

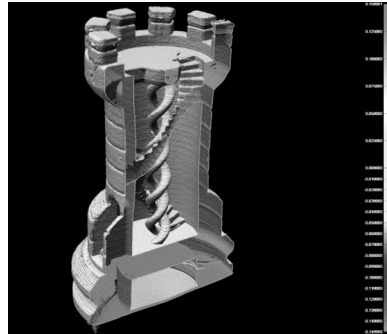
1.9.8. PRECISE 3D DIMENSIONAL METROLOGY USING HIGH RESOLUTION X-RAY COMPUTED TOMOGRAPHY (μ CT)

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Over the last years computed tomography (CT) with conventional X-ray sources has evolved from imaging method in medicine to a well established technology for industrial applications in the field of material science, microelectronics, geology, etc. By using modern microfocus and nanofocus X-ray tubes, parts can be scanned with sub-micrometer resolutions. Currently, micro-CT is used more and more as a technology for metrology applications e.g. in the automotive industry. Especially if complex parts with hidden or difficult accessible surfaces have to be measured, CT offers big advantages comparing with conventional tactile or optical coordinate measuring machines (CMMs): high density of measurement points and fast capturing of the complete sample's geometry.

When using this modern technology the question arises how precise a μ CT based CMM can measure in comparison to conventional CMMs? To characterize the metrological capabilities of a tactile or optical CMM, internationally standardized characteristics like length measurement error and probing error are used. To increase the acceptance of CT as a metrological method, the definition and usage of these parameters is important.

In this paper, an overview of the process chain in CT based metrology will be given and metrological characteristics will be described. With the help of a special material standard designed and calibrated by PTB – National Metrology Institute of Germany – the influence of methods for beam hardening correction and for surface extraction on the metrological characteristics will be analyzed. It will be shown that with modern μ CT systems length measurement error of less than $1\mu\text{m}$ for an object diameter of 20 mm can be reached.



**Fig. 1. CAD variance analysis
of a micropart (height 2.09 mm)
with complex internal geometries**