Technion-Israel Institute of Technology
Faculty of Mechanical Engineering

הטכניון-מכון טכנולוגי לישראל
הפקולטה להנדסת מכונות

TASP TECHNION AUTONOMOUS SYSTEMS PROGRAM

סמינריון

הנך מוזמן/ת להרצאה סמינריונית של הפקולטה להנדסת מכונות **במסגרת דוקטורט**,
בתוכנית הטכניונית למערכות אוטונומיות ורובוטיקה שתתקיים ביום ד' 21.02.2018
(ו' באדר, תשע"ח), בניין דן קאהן, אודיטוריום 1, 13:30.

מרצה: לה מי

מנחה: פרופ' עודד גוטליב

על הנושא:

Nonlinear Dynamics and Autonomous Stabilization of a Multi-Tethered Spherical Aerostat in Severe Environmental Conditions

The seminar will be given in English

להלן תקציר ההרצאה:

Tethered aerostats are restrained lighter-than-air systems that consist of buoyant bodies connected to the ground by mooring cables. These systems have been widely used for remote sensing applications for over a century. Recently, multi-tethered aerostats have been proposed for wind energy harvesting and for supporting reflectors of radio telescopes or optical energy transmission devices in remote regions. In severe environmental conditions, a tethered aerostat system is subject to vortex-induced vibration (VIV) where alternating vortex shedding transfers energy to the structure, causing large amplitude oscillatory behavior that can become nonstationary. This requires consistent nonlinear theoretical models that incorporate the spatio-temporal dynamics of both tether cables and the lighter-than-air lifting body and their fluid-structure interaction. Furthermore, to-date aerostat stabilization has been obtained via passive means, or by ground-based cable tensioners that are limited to mild operating conditions, and do not react autonomously to changing environmental conditions.

The challenges faced by modern aerostat systems are addressed in this research. We derive and analyze a Lagrangian based model for a multi-tethered spherical aerostat system with massless elastic tethers. The structural model is augmented by a coupled three-dimensional nonlinear wake oscillator describing the self-exciting VIV mechanism. The system parameters are determined by asymptotic model-based estimation for single tether benchmarks in water and air. We show that the proposed model incorporates multiple internal resonances, and exhibits diverse periodic, quasiperiodic and chaotic-like solutions. We formulate a planar initial-boundary value problem using the extended Hamilton's principle to investigate the effect of cable tether dynamics. We numerically demonstrate the importance of secondary combination resonances at high altitudes. We then consider amplitude reduction of maximal translations and rotations as our main goal for stabilization in severe environmental conditions. We employ a combined singular perturbation and numerical bifurcation methodology to investigate optimization of system design parameters and the influence of inertia wheel feedback for rotational amplitude reduction.

בברכה,

פרופ"מ מתי סאסו
מרכז הסמינרים