



Mechanical Engineering Seminar

Monday, 17 November, 2025 at 14:30, D. Dan and Betty Kahn Building, Room 217

Zoom link: <https://technion.zoom.us/j/98771662702>

Energy Cycles in Autonomous Systems: Ocean Waves Energy Harvesting, Propelling Swimmers, and Combustion-Driven Digging

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Autonomous systems are rapidly transforming domains that demand agility, endurance, and sustainability. Yet at small scales, fundamental physics impose strict limits on energy density, actuation efficiency, and environmental adaptability. My research addresses these challenges by developing embodied-energy systems – integrated framework that unites energy harvesting, storage, and propulsion, enabling synergies across domains, offering a more effective path toward achieving robust, efficient, and scalable autonomy.

In my doctoral research I developed analytical models for fluid-structure interactions in multistable systems, including the ability to achieve any desired pattern in a multistable structure using single-input and novel metafluids with energy harvesting and storing capabilities. In my postdoctoral research I developed, built, and tested embodied-energy systems and propulsion mechanisms for different autonomous platforms, including underwater unmanned vehicles, and underground moling systems.

In this talk, I will present selected projects that illustrate this vision. First, a soft origami-based wave energy harvester that converts ocean wave motion into power to operate and propel underwater platforms. Second, a micro-combustion compliant actuation system that achieves high-power, directional impact for underground digging. Together, these studies establish a unified framework for small-scale autonomy that couples propulsion, harvesting, and storage. Looking ahead, I aim to advance embodied-energy principles to create systems that move, adapt, and power themselves efficiently.

Ofek Peretz received his B.Sc. (Summa Cum Laude) and Ph.D. (direct track) in Mechanical Engineering from the Technion – Israel Institute of Technology, where he worked with Assoc. Prof. Amir D. Gat. He is currently in his third year as a Postdoctoral Associate in the group of Prof. Robert F. Shepherd at Cornell University. His research lies at the intersection of propulsion mechanisms, dynamic systems, and embodied energy, with a focus on small-scale autonomous systems.

