הטכניון TECHNION
מכון טכנולוגי לישראל Israel Institute of Technology

Faculty of Mechanical Engineering הפקולטה להנדסת מכונות

MECHANICAL ENGINEERING STUDENT SEMINAR

Wednesday, January 3, 2023, at 13:30, D. Dan and Betty Kahn Building, Room 217.
Online: https://technion.zoom.us/j/92727774827

Modeling of Particle Dampers Embedded in Additive-Manufacturing Based Designs

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This research aims to propose a simple model for the dynamics of structures embedded with particle dampers (PDs) and to suggest a framework for optimizing such two-phase (solid-powder) structures. The work that will be presented encompasses an experimental campaign of beams embedded with PDs, an empirical model for the nonlinear structural dynamics based on experiment results, a nonlinear identification method developed for the analysis of the experimental results, and an experimental investigation of PDs at the particle scale to root the numerical model in the physics of particle dynamics.

Integrating dampers into structures is a space-saving approach for vibration mitigation. Fabricating components using Laser Powder Bed Fusion (LPBF), enables the creation of powder-filled cavities inside the component to serve as PDs. The design flexibility LPBF offers allows optimizing the PDs to reduce the response of the structure to specific dynamic loads it may encounter during operation. However, developing an efficient optimization procedure requires a simple model for the nonlinear structural response – yet no such model has been universally accepted. This seminar will cover the following topics:

First, the results of an experimental campaign studying the dynamics of beams embedded with PDs will be presented. The beams' response to various excitation frequencies and amplitudes is measured to accurately characterize the nonlinearity exhibited by the beams and the conclusions drawn from these experiments are used to derive a simple model for the beams' dynamics.

Next, the nonlinear identification method developed for the experimental study will be described. Based on the FORCEVIB method – used to identify non-parametric relationships between a structure's modal properties and its response, a modification accounting for systems with a non-constant inertia term was developed and demonstrated theoretically and experimentally.

Finally, current efforts to root the numerical model in the physics of PDs will be discussed. An experimental system that allows visualizing the particles' motion during vibration is used to study the relations between the particle-scale dynamics and the structure-scale dynamics.

Note: the seminar will be given in English

Seminars Coordinator: Assoc. Prof. Matthew Suss.