MECHANICAL ENGINEERING SEMINAR

Monday, October 12, 2026 at 14:30, Lady Davis Building, Auditorium 250 Online:
https://technion.zoom.us/j/92796296845

A Laboratory-Scale X-ray Technique for Stress–Strain Mapping: Informing Data-Driven Mechanics

Ben Amir, Ph.D.
Research Associate, Mechanical Engineering
Cambridge University

Hosted by: Prof. Alon Wolf

Data-driven constitutive modeling has the potential to redefine material mechanics, yet its progress is fundamentally bottlenecked by the difficulty of experimentally capturing rich, multiaxial stress–strain datasets. Conventional methods like Digital Image Correlation (DIC) provide full-field total strain distributions but lack direct local stress information, traditionally requiring hundreds of separate, homogeneous mechanical tests or scarce access to synchrotron beamlines.

To overcome this limitation, this seminar presents a novel laboratory-scale experimental platform capable of high-throughput, pointwise stress–strain measurements directly from single, geometrically complex specimens. By integrating a high-flux liquid metal-jet X-ray source for Energy-Dispersive X-ray Diffraction with optical DIC, the system simultaneously resolves local elastic and total strain fields, bringing synchrotron-grade stress-mapping capabilities into a standard laboratory environment.

The talk will detail the experimental design, system integration, and rich measurement outputs across designed specimen geometries. By directly capturing local stress–strain responses, the platform exposes complex anisotropic plasticity, such as pronounced tension–compression asymmetry and multi-axial hardening, that conventional tests overlook. We further show that feeding these rich datasets into mechanics-constrained neural operators enables accurate reconstruction of evolving yield surfaces, significantly outperforming classical phenomenological models. Ultimately, this demonstrates how a single, geometrically complex specimen can replace extensive traditional testing campaigns, delivering an efficient, laboratory-based framework for high-fidelity constitutive modeling.

Dr. Ben Amir is a Research Associate in the Solid Mechanics group at the University of Cambridge, working under Professor Vikram Deshpande. He earned his Ph.D. in Mechanical Engineering from Ben-Gurion University of the Negev. His research focuses on experimental and computational solid mechanics, specializing in the dynamic mechanical behavior of additively manufactured metals, fracture mechanics, and full-field stress-strain measurements. Dr. Amir's is the recipiant of the Fulbright Postdoctoral Fellowship, the Blavatnik Postdoctoral Fellowship, the Council for Higher Education's Nehemiah Levtzion Ph.D Fellowship, and the Kreitman Dean's Award from Ben gurion University of the Negev.

Seminars Coordinator: Prof. Sefi Givli