Non-destructive characterization of porosity distribution in additively-manufactured metal components

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Additive manufacturing (AM) makes possible the production of high-performance and high-value titanium parts with complex geometries. However, such parts often have internal porosity defects in multiple length scales down to sub-micron size, which affect their fit-for-purpose performance. Non-destructive detection and characterization of such multi-scale defects is challenging, even with state-of-the-art non-destructive quality evaluation technology such as X-ray CT (computed tomography), where the smallest imaging voxel size is at the order of 1/1000 component size. Discrete image segmentation of CT images loses the sub-voxel information. CSIRO has developed a data-constrained modelling (DCM) technique that overcomes this limitation by incorporating multi-energy and quantitative X-ray CT and statistical mechanics. DCM has been successfully applied in several fields, and is further developing the DCM method for quality evaluation of AM parts. This presentation will give an overview of the DCM method, and demonstrate its applicability to porosity characterization of cold-spray and electron-beam-melting 3D-printed titanium and other metal parts.