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 ב׳
26.02.2018 (יא׳ באדר, תשע״ח), בניין דן קאהן, אודיטוריום 1, 14:30.


**מרצה**: רע יקר

**מנחה**: פרופ׳/ח מרים זקסנהויז


**על הנושא:**

## Machine Learning Tools Facilitate the Tuning of Networks of Matsuoka Oscillators for Controlling Bipedal Walking

The seminar will be given in Hebrew

**להלן תקציר ההרצאה:**


Networks of coupled oscillators are common models for generating coordinated patterns of rhythmic output. Those networks have been motivated by biological Central Pattern Generators (CPGs), which inspired their use for controlling rhythmic functions, such as walking, in robots. The output of the CPG can be used to control the robot in different ways, and, in particular, by: (I) producing torque signals for the robots joints, (ii) producing reference signals for the positions of the joints, or (II) coordinating the timing of predefined joint actuation signals.
Due to nonlinear interactions between the different parameters of some types of CPG networks, heuristic parameter tuning to achieve a desired performance is an intricate and challenging task. In many cases researchers turn to Genetic Algorithms (GA) or other optimization methods for parameter tuning. However, not every set of parameters would generate oscillations, which is the first requirement for a feasible CPG. Constraining the search space to include only feasible (oscillatory) CPGs would facilitate better optimization and shorten the computational time. However, determining whether a specific CPG is feasible is a relatively costly computation wise. Here I present a machine learning approach to cut down the computation time by using a neural network to check verify the feasibility of the CPGs prior to their evaluation stage in the GA.
The proposed method is demonstrated for tuning CPG networks of three coupled Matsuoka oscillators that generate control signals for a walking Compass Biped (CB) model. The GA evaluates three objectives: (I) the CB walking speed, (II) the CB energy efficiency and (III) the range of speed that the CB is able to walk using a higher-level speed command. The proposed approach consistently facilitates faster evolution of CPG controllers for walking CBs and achieve superior performance in all of the objectives within. In particular, using the proposed approach resulted in CPGs that achieve 14% higher velocity and CPGs that achieve 48% larger range of velocities.


בברכה,

*פרופ״מ מתי סאסו*
מרכז הסמינרים