



MECHANICAL ENGINEERING MSc SEMINAR (30 min.)

Thursday, March 26 2025 at 13:30-14:00, Zoom:

<https://technion.zoom.us/j/98537592597>

Nonconventional synchronization in parametrically driven system of oscillators with bi-stable coupling interaction

Amir Cohen

Adviser: Prof. Yuli Starosvetsky

In the present research, we investigate a nonconventional synchronization mechanism in damped–driven systems of nonlinearly coupled parametric oscillators, wherein the synchronized state is manifested by persistent nonlinear beats rather than conventional and stationary time-periodic states. Our aim is in understanding the role of structural bistability incorporated in the coupling mechanism on the transient and steady state dynamics of two qualitatively distinct, coexisting regimes of intense beats. For moderate initial conditions and sub-threshold parametric excitation, the system either collapses to amplitude death or synchronizes on a low-amplitude beat state, with both oscillators confined within a single potential well. In contrast, when either the initial energy is elevated or the parametric drive exceeds a critical level, the system converges—after transients—to a nonstandard high-amplitude beat-state manifested by a recurrent burst-type regime in which each oscillator traverses the potential barrier, producing irregular, yet repeatable, double-well domain spanning beat cycles. We develop an analytical framework that characterizes the existence and the selection mechanisms of both beat-states and delineates their parameter domains of coexistence. The analysis further identifies a transition boundary at which the low-amplitude beat ceases to persist as excitation increases, giving way to the burst-type beat state. Extensive numerical simulations corroborate the theoretical predictions, including thresholds and beat-state switching behavior.