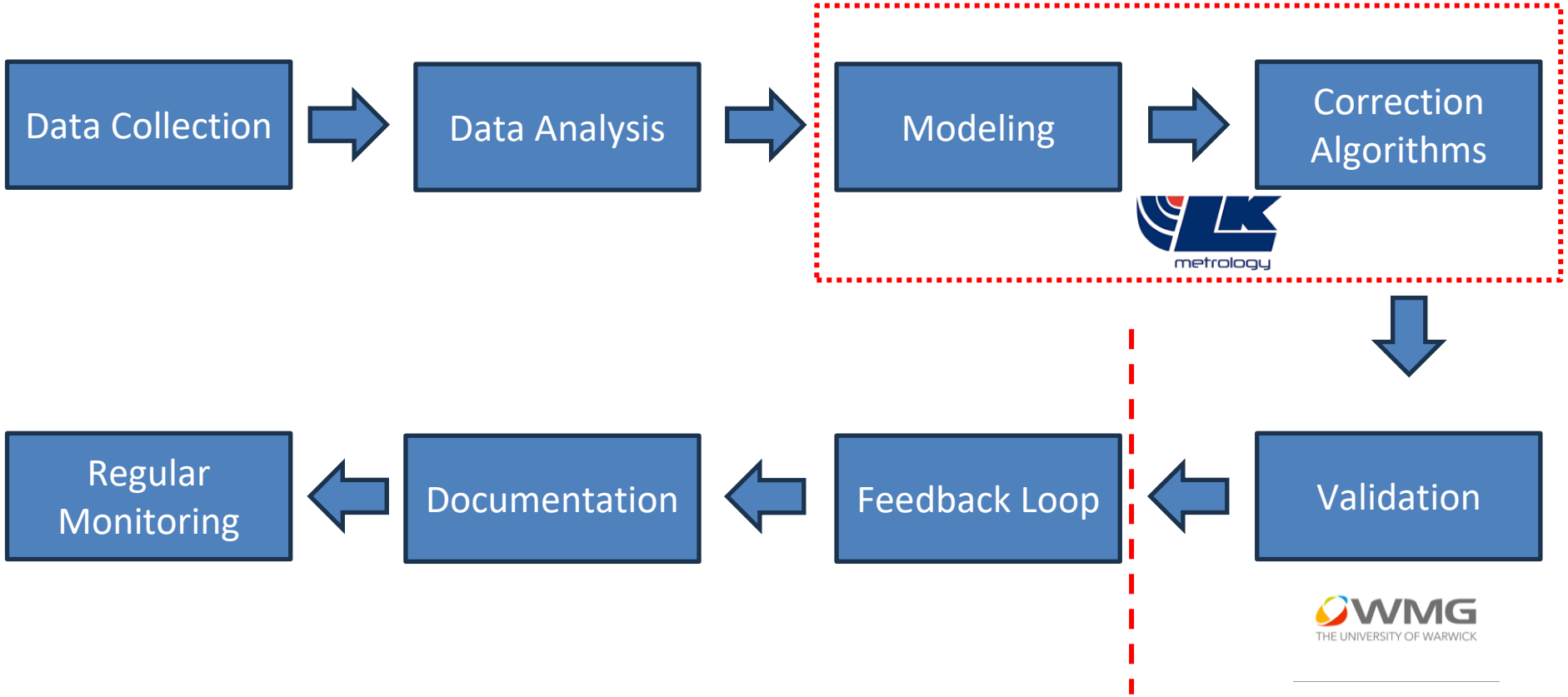
Calibration- Indexing vs Inferred

- Current practice for qualifying process
- Inferred measurement process
- Experimental Validation





Steps involved in inferred calibration



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Part 1 - Experimental Set-up

- Measurement programmes were written to measure all features for the Z9
- In total, 115 measurement points

Surface points:	67	Slots:	20
Holes:	26	Pins:	2

- A single horizontal arm were used in the study.
- The alignment datum was used throughout the study
- 30 repeat runs of the measurement program. In total, 90 runs. Each run took 29 min.
- The artefact was stationary throughout the study and the environment was maintained at 20°C ± 1

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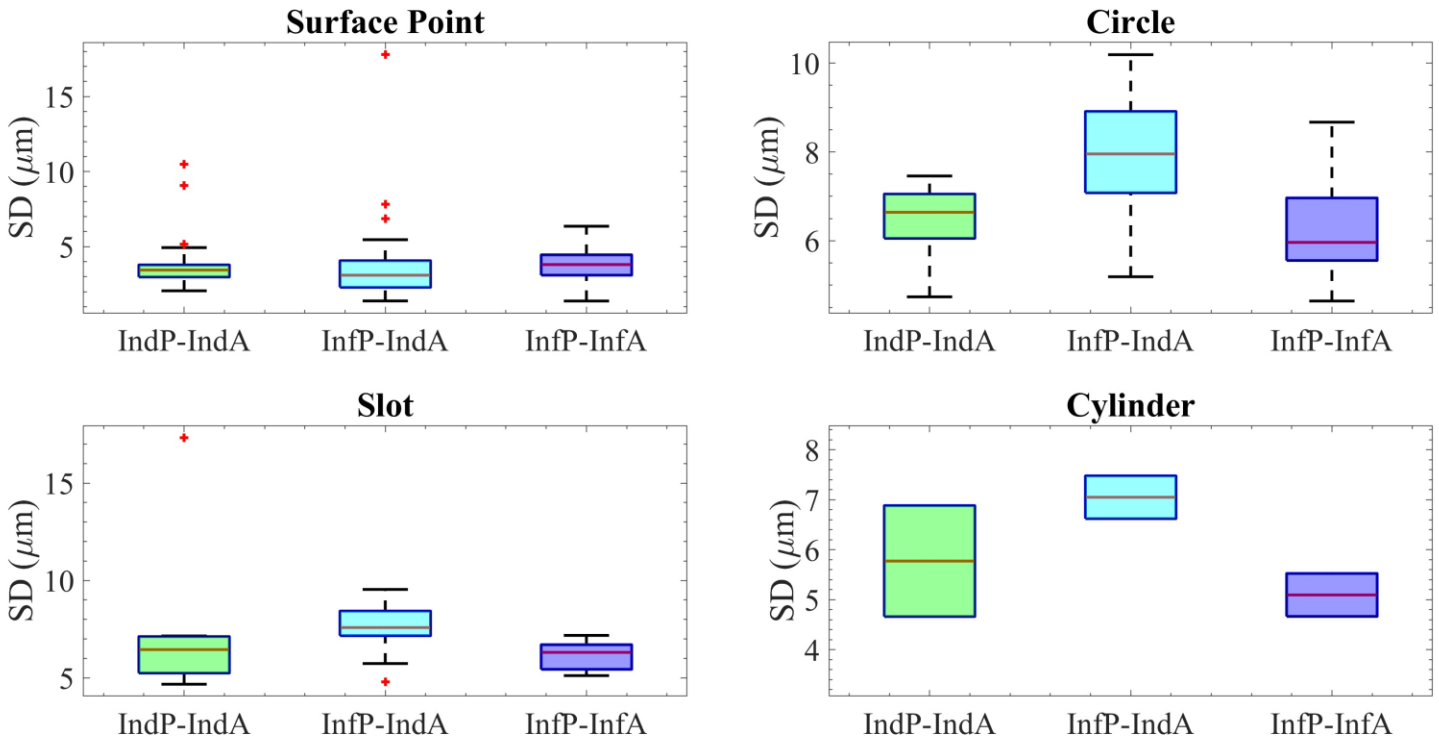
Part 1 - Results- Standard Deviation



IndP-Ind A - Indexing probe (Imperial Probe) based on indexing probe alignment
InfP-IndA - Inferred probe based on indexing probe alignment
InfP-InfA - Inferred probe based on inferred probe alignment

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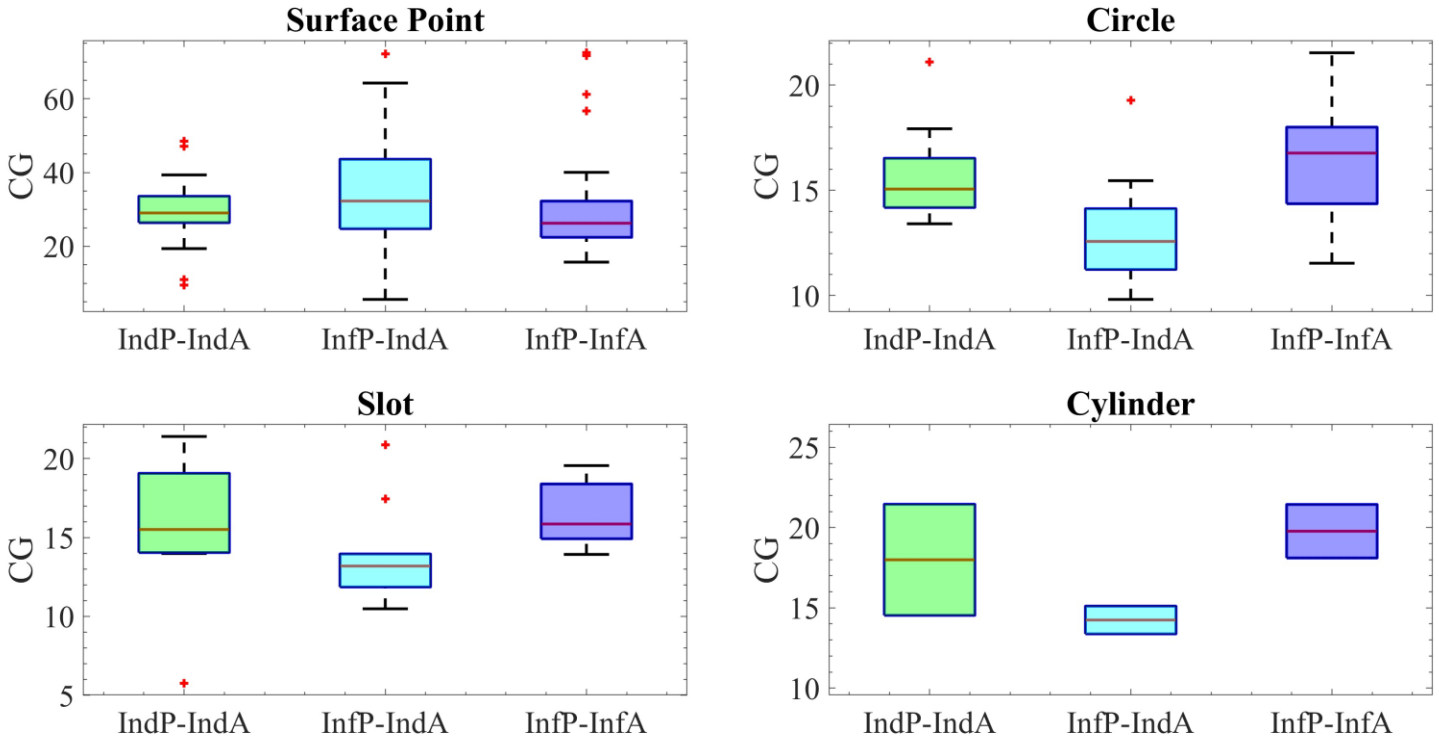
Part 1 - Results- Cg



IndP-Ind A - Indexing probe (Imperial Probe) based on indexing probe alignment
InfP-IndA - Inferred probe based on indexing probe alignment
InfP-InfA - Inferred probe based on inferred probe alignment

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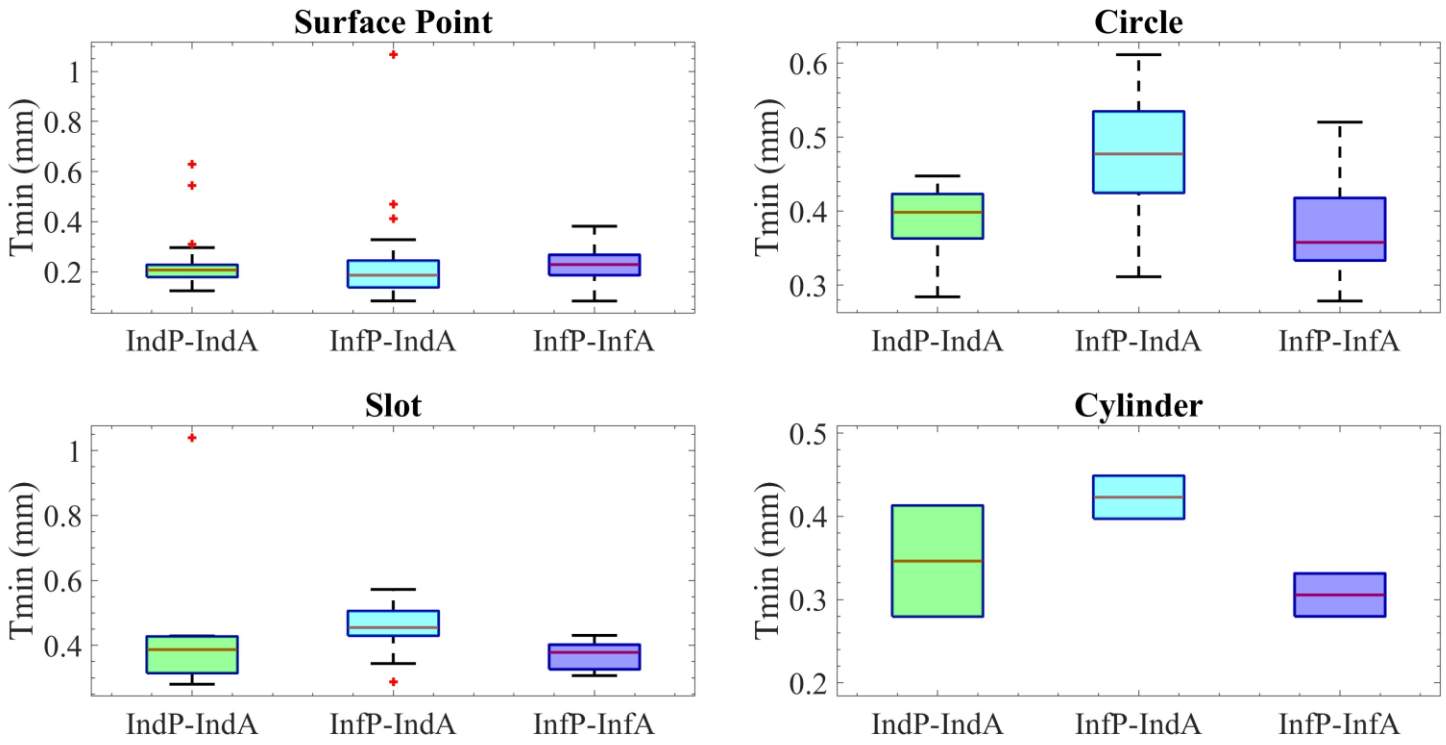
Part 1 - Results- Tmin



$$T_{min} = \frac{1.33 * 3 * SD}{\left(\frac{k}{200}\right)}$$

6σ (Cgk = 1.00)
8σ (Cgk = 1.33)
10σ (Cgk = 1.67)
12σ (Cgk = 2.00)

IndP-Ind A - Indexing probe (Imperial Probe) based on indexing probe alignment
InfP-IndA - Inferred probe based on indexing probe alignment
InfP-InfA - Inferred probe based on inferred probe alignment

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Summary

Key Findings:

•Inferred probe qualification can effectively be used in automotive inspections *without compromising measurement accuracy*.

•There is no significant difference in measurement results between using inferred probes or indexing probes.

•Mixing inferred and indexing probes can lead to higher variations in measurements.

•Inferred probe qualification can reduce measurement costs and improve overall productivity.

Benefits:

- **Time-saving:** Eliminates the need for frequent physical calibrations.
- **Cost-effective:** Reduces measurement costs and measurement setup times.
- **Improved quality:** Ensures higher quality of manufactured parts.
- **Increased productivity:** Streamlines measurement processes.

Next Steps

- **Expand the scope of studies:** Investigate the effectiveness of inferred probe qualification in other manufacturing industries and applications.
- Inferred calibration for laser scanners.
- **Develop standardized guidelines:** Create industry-wide standards for implementing inferred probe qualification.
- **Address implementation challenges:** Develop strategies to overcome technological and training barriers.
- **Promote awareness:** Raise awareness of the benefits of inferred probe qualification among manufacturing professionals.