MECHANICAL ENGINEERING SEMINAR

Monday, May 23th 2022 at 14:30, Betty and Dan Khan Building, Auditorium 1.

Trainable Materials

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It is notoriously easier to train a neural network to identify pictures of cats, than devise an algorithm with the same task. We adopt this "learning" approach for realizing complex responses in amorphous materials, modeled as disordered networks of springs. The response is attained by training a material with carefully applied sequences of strains that cause the system to remodel its structure, as it evolves towards the desired behavior. Training relinquishes the need for design and fabrication, potentially making this approach highly scalable.

In this talk I will discuss three aspects of material training. (1) The capacity for complex responses (2) Scenarios by which training fails. (3) The ability to alter the function or adapt to a new environment. I will show how many of the behaviors can be understood in terms of the density of states, where the trained response competes with degradation marked by an excess of spurious low frequency modes. I will conclude with an outlook on how these ideas could be useful in manipulating other forms of matter, its relevance in biology and in architecture of processors for machine learning.

Daniel Hexner is an Assistant Professor of Mechanical Engineering at the Technion, Israel Institute of Technology. His research interests include, learning in physical system, and amorphous states of matter, such as, packings, suspensions, and disordered mechanical metamaterials. He earned all of his degrees from Technion's physics department and then moved for a joint postdoc at the James Franck Institute at the University of Chicago, and the University of Pennsylvania. Daniel received the Alon fellowship.

Seminars Coordinator: Assoc. Prof. Matthew Suss.