הטכניון מכון טכנולוגי לישראל TECHNION Israel Institute of Technology

Faculty of Mechanical Engineering הפקולטה להנדסת מכונות

MECHANICAL ENGINEERING MSc SEMINAR

Wednesday, September 3 2025 at 13:00-14:00, D. Dan and Betty Kahn Building, Room 217
Hybrid lecture, zoom link: https://technion.zoom.us/my/izhak

Controlling the movement of acoustically levitated particles by manipulating piezoelectric transducers

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Acoustic levitation is a technique that employs sound waves to suspend particles in a levitated state within a compressible fluid. An array of ultrasonic transducers generates standing waves within a confined domain, resulting in nonlinear effects that position the particles at specific locations, known as equilibrium points, which serve as potential wells. To manipulate the trajectories of levitated particles in three-dimensional space, this research proposes a novel method that governs the relative phase and tilting angle of piezoelectric transducers. The study demonstrates that by adjusting the phase and tilt of these transducers, the acoustic field can be deformed to facilitate rapid and effective movement of the particles. To validate and illustrate this methodology, a numerical simulation utilizing the Boundary Elements Method was conducted in the COMSOL Multiphysics software. This simulation relates the displacement of the levitated particles to the inclination angle and the relative phase of the transducers. Notably, the transducers' movement of potential wells is continuously controlled. The model accounts for the influence of the acoustic field on boundary conditions and transducer dynamics, thereby avoiding the use of prescribed velocity assumptions commonly employed in prior studies. Furthermore, the simulation incorporates the modal shape of the transducers under impedance boundary conditions, instead of relying on plane wave or one-dimensional approximations, resulting in trajectories that better correspond with experimental observations. The study critiques the limitations of traditional tools such as Gor'kov's acoustic potential field and proposes alternative approaches based on the computation of the acoustic intensity vector field. Additionally, methodologies are presented for analyzing the contribution of the standing wave component within the acoustic field. The validity of the results is confirmed through an experimental setup involving a Schlieren imaging system and ABEL transformation, which visibly demonstrates the deformation of the acoustic field.

Note: the seminar will be given in Hebrew

Seminars Coordinator: Assoc. Prof. Shmuel Gal.