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# Transition Waves in Controllable Cellular Structures with High Structural Resistance

Leonid Slepyan[(1)], **Andrej Cherkaev**[(2)], Elena Cherkaev[(2)], Vladimir Vinogradov[(2)]

(1) *Tel Aviv University, Israel*
(2) *University of Utah, USA*

The paper suggests an approach for optimization of morphology of mechanical structures subjected to an impact. We consider chains or lattices with breakable bistable links. A nonmonotonic constitutive relation for each link consists of two stable branches separated by an unstable branch. Mechanically, this model can be envisioned as a twin-element structure which consists of two elastic-brittle or elastic-plastic links (rods or strands) of different lengths joined by the ends. The longer link does not resist to the loading until the shorter rod breaks or develops a neck. When a chain or lattice of these elements is elongated they excite waves of damage that carry the energy away. We analytically describe and simulate transition waves of damage in bistable structures. We show that strength against an impact of the chain or lattice with nonmonotonic links increases several times; such structure can absorb much more energy before breakage than a conventional structure.

View the extended summary