Paper ID: 82354
interactive

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Advancements in Materials Applications, Additive Manufacturing, and Rapid Prototyping Manufacturing and Rapid Prototyping (8)

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QUALITY ASSURANCE OF AM SPACE PARTS BY HIGH-ENERGY X-RAY CT

Abstract

Additive manufacturing (AM) is a promising new route of designing aerospace parts with highly complex structures compared to traditional methods of manufacturing that often include very labour-intensive steps and less flexibility in their design possibilities. The complex internal geometries produced by AM, however, are a challenge for many traditional techniques of quality assurance. As a lack of quality assurance can lead to a total vehicle loss in space applications, new methods of non-destructive inspection (NDI) must be developed.

Here, we present our in-house high energy x-ray computerised tomography (CT) setup which is a modular inspection cell allowing quick exchange between x-ray source and detector components to ideally fit the specimen. In our current R&D project supported by ESA, we are investigating flaws in thrust chamber assemblies produced by an aero-space company using AM. These specimens are up to one metre in height and produced in a nickel-chromium allow. To scan such a large and dense specimen, we are employ-ing a 7.5 MeV betatron as x-ray source and a tungsten collimated line detector. The specimen is thus scanned layer by layer and by moving the source-detector assembly between scans, a 3D model of the specimen can be constructed.

As the CT scans show both external and internal features of the specimens, we were able to detect non-conformances such as geometric displacement and remaining pow-der blocking internal cooling channels down to submicrometre resolution. Furthermore, the method is also able to detect porosity and foreign material inclusions. Based on these initial findings, we are currently designing an NDI cell to be employed at the pro-duction site for quality assurance between production steps and for evaluating post-launch reusability of components.