# MECHANICAL ENGINEERING PhD SEMINAR

**Thursday, December 03 2026 at 13:30, D. Dan & Betty Kahn Building, Auditorium 1**

## Automated Quantitative Fractography Through Dimple Analysis

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Fracture surfaces contain evidence of a material's condition and loading history. Scanning electron microscopy (SEM) reveals this evidence in detail, but interpreting and comparing large collections of fracture images remains strongly dependent on expert judgment. This research develops an automated approach to quantitative fractography, with an emphasis on the dimples characteristic of ductile fracture.

The method converts each SEM image into a numerical fingerprint and uses the XGBoost machine-learning algorithm to classify it. Each image is divided into smaller sub-frames to measure local geometry, variation across the surface, grayscale-intensity features, and texture at different scales. These measurements provide a structured representation that supports both classification and interpretation of the features influencing the model.

The main study examines five classes of aluminum alloy AA6061 with different aging treatments, specimen geometries, and loading conditions. Performance was evaluated over 80 repeated image-level training and test splits. Mean classification accuracy increased from 75.25% with the original 18 features to 86.53% with a compact subset selected from an expanded pool of 88 features. Multiscale wavelet features produced the largest improvement during feature development. Separate experiments with updated SEM image set achieved approximately 89% accuracy and demonstrated the importance of image quality and dataset composition.

Additional studies examined the influence of image count and class composition, and tested the method within AA7075 and hydrogen-related nickel datasets. The results demonstrate image classification within the studied datasets, while generalization to new specimens remains a subject for further validation. The framework offers quantitative evidence to support professional fracture analysis and connects machine-learning predictions with measurable characteristics of fracture surfaces.

Note: the seminar will be given in Hebrew

Seminars Coordinator: Prof. Sefi Givli