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Author :  Sam Yang - CSIRO

Co-Authors :  Sam Yang (CSIRO) | Clement Chu (CSIRO) | Tony Murphy (CSIRO) | Leon Prentice (CSIRO) |

TITLE : NON-DESTRUCTIVE QUALITY EVALUATION OF ADDITIVELY-MANUFACTURED COMPONENTS

ABSTRACTS

Additive metal manufacturing (AM) offers distinctive advantages over conventional subtractive manufacturing processes such as machining from metal castings. AM is capable of producing complex high-performance components with shapes that are practically impossible to achieve with conventional processes. The design flexibility offered by AM is particularly important for high-value applications such as aerospace, where the performance-to-weight ratio is critical. AM components require little or no additional machining or other processing steps. This reduces both the manufacturing cost and environmental impact through reduced wastage. However, due to the specific conditions of the AM process, AM components often have microscopic structural defects such as porosity that are difficult to detect non-destructively with current off-the-shelf technology. Microscopic structural defects affect the fit-for-purpose performance of the components. These defects typically manifest as microscopic porosity distributions. Available non-destructive testing (NDT) technologies have major shortcomings. For instance, the BET (Brunauer-Emmett-Teller) analysis is unable to determine the location of defects, and the conventional X-ray CT (computed tomography) imaging analysis cannot resolve the microscopic porosity defects in macro-sized parts, due to limitations in resolving the multiple length scales.

In the last ten years, CSIRO has developed a data-constrained modelling technology. Together with quantitative X-ray CT, it allows the resolution of fine defects in AM metal components. This has been demonstrated using test samples and synchrotron-based X-ray CT imaging. The technology is being further developed NDT of with macro-sized AM metal components using industrial X-ray CT facilities.

KEYWORDS

Additive-manufacturing | AM | non-destructive quality evaluation | data-constrained modelling | DCM |