MECHANICAL ENGINEERING STUDENT SEMINAR

Thursday, March 27 2025 at 13:30, D. Dan and Betty Kahn Building, Room 217.

"Static to dynamic mechanical characterization of AM MJF PA 12"

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Polyamide 12 (PA12) is widely used in engineering for its excellent mechanical properties, chemical resistance, and ease of printing. Additive manufacturing (AM), especially Multi Jet Fusion (MJF), enables fast and flexible prototyping, offering a cost-effective alternative to traditional injection molding. Fast manufacturing of prototypes is essential, as it significantly reduces time and cost in the design process. However, AM parts often exhibit different mechanical behavior due to the anisotropic nature of the layer-by-layer process, emphasizing the need to thoroughly understand their performance early in the design workflow.

The work emphasizes the influence of printing orientation, loading mode (tension, compression, shear), and strain rate on material behavior.

The study began with static creep and stress relaxation tests within the linear elastic regime, enabling viscoelastic modeling using Maxwell-Wiechert and Extended Zener models, which showed strong correlation with experimental data.

Subsequent quasistatic tests revealed notable anisotropic behavior, with Z-axis specimens exhibiting reduced ductility and earlier brittle fracture compared to X and Y axes. In addition, post-mortem observations will contribute to correlating between the PA 12 mechanical response and the manufacturing process.

Dynamic characterization using Split Hopkinson Pressure Bar (SHPB) was conducted under tension and compression. The results demonstrated increased flow stress with higher strain rates, especially in X and Y orientations, while Z-oriented specimens remained less strain-rate-sensitive. Although dynamic shear tests were also performed, achieving pure shear failure proved challenging, and several specimen designs were evaluated in an attempt to overcome this limitation.

This work provides valuable insights for optimizing MJF-printed PA12 and serves as a foundation for future comparison with injection-molded and fiber-reinforced materials.

Note: the seminar will be given in Hebrew