
DVC Analyses and LEFM parameter calibration for additively manufactured Inconel 718 mini-CT specimens

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Abstract

In the present work, the mechanical response of additively manufactured mini CT specimens made of Inconel 718 alloy were studied when subjected to tensile loading. The specimens were printed with two build orientations, flat and upright and with +/- 45° and 0°/90° raster orientations. The effect of the printing parameters on the fracture parameters was evaluated. The tests were monitored using X-ray tomography. Kinematic fields were measured via Finite Element based (global) Digital Volume Correlation (DVC). A special mesh accounting for the crack (i.e., allowing for displacement discontinuity along the crack plane) was used. These kinematics fields were used to extract Linear Elastic Fracture Mechanics parameters by using William's series. The mesh adaption greatly improved the correlation residuals and the LEFM parameters were successfully extracted from the measured displacement fields using the aforementioned procedure. It is shown that the fracture toughness and Young's Modulus of the sample printed in the vertical direction decreased compared to the other two printed horizontally. Conversely, there were no significant differences between the two 'flat' samples with different raster angles.

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