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On-machine dimensional measurement of large parts by compensating for volumetric errors of machine tools

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Highlights

- A novel on-machine measurement system is developed in large factory spaces.
- The robustness of length compensation for workpiece is verified on a large lathe.
- Straightness compensation procedure is validated in diameter measurement.
- Calibration methods for machine tools are also carried out to certify the results.

Abstract

To improve the productivity of large-part manufacturing, we develop a novel on-machine dimension measurement system. The aim is to establish a traceable and automated procedure in a conventional factory space to ensure the quality of actual products. The on-machine system is structured to measure a steam turbine rotor mounted on a large computer numerical control (CNC) lathe. The system includes a laser tracker as the length-measurement apparatus, a probing unit, and a length-calibrating artefact. By carefully considering the volumetric errors of the machine tool in each case, some measurement results regarding the axial-wheel positions and shaft diameters are described. The new system is compared with the conventional manual method using a large micrometre. To validate the on-machine results, other assessment strategies for unloaded machine tools are also implemented using a conventional length-measuring interferometer and a Lasertracer. The uncertainties of the measurements are also discussed.

Keywords: machine tool; volumetric compensation; on-machine measurement

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1. Introduction

Manufacturing techniques for large-scale structures are necessary to realise continuous growth in heavy

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