MECHANICAL ENGINEERING SEMINAR

Thursday, May 8th, 2025 at 14:30, D. Dan and Betty Kahn Building , Room 217

Online: http://technion.zoom.us/BestSeminarEver

Data-driven Koopman Linear Quadratic Regulator Control of Microbubble Oscillations

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Hosted by: Prof. Gal Shmuel

Encapsulated microbubbles (EMBs) are used in biomedicine for both diagnostic and therapeutic purposes that include ultrasound imaging and targeted drug delivery. A data-driven method to control the oscillations of EMBs using the applied acoustic field is presented based on Koopman operator theory, which is a method for transforming a nonlinear dynamical system on a state space into a linear system on an infinite-dimensional function space. This method preserves the underlying nonlinear dynamics of the system, and the function spaces can be approximated through data-driven methodologies, which enables the application of classical linear control strategies to the nonlinear system. Here, we apply a Koopman linear quadratic regulator (KLQR) to control the nonlinear oscillations of a EMB through the applied acoustic field. Results are presented that demonstrate the effectiveness of the modified KLQR controller in driving the EMB to follow arbitrarily prescribed radial oscillations and stabilize at nonequilibrium radius.

Dr. Xin (Cindy) Yee is an assistant professor in the Mechanical and Aerospace engineering department at the University of Colorado, Colorado Springs. Cindy received her Ph.D. from Caltech in 2015, and her B.S. from MIT in 2009. Dr. Yee has an extensive background in numerical linear algebra, functional analysis, and applications of data-driven and machine learning methods. Her research focuses on developing and applying data-driven computational tools and techniques to model and control nonlinear and complex systems. The methods that we work with are supervised and unsupervised dimensionality reduction methods, dynamic model decomposition, Koopman linear quadratic regulator control, and deep neural networks.

Seminars Coordinator: Assoc. Prof. Shmuel Gal.