MECHANICAL ENGINEERING STUDENT SEMINAR

Wednesday, December 6 2023 at 13:30, D. Dan and Betty Kahn Building, Room 217.
Online: https://technion.zoom.us/j/96812371811

Modulation of High-Frequency Acoustic Waves to Control Low-Frequency Signals

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Utilizing the principles of nonlinear acoustic theory, the parametric acoustic array (PAA) serves as a sound-transmitting device capable of producing spatially focused low-frequency sound beams across a broad frequency spectrum using small aperture transducers. Because of this unique capability, PAAs have been raising interest in their study and application in various fields both in the air and underwater, for more than half a century.

This research explores the intermodulation effect between high-intensity ultrasonic waves with slight frequency differences, transmitted in the form of amplitude modulation. It investigates the generation of a directional, low-frequency sound beam using the intermodulation effect with a PAA. Additionally, numerical analyses were performed to improve the PAA's design, aiming to create a directional beam characterized by a high-intensity main lobe and minimized low-intensity side lobes.

Given the high-intensity signals and nonlinear nature of the medium, undesired harmonic distortions are also obtained. An optimization process is proposed and validated through experiments, demonstrating the reduction of unwanted distortions by optimizing the driving signal.

The impact of the sound field generated by the PAA on a low-frequency signal emitted by an external sound source is also investigated. The attenuation of the external signal is achieved through a self-demodulated amplitude-modulated signal transmitted by the PAA while maintaining low harmonic distortions at the laboratory.

Furthermore, a suggestion for real-time cancellation of the external low-frequency signal using the PAA is introduced and substantiated through simulations. This real-time cancellation relies on closed-loop control, employing an adaptive filtering method for designing the driving signal.

Note: the seminar will be given in Hebrew

Seminars Coordinator: Assoc. Prof. Shmuel Gal.