MECHANICAL ENGINEERING STUDENT SEMINAR

Wednesday, September 25, 2024, at 11:00, D. Dan and Betty Kahn Building, Room 217.
Online: https://technion.zoom.us/j/95874702378

Real-Time Viscosity Tuning: The Electro-rheological Effect

Shimon Graff

Adviser: Prof. Eyal Zussman

This study explores the feasibility of a tunable vibration damper utilizing the electro-rheological (ER) effect to optimize dissipation in oscillating systems. The investigation encompasses both modeling approaches and experimental methods to delve into the ER effect. A specific ER fluid was formulated by dispersing cellulose nanocrystals (rod-like particles) in silicone oil. The ER effect occurs when dispersed particles polarize and assemble into chainlike structures under an electric field, increasing effective viscosity.

Analysis of the ER fluid using a rheometer determined response times under various conditions and established a correlation between electric field strength and dynamic moduli. These experiments further revealed that specific couplings of mechanical and electrical fields resulted in an increase of over an order of magnitude in both storage and loss moduli. This enhancement was observed within a defined range of shear amplitudes dependent on the electric field strength. The effect was attributed to the bundling of periodic chainlike structures of particles formed within the suspension. In situ measurements confirmed this phenomenon using a novel device that simultaneously controlled shear amplitude and electrical field strength, allowing observation of structure formation and destruction under an optical microscope.

As a result of these findings, the potential for ER fluids as active elements in tunable vibration dampers is revealed, demonstrating and quantifying the electrically induced changes in mechanical rigidity and dissipation. Additionally, this study introduces a novel approach for flow-induced structure control in ER fluids.

Note: the seminar will be given in English

Seminars Coordinator: Assoc. Prof. Shmuel Gal