סמינריון

הנך מוזמן/ת להרצאה סמינריונית של הפקולטה להנדסת מכונות שתתקיים ביום ה' 17.02.2022
(ט"ז אדר א', תשפ"ב), בשעה 13:00 באודיטוריום 1, קומה 0 בניין דן קאהן.
***אם לא יתאפשר לבצע את ההרצאה בצורה פרונטלית, ההרצאה תועבר בזום:**
https://technion.zoom.us/j/96235369945

מרצה: צבי צ'פניק

מנחים: פרופ' חבר יזהר אור

על הנושא:

Spatial dynamics of flexible nano-swimmers under a rotating magnetic field

The seminar will be given in Hebrew

תקציר ההרצאה :

Inspired by the motion of bacteria and other microorganisms, researchers have developed artificial nano-structures that can be propelled upon a suitable stimulation by external energy sources. These devices attract much interest because of their great potential for bio-medical purposes. The most common strategy is actuating magnetically responsive structures that revolve around their long axis when they are actuated using rotating magnetic fields, resulting in corkscrew locomotion.

Our previous joint work presented fabrication and actuation of a simple magnetic nano-swimmer, two rods connected by a elastic hinge. Experiments under different actuation frequencies result in different motion phases. At low frequencies in-plane tumbling; at a higher frequencies, moving forward in a spatial helical path in synchrony with the rotating magnetic field; in further frequency increase, asynchronous swimming is obtained. Furthermore, we presented a simplified two-link model of the swimmer and conducted numerical simulations of its nonlinear spatial dynamics, obtaining qualitative agreement with experimental observations.

In this contribution, we revisit the two-link model and explicitly formulate and analyze its nonlinear 7 DOF dynamic equations. For the synchronous motion, we reduced the dynamic equations to 4 DOF time-invariant system using transformation of variables. For the first time, we obtained explicit semi-analytic solutions of this motion under simplifying assumptions, in both in-plane, helical swimming synchronous regimes. We conduct stability analysis of the solutions and obtain an explicit expression for the forward speed. We also obtain closed-form expressions of the critical transitions frequencies. Using perturbation expansion in the limit of low stiffness, we develop an approximate formulation of the helical motion, allowing to find the optimal frequency and swimming speed analytically. Finally, we present numerical analysis of the influence of additional effects, as well as parametric optimization of the swimmer's performance.

בברכה,

פרופ"ח מתי סאסו

מרכז הסמינרים