More Than a Shadow

Computed Tomography Method Development and Applications
Concerning Complex Material Systems

av

Anton Jansson

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Opponent: Prof. I. Giovanni Bruno
Bundesanstalt für Materialforschund und prüfung (BAM)
Berlin, Tyskland

Örebro universitet
Institutionen för Naturvetenskap och Teknik
701 82 ÖREBRO

Abstract

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The complexity of the components fabricated in today's industry is ever increasing. This is partly due to market pressure, but it is also a result from recent progress in fabrication technologies that open up new design possibilities. The increased use of additive manufacturing and multi-material systems, especially, has driven the complexity of parts to new heights. The new complex material systems bring benefits in many areas such as; mechanical properties, weight reduction, and multifunctions. However, the increased complexity also makes inspection and dimensional control more difficult. In additive manufacturing, for example, internal features can be fabricated which cannot be seen or measured with conventional tools. There is thus a need for non-destructive inspection methods that can measure these geometries. Such a method is X-ray computed tomography.

Computed tomography utilizes the X-rays ability to penetrate material to create 3D digital volumes of components. Measurements and material investigations can be performed in these volumes without any damage to the investigated component. However, industrial computed tomography is still not a fully mature method and there are many uncertainties associated with the investigation technique.

In this work, a dual-energy computed tomography tool has been developed with the aim to increase the performance of computed tomography when investigating complex geometries and material combinations. This method has been applied to various phantoms and an industrial case. Also, in this work, complex lattice structures fabricated with additive manufacturing have been investigated and analysed using computed tomography. The results show that the new DECT method improves measurement results and can be utilized to inspect multi-material components. The results also show that computed tomography can be used successfully to gain knowledge about complex lattices.

Keywords: Computed tomography, additive manufacturing, dual-energy, material inspection, complex material systems, measurement consistency.

Anton Jansson, School of Science and Technology
Örebro University, SE-701 82 Örebro, Sweden, anton.jansson@oru.se