MECHANICAL ENGINEERING PhD SEMINAR

Monday, September 15, 2025, at 14:30, D. Dan and Betty Kahn Building, Room 217

Dynamic and quasi static response of 2D bistable lattices

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In this work, we study a relatively new class of metamaterials, namely architected materials with bistable building blocks. These multi-stable architected materials offer a unique set of mechanical properties and behaviors, such as the ability to undergo large reversible deformations, the ability to provide mechanical protection and efficient shock absorption, and the ability to retain variety of geometrical configurations after loads have been removed. In addition to its relevance to metamaterials, the study of lattice-based multi-stable structures is of relevance to a range of engineering and physical phenomena, such as atomic models of shape memory materials, mechanics of protein networks, foldable structures for engineering applications, and more.

We investigate the behavior of 2D multi-stable lattices under both quasi-static and dynamic loading. Building on prior studies of unidirectional tension and the dynamic response of 1D bistable chains, our study explores how 2D multi-stable lattices behave under shear loading in the quasi-static case and how they respond dynamically to impacts. Particular attention is given to equilibrium configurations, phase-transition patterns, stability, and overall force–displacement relations, as well as the influence of lattice geometry and bistable spring properties. From a dynamic perspective, we explore how impacts generate nonlinear wave patterns, ranging from solitary to surface waves, and investigate their potential to mitigate impacts. We also consider heterogeneous lattices built from bistable springs with different properties, which give rise to a wide range of nonlinear responses. Through combining theoretical analysis and extensive numerical simulations, this study provides new insights into the mechanics of multi-stable lattices and deepens the understanding of their role in energy transfer, including guided wave transitions.

Note: the seminar will be given in Hebrew

Seminars Coordinator: Assoc. Prof. Shmuel Gal.