1.9.12. PERFORMANCE ASSESSMENT OF GEOMETRY MEASUREMENTS WITH MICRO-CT USING A DISMOUNTABLE WORK-PIECE-NEAR REFERENCE STANDARD

Bartscher M., Neukamm M., Koch M., Neuschaefer-Rube U.,
Physikalisch-Technische Bundesanstalt PTB, Braunschweig & Berlin, Germany;
Staude A., Goebbels J., Ehrig K.,
BAM Federal Institute for Materials Research and Testing, Berlin, Germany

Analyzing the dimensional (geometry) measurement performance of computed tomography (CT) systems requires specialized test samples. A highly artificial but nevertheless work-piece-near designed part is used for this purpose. The general features of this test sample are presented in [2]. In this paper we describe the application of this reference standard (fig. 1) to analyze the dimensional (geometry) measurement performance of CT systems utilized for the measurement of cast parts of the given size.

The reference standard [2] features several unique properties; it is work-piece-near designed, it is dismountable and finally its segments can be registered by means of regular geometries. This body features as a work piece near body sculptured surfaces. These object regions contain non-trivial dimensional measurement tasks for the CT systems under study. The body is dismountable, i.e. it consists of segmented (cut) pieces, which measurement data can be registered mathematically (by using CAD software) by means of inserted and carved out reference elements. These reference elements are spheres and inner and outer rings. Despite being modified the general geometry of the body and also the X-ray absorption properties stay to be near the original cast part. Each segment has been measured by a tactile coordinate measuring machine to achieve reference data for the performance evaluation of CT.

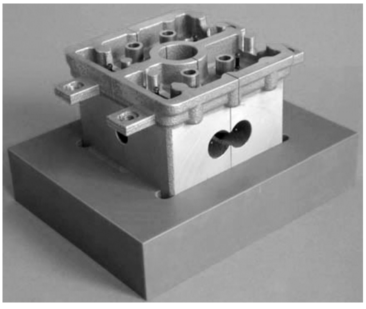

Fig. 1. Mounting of the 4 segmented pieces of the work piece near reference standard (size 10 × 10 × 10 cm)

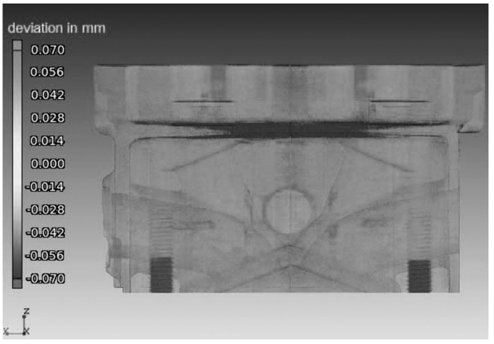

Fig. 2. Sample data of the mounted reference standard. Shown is the deviation of the common measurements (one data set) of the 4 composed segments and 4 measurements of the 4 single segments. The 5 measurement data sets have been registered by the use of the 3 respective spheres of each segment

The measurement errors are a point of special interest of CT systems depending on the geometry of the part under study. Usual studies [3] analyze the measurement errors of CT by a view of the outer geometry of the part or open the part in a heavily destructive way to assess the inner geometries. Especially continued case studies of the performance for inner measurements stay impossible due to the destruction of the part. The dismountable reference standard enables the analysis of measurement errors in the interior by a comparison to tactile assessed data. Alternatively CT data sets of the individual segments, measured with a higher resolution and in different orientations can deal as reference (fig. 2). Systematic effects from the assembly and the modification of the reference standard can be measured by the comparison of the unmodified and the segmented reference standard in common regions. The paper will discuss these applications by the analysis of assessed CT data.

Additionally a comparison of different assemblies (single to four segments) yields a view of the geometry induced effects. Measurements have been performed keeping the effective voxel size and the signal to noise ratio of the assessed projections equal to enable a comparison of effects. We discuss the results of measurements in the assembled state with respect to the tactile reference data.

The authors suppose that the principle of a dismountable work piece near reference body can be used as a sensitive verification tool for checking the entire measurement process of industrial CT measurements for a given product. In contrast to the use of artificial reference standards, e.g. ball bars, gage blocks or step cylinders, the native and complete measurement process of the product can be monitored. The use of reference standards of this type will result in a better process control and a more secure process chain. The paper outlines this application and discusses a verification schedule for a given CT system on the basis of assessed data.

References:

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