Design and testing of a coordinate measuring system for high-speed inspection of forged parts at elevated temperature

Enrico SAVIO[1*], Alexander SCHÖCH[2], Simone CARMIGNATO[3]

[1] Corresponding author: University of Padova, Italy, enrico.savio@unipd.it*
[2]NTB Buchs, Switzerland, alexander.schoech@ntb.ch
[3]University of Padova, Italy, simone.carmignato@unipd.it

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Geometrical distortions due to inappropriate setting of process parameters are one of the main causes of variability in manufacturing hot forged thin parts. Their identification and measurement at the earliest steps of the process chain may have significant economic benefit especially in case of small batch production.

The talk presents the design of a coordinate measuring system for fast inspection of freeform parts at elevated temperatures through multiple sensors based on high-speed laser triangulation, and discusses the results of testing in a forging plant for in-line inspection applications.

The system is capable of measuring the geometry of complex-shape parts at temperatures up to 1200 °C in less than 10 s (for 800 mm long workpieces), which can be considered fast enough for the typical production rate of one part (e.g. turbine blades) every 4 min, using multiple laser scanning triangulation sensors. Main error sources (thermal effects and laser planes misalignment) are discussed, and a method to reduce errors introduced by imperfect alignment of sensors is presented. A procedure for testing the prototype coordinate measuring system in hot conditions is also presented. Test results demonstrate that the prototype system, after more than 1 h of operation in hot conditions, is measuring with bidirectional length measurement errors in the order of 0.05 mm.

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