The contact mechanics of structures with exoskeletal components deviate significantly from classical Hertzian and non-linear models. In the case of fish scale inspired samples under blunt indentation loading these factors are inherently tied to the distribution and orientation of the scales. Control of these geometric parameters provides a pathway to tailor the properties of surfaces for better grip, damage mitigation and controlled deformation. This study explores the response of a substrate with stiff scales protruding from its surface, which is comprised of a soft elastomeric material with properties typical of those in soft robotics applications. It is found that the exoskeletal components amplify the non-linearity of the system by artificially increasing the effective Hertzian contact area, which alters the contact stiffness and breaks the symmetry of the load across the surface. These effects are quantified using a combination of numerical modeling, finite element (FE) computation and experimental 3D Digital Image Correlation (DIC). While previous works have focused on biological fish scales, fully embedded scale composites and perforation studies, this study develops a numerical model to quantify the contact behavior of nonlinear elastic substrates with exoskeletal scale structures.

Major: Mechanical Engineering

Educational Career:
Bachelor's of Mechanical Engineering, BS, 2019, University of Central Florida

Committee in Charge:
Ranajay Ghosh, Chair, MAE
Kawai Kwok, UCF MAE
Andrew Dickerson, UCF MAE

Approved for distribution by Ranajay Ghosh, Committee Chair, on April 19, 2020.

The public is welcome to attend.