MECHANICAL ENGINEERING SEMINAR

Monday, June 10 2024 at 14:30, D. Dan and Betty Kahn Building , Room 217

Online: Zoom Link to a Meeting 10/06/2024

Transient Resonant Regimes and Localized States of Essentially Nonlinear Media: Analytical Study

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Hosted by: Prof. Alon Wolf

Theoretical characterization and control of transient, resonant responses of many real mechanical systems encounter significant challenges due to their essential nonlinearity. Strong nonlinearity manifests in systems with intermittently interacting components such as granular materials, structures with breathing cracks, interlocking materials, suspension bridges as well as in smooth systems such as for instance light and slender structures exhibiting high amplitude vibrations. Understanding their strongly nonlinear and highly nonstationary behavior under various loading conditions is crucial for successful engineering design in many applications. While many previous analytical studies primarily focused on the steady-state phase of the response of forced, essentially nonlinear media, transient responses play a crucial role in many real-life applications. My presentation covers three key aspects.

- Mathematical analysis and control of resonant excitations in models exhibiting piece-wise linear nonlinearity. These models are widely exploited in mathematical modeling of systems with intermittently interacting components. We present a complete analytical characterization of their resonant response regimes, unveiling their unique resonant structure which can be efficiently exploited in various engineering applications.
- Analysis of localized excitations in excited medium. Energy localization is a prevalent phenomenon in mechanical, physical, and biological models. Emergence of intrinsically localized modes in repetitive mechanical systems including aeroengine fans and wind turbine rotors, often lead to undesirable response regimes and structural failures. We will present analytical techniques for characterization and control of the dynamics of localized wave-packets emerging in forced, essentially nonlinear repetitive structures.
- Mathematical methods of analysis of the transient dynamics, of a special family of non-stationary nonlinear waves (beat-waves) emerging in nonlinear parametric oscillator arrays due to parametric instability. In the same part of the talk, we will demonstrate a novel control strategy over the dynamics of these complex nonlinear wave-states.

Seminars Coordinator: Assoc. Prof. Shmuel Gal.