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Shock Wave Propagation in Functionally Graded Mineralized Tissue MATTHEW NELMS, University of Mississippi, WAYNE HODO, U.S. Army Engineer Research and Design Center - Vicksburg, KEN LIVI, Johns Hopkins University, ALYSSA BROWNING, Carl Zeiss X-Ray Microscopy, Inc., BRYAN CRAWFORD, Johns Hopkins University, A.M. RAJENDRAN, University of Mississippi —
In this investigation, the effects of shock wave propagation in bone-like biomineralized tissue was investigated. The Alligator gar *(Atractosteus spatula)* exoskeleton is comprised of many disparate scales that provide a biological analog for potential design of flexible protective material systems. The gar scale is identified as a two-phase, (1) hydroxyapatite mineral and (2) collagen protein, biological composite with two distinct layers where a stiff, ceramic-like ganoine overlays a soft, highly ductile ganoid bone. Previous experimentations has shown significant softening under compressive loading and an asymmetrical stress-strain response for analogous mineralized tissues. The structural features, porosity, and elastic modulus were determined from high-resolution scanning electron microscopy, 3D micro-tomography, and dynamic nanoindentation experiments to develop an idealized computational model for FE simulations. The numerical analysis employed Gurson's yield criterion to determine the influence of porosity and pressure on material strength. Functional gradation of elastic moduli and certain structural features, such as the sawtooth interface, are explicitly modeled to study the plate impact shock profile for a full 3-D analysis using ABAQUS finite element software.

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