MECHANICAL ENGINEERING MSc SEMINAR (30 min.)

Thursday, March 5, 2026, at 13:30-14:00, Lady Davis Building, Auditorium 250

Investigation of the static response of an elongated multi-stable soft robot in a planar obstructed environment

Eyal Kaldor

Advisers: Prof. Yizhar Or and Dr. Lior Salem

Soft robotics has emerged as a promising approach for robotic operation in confined and unstructured environments, leveraging compliant materials and deformable structures to achieve adaptability beyond that of traditional rigid-body systems. An important subclass of soft robots is multi-stable robots, which possess multiple stable configurations and can maintain a given state without continuous energy input. These characteristics make multi-stable soft robots attractive for applications requiring passive stability, robustness, minimal actuation, and mechanical simplicity. However, the static behavior of elongated multi-stable soft robots interacting with their environment remains an open area of investigation.

This work investigates the static response of an elongated multi-stable soft robot in a planar environment with obstacles. The robot is modeled as a long, segmented, compliant structure in which each stable state of a unit segment (closed, open, or bent) is represented by a distinct set of mechanical stiffness parameters. The study examines how environmental interactions reshape the static equilibrium deformations of such robots. Particular emphasis is placed on the influence of gravity, external loads, and geometric constraints imposed by contact with obstacles on equilibrium shapes and the distribution of internal forces.

An energy-based mechanical model is developed to describe the robot's static equilibrium. The formulation incorporates elastic effects through torsional stiffness, gravitational loading, and frictionless contact with rigid obstacles. Each stable state is analyzed independently, enabling systematic comparison of obstacle-induced deformations across multiple equilibrium configurations.

Additionally, a modular experimental setup was designed and constructed, incorporating camera-based measurements and image processing to calibrate stiffness parameters and validate model predictions. In this talk, I will present modeling and experimental results demonstrating how obstacle contact conditions and external loads influence the static behavior of elongated multi-stable soft robots, and will discuss how the proposed framework can support physics-based simulation, motion planning, actuation strategies, and localization in cluttered or confined environments.

Zoom link: Link

Seminars Coordinator: Prof. Sefi Givli

Note: the seminar will be given in Hebrew