Technion-Israel Institute of Technology
Faculty of Mechanical Engineering

הטכניון-מכון טכנולוגי לישראל
הפקולטה להנדסת מכונות

סמינריון

הנך מוזמן/ת להרצאה סמינריונית של הפקולטה להנדסת מכונות, שתתקיים ביום ה׳ 11.05.17
(טו׳ באייר, תשע״ז), בניין דן-קאהן, קומה 0, אודיטוריום 1 , 13:30.

ירצה: דותן אילסר

מנחה: פרופ׳ יצחק בוכר

על הנושא:

הצפה אקוסטית ושינוע של פרוסות סיליקון: מיקום מדויק והנעה בעזרת גלים מתקדמים

Acoustic levitation and propulsion of silicon wafers: accurate positioning and traveling wave based transportation

The seminar will be given in Hebrew

להלן תקציר ההרצאה:

During handling and transportation of silicon wafers throughout inspection and manufacturing processes, the microelectronics industry uses conveyers, chucks and robotic arms, making mechanical contact with the substrates. Such contact generates particles that contaminate the highly controlled work environment, and thus affect the yield significantly. To overcome this problem it is proposed to utilize the near-field acoustic levitation phenomenon, exploiting the compressibility and the viscosity of the gas trapped between a rapidly oscillating surface and a handled object, to elevate its time averaged pressure above the ambient pressure. By these means, the vertical position of loads weighing up to several kilograms can be varied between dozens and hundreds of micrometers. Furthermore, flexural traveling waves of the driving surface create flow along the waves' progression, applying shear forces which are capable of propelling the handled object.

The first part of this research deals with simplified modelling of the governing, slow component of the levitated object's vertical motion, under excitation with an arbitrary, standing flexural wave. Due to the relatively simple form of the model, it constitutes a convenient foundation for model based control algorithms, governing the slow dynamics of acoustically levitated objects. Indeed, based on the former, a height dependent, gain scheduled controller was devised and verified numerically and experimentally.

It should be noted that the entrapped gas applies harmonic forces on the ultrasonic actuator, used to excite the system, where these harmonic forces depend on the height of the levitated object. Namely, different loadings and excitation conditions, affect the dynamic properties of the coupled system, what can cause a significant performance reduction. Therefore, in order to be able to accurately and efficiently control the height of an acoustically levitated object, a constant excitation frequency is impractical. To predict the effect of the levitation mechanism on the dynamic behavior of the system, and to allow devising a model-based resonance tracking algorithm, a reduced order model, combining all the component of the system was formulated, and validated experimentally. This model couples a piezoelectric actuator operating at ultrasonic frequencies, to a near-field acoustically levitated object, through a compressible thin layer of gas.

The last part of the research is an ongoing subject, dealing with the dynamics of a circular object, excited with flexural waves of different qualities. A developed model, capturing the prevailing dynamics of this system allows controlling both the vertical and rotational motions of the carried object.

בברכה,

פרופ״מ שמואל אוסובסקי
מרכז הסמינרים