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Auxetic cell-structures applied to soft exoskeleton suits and protection garments

This research seeks to develop an innovative wearable garment that will be used as a structural member of an exoskeleton when it conducts its own tasks such as lifting heavy loads, walking and running, as well as protecting the human body from external blunt impact. In order to design a structure with elastic flexibilities in the soft wearable suit, it is important to develop an auxetic unit cell with adjustability of stiffness. This research proposes an enhanced auxetic structure and examining its mechanical behavior in static and impact load conditions. We focus on the nonlinearity and shock-absorption performance of the structures. FEA models were used to examine how the stiffness and Poisson's ratio are affected by static load conditions and also how the dynamic loads are transmitted through the auxetic structure. 3D printing techniques were used to build fixtures and prototypes of the auxetic structures and experiments of several specimens were conducted to verify mechanical characteristics of the proposed structures. Stiffness and Poisson's ratio were examined both in tensile and compression loading conditions and the measured values of mechanical properties were compared

with the computational results. It was shown that the proposed auxetic structures had nonlinear behavior and excellent shock absorption performance, which could be useful properties for developing body protection pads and soft wearable suits.

Biography

Chulho Yang received a Ph.D. degree in Mechanical Engineering from Purdue University at West Lafayette, IN, USA as well as M.S. and B.S. degrees from Hanyang University in Korea. Before joining OSU in 2008, he acquired 11 years of industrial experience with ArvinMeritor technical center, IBM Korea, and KIA Motors R&D Center. Much of his work focused on structural design and optimization, vehicle NVH test, sensitivity analysis, structural health monitoring, human body protection, and design methodologies. He registered many patents in the USA, Europe, Japan, and Korea. He received an "Innovation and Achievement Award" from ArvinMeritor, Inc., a "Best Paper Award" from the International Symposium on Advanced Material and Mechanical Application, an "Outstanding Presenter Award" from the International Symposium on Green Manufacturing and Applications. He also served as a keynote speaker or a session chair for multiple international conferences.

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