MECHANICAL ENGINEERING STUDENT SEMINAR

Wednesday, May 1 2024 at 13:30, D. Dan and Betty Kahn Building, Room 217.
Online: https://technion.zoom.us/j/91791879937

Novel methods for measurement and data-driven analysis of nano-avalanches

Emil Bronstein
Advisers: Prof. Doron Shilo and Prof. Ronen Talmon

In the field of mechanics of materials, "avalanches" are local, discrete, and abrupt events that occur during transient phenomena such as plasticity, crack propagation, phase transformations, and domain switching. The experimental study of avalanches is especially challenging, as these transient events occur at small scales of length and time. Existing experimental methods for studying avalanches are limited either in their detection capabilities or in the interpretability of the signals they measure. In my research, I develop new experimental methods and data-driven tools to address these limitations, particularly to enable the detection of small-scale avalanches and the extraction of insightful information about the physical processes that constitute the sources of avalanches.

In this seminar, I will present a novel experimental method capable of detecting and providing direct, quantitative information on nano-avalanches occurring at the nanometer and microsecond scales during twin boundary motion. Next, I will present a data-driven, equation-free method developed for the analysis and characterization of dynamical systems, particularly focusing on one-dimensional signals corrupted with high levels of noise. Finally, I will demonstrate two beneficial outcomes of applying our data-driven method to acoustic signals measured during avalanche events using the prevalent and powerful experimental acoustic emission (AE) method. In the first, we enhance the detection capabilities of the AE method, and in the second, we distinguish, in an unsupervised fashion, between different avalanche mechanisms that are indistinguishable by common approaches.

Note: the seminar will be given in English