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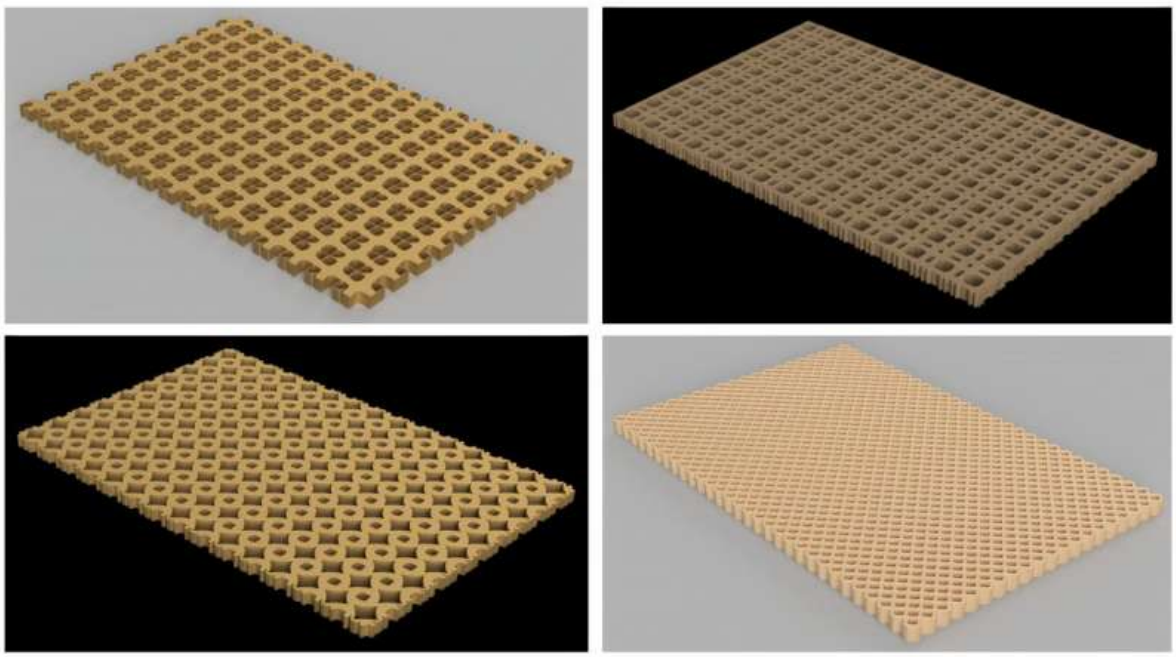
New algorithm can help improve cellular materials design

by Swansea University



Four robust micro-structure topologies of extreme metamaterials emerged from the proposed framework. Credit: Swansea University

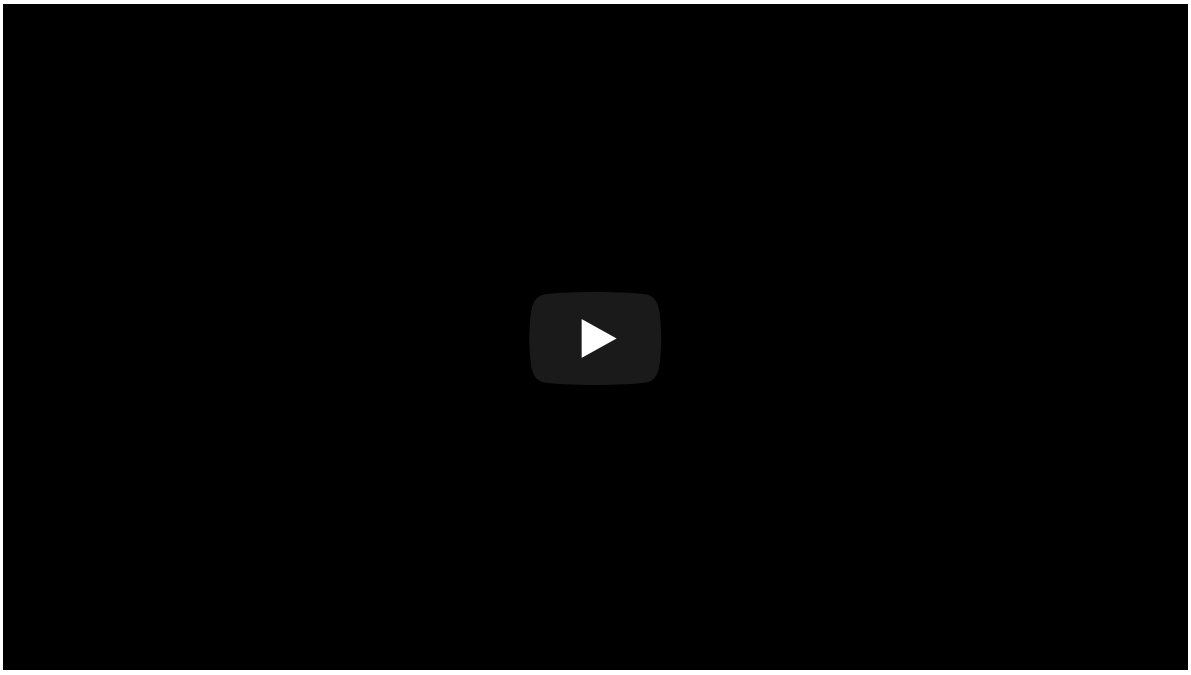
New research published in *Scientific Reports* has revealed that a simple but robust algorithm can help engineers to improve the design of cellular materials that are used in a variety of diverse applications ranging from defense, bio-medical to smart structures and the aerospace sector.

The way in which cellular materials will perform can be uncertain and so calculations to help engineers predict how they will react for a particular design, for a given set of loads, conditions and constraints, can help maximize their design and subsequent performance.

The research collaborators at the Faculty of Science and Engineering,

Swansea University, Indian Institute of Technology Delhi and Brown University, U.S., found that running specialized calculations can help engineers to find the optimum micro-structure for cellular materials that are used for a wide range of purposes, from advanced aerospace applications to stents used for blocked arteries.

Research co-author Dr. Tanmoy Chatterjee said "This paper is the result of one year of sustained collaborative research. The results illustrate that uncertainties in the micro-scale can drastically impact the mechanical performance of metamaterials. Our formulation achieved novel microstructure designs by employing computational algorithms which follow the evolutionary principles of nature."



Extreme metamaterial micro-structures by robust topological designs. Credit: Swansea University

Co-author Professor Sondipon Adhikari explains: "This approach allowed us to achieve extreme mechanical properties involving negative Poisson's ratio (auxetic metamaterial) and elastic modulus. The ability to manipulate extreme mechanical properties through novel optimal micro-architecture designs will open up new possibilities for manufacturing and applications."

More information: Tanmoy Chatterjee et al, Robust topological designs for extreme metamaterial micro-structures, *Scientific Reports* (2021). DOI: 10.1038/s41598-021-

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