

MECHANICAL ENGINEERING PhD SEMINAR

Thursday, October 16 2025 at 13:30, D. Dan and Betty Kahn Building, Room 217

Analytic analyses of the planar mechanical response of cubic anisotropic structures using perturbation theory, with numerical validation

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The planar mechanical response of structures made from anisotropic cubic materials has been of interest since the 1980s in the field of micro-electro-mechanical systems (MEMS). In MEMS, many devices are made from single-crystalline silicon (SCS) wafers, a material that exhibits cubic anisotropy (i.e., it has three independent mechanical coefficients in the stiffness tensor).

Recently, the mechanical behavior of these materials has gained renewed attention due to the rise of additive manufacturing. In this field, new microstructures, such as lattices, are being created that, on a macroscopic scale, behave like anisotropic cubic materials. These lattice structures include various types, such as beam-based lattice (e.g. BCC) or surface-based lattice (e.g. gyroid).

Despite the growing interest, analytical studies on the mechanical response of these structures are limited due to their complexity, high degrees of freedom, and challenging integral calculations. This seminar presents several analytical approaches for both static and dynamic responses, using perturbation methods to derive explicit expressions. These expressions are then compared to finite element simulations, showing good agreement.

The analyses specifically focus on serpent springs, arc-curved flexures, spiral springs, and vibrating rings for gyroscopes.

Note: the seminar will be given in Hebrew