

3D Electrical Resistance Tomography For Localizing Damage In Skin-Covered Lattice Structures

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Additively manufactured skin-covered lattice structures with multi-scale geometrical features and designs exhibit impressive mechanical properties, which make them particularly useful for next-generation lightweight engineering applications. However, damage such as broken or disconnected struts can occur because of unexpected impact or environmental effects during service, hence degrading their mechanical performance. Covered skins, which conform to their arbitrary external geometry, are commonly used to serve as an effective protection method for the lattice structure. However, the skin makes conventional nondestructive evaluation (NDE) methods harder to detect and localize any underlying damage features. In this study, 3D electrical resistance tomography (ERT) was employed to localize damage in skin-covered honeycomb structures. ERT utilizes boundary electrical potential measurements to reconstruct the interior conductivity distribution of a conductive target. The abrupt decrease of conductivity correlated to damage in the structure could be further localized in the reconstructed conductivity distribution. Damage localization was validated and evaluated with numerical simulations. The simulation results solved with different electrode placements and four current injection patterns were assessed with image area error in search of an effective ERT configuration for these skin-covered lattice structures. In addition, a strut-based normalized sensitivity map was implemented to improve damage detection resolution and accuracy.