

Inter laboratory comparison on Industrial Computed Tomography - DTU Orbit (09/11/2017)

Inter laboratory comparison on Industrial Computed Tomography: CIA-CT comparison. Final Report

An interlaboratory comparison on industrial X-ray Computed Tomography (CT) was organized by the Centre for Geometrical Metrology (CGM), Department of Mechanical Engineering, Technical University of Denmark (DTU) and carried out within the project "Centre for Industrial Application of CT scanning - CIA-CT". In the comparison, 27 laboratories from 8 countries were involved, and CT scanned two items selected among common industrial parts: a polymer part and a metal part. Altogether, 27 sets of items were circulated in parallel to the participants. Different measurands are considered, encompassing diameters, roundness, and lengths. The results of each participant are kept confidential. Each participant can identify their own results in this report using an anonymous identification number provided by the coordinator. Measuring instructions distributed by the coordinator were followed by all participants without problems. Participants carried out measurements and sent their results to the coordinator. All single items were measured by the coordinator using coordinate measuring machines before and after circulation. Both the metal item and the plastic item have shown a good stability over the total period of approx. 6 months. Depending on item and measurand, reference expanded uncertainties ($k=2$) ranging from approx. $1.5 \mu\text{m}$ up to approx. $5.5 \mu\text{m}$ were estimated. The expanded uncertainties stated by the participants are in the range $8\text{-}12 \mu\text{m}$ for both items and all measurands. Results by the single participants were compared with the reference values provided by the coordinator through the En value, where $|En| < 1$ indicates agreement between measurement results while $|En| \geq 1$ shows disagreement. Out of a total of 167 single results obtained by the participants using CT scanning, 55% of the measurements yield $|En|$ values less than 1, and 45% larger than 1. Systematic errors were detected for some participants on the diameters and lengths, for both plastic and metal items. The roundness measured by the participants for both plastic and metal items was higher than the unfiltered reference value. A clear influence from the surrounding wall thickness on the measurement of roundness was documented for the metal item. The comparison shows that CT scanning on small industrial parts, generally speaking, is connected with uncertainties in the range $8\text{-}53 \mu\text{m}$, as compared to an uncertainty range of $1.5\text{-}5.5 \mu\text{m}$ using CMMs. Each participant can use the comparison results in the report to investigate the presence of systematic errors or an underestimation of uncertainties. Statistics related to the used equipment and procedures show that participants, in general, have followed state of the art procedures for their measurements. The industrial items are suitable artefacts for CT measurements of this kind, and each participant has been offered to keep a set used for the measurements in the comparison.

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