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Design and Industrial Integration of Automated Coordinate Measuring Machines for Automotive Production

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Abstract-

Recent advances in machine design, automation, and industrial digitalization have transformed Coordinate Measuring Machines (CMMs) from standalone inspection devices into fully integrated elements of automated manufacturing systems. In the automotive sector, CMMs increasingly operate in workshop, near-line, and in-line environments, interacting with production equipment and contributing directly to process control and zero-defect manufacturing strategies. This paper presents a structured methodology for the industrial deployment of automated CMMs in automotive mechanical manufacturing. The proposed approach is illustrated through an industrial use case involving the dimensional inspection of mechanically machined components under real production conditions. The methodology addresses machine design selection, sensor configuration, environmental constraints, and multi-axis architectures, as well as validation and acceptance procedures based on the ISO 10360 series. Particular attention is given to the integration of CMMs within automated manufacturing systems, including robustness against thermal variations, vibrations, and contamination, and the use of metrological data for feedback to machining processes. Rather than introducing new metrological principles, the proposed approach focuses on the structured integration of established engineering practices into a coherent lifecycle-based deployment framework. Based on industrial experience, the proposed methodology is illustrated through an industrial case study to support the reliable of automated dimensional inspection, reduce measurement-related risks, and support the integration of CMMs as active components of modern automated manufacturing systems.

Index Terms- Coordinate Measuring Machine (CMM); machine design; industrial automation; automotive manufacturing; dimensional inspection; metrology integration; smart manufacturing; zero defect manufacturing; Máquina de medición por coordenadas (MMC), diseño de máquinas, automatización industrial, fabricación automotriz, inspección dimensional, integración metrológica, fabricación inteligente,fabricación cero defectos

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