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' 8.02.2018 (כג' בשבט, תשע"ח), בניין דן קאהן, אודיטוריום 1, 13:30.

מרצה: נתנאל חסן

מנחה: פרופ"מ אמיר גת

על הנושא:

Dynamics and instabilities of an arbitrarily clamped elastic sheet in potential flow with application to shape-morphing airfoils

The seminar will be given in Hebrew

להלן תקציר ההרצאה:

Shape-morphing airfoils have attracted much attention in recent years. They offer substantial drag reduction by comparison to conventional airfoils and a premise of superior aerodynamic performance. Such shape changing airfoils involve significant chord-wise elasticity, commonly akin to the aerodynamics of flags, sails as well as membrane wings and many natural flyers, but otherwise neglected in most conventional aircraft wing applications. In the current work, we model a shape-morphing airfoil as two, rear and front, Euler-Bernoulli beams connected to a rigid support at an arbitrary location along the chord. The setup is contained within a uniform potential flow field and the aerodynamic loads are modelled by thin airfoil theory. The aim of this work is to study the dynamics and stability of such soft shape-morphing configurations and specifically the modes of interaction between the front and rear airfoil segments. Initially we present several steady-state solutions, such as canceling of deflection due to aerodynamic forces and transition between two predefined cambers via actuation of the airfoil. The steady results are validated by numerical calculations based on commercially available software. We then examine stability and transient dynamics by assuming small deflections and applying multiple-scale analysis to obtain a stability condition. The condition is attained via the compatibility equations of the various spatial modes of the first-order correction. The results yield the maximal stable speed as a function of elastic damping, fluid density and location of clamping. The results show that the interaction between the front and rear segments is the dominant mechanism for instability for various locations of clamping. Instabilities due to interaction dynamics between the front and rear segments become more significant as the location of clamping approaches the leading edge. Several transient dynamics are presented for stable and unstable configurations, as well as for instability initiated by cyclic actuation at the natural frequency of the airfoil.

בברכה,

פרופ"א מתי סאס
מרכז הסמינרים