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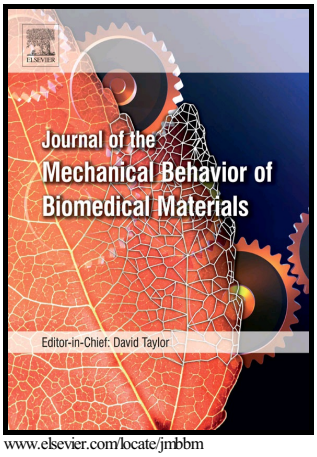
N. Vanderesse, A. Richter, N. Nuño, P. Bocher



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Measurement of deformation heterogeneities in additive manufactured lattice materials by Digital Image Correlation: strain maps analysis and reliability assessment

N. Vanderesse[1], A. Richter[2], N. Nuño[2], P. Bocher[1]

[1]École de technologie supérieure, LOPFA, 1100 rue Notre-Dame O., Montreal, QC, H3C 1K3, Canada.

[2]École de technologie supérieure, LIO, 1100 rue Notre-Dame O., Montreal, QC, H3C 1K3, Canada.

Abstract

The mechanical behavior of porous lattice materials for potential orthopaedic applications was investigated at a fine scale by means of digital image correlation (DIC). Specimens with cubic, body cubic-centered reinforced (BCCZ), and diamond mesostructures were tested in quasi-static compression up to failure. Images were continuously recorded by an imaging setup and processed by a custom DIC program, OpenDIC. The resulting strain maps were analyzed in both spatial and temporal scales, displaying the onset and evolution of strain heterogeneities. The three geometries show different failure modes, i.e. collective buckling of an entire row for cubic, diagonal shearing band for BCCZ, and generalized crushing for diamond. The strain maps correlate well with these patterns. Most importantly, they show early strain localization below the macroscopic elastic limit. After failure, a phenomenon of strain release was