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' 31.08.17 (ט' באלול, תשע"ז), בניין דן-קאהן, אודיטוריום 1 , 13:30.

יצה: ישראל שלהיים

מנחה: פרופ'/ח מרים זקסנהויז

על הנושא:

Implementation and Reinforcement Learning of a Gait Controller on a Mono Pedal Robot

The seminar will be given in Hebrew

להלן תקציר ההרצאה:

Dynamically walking robots exploit their natural dynamics by 'falling' forward into the swing leg at each step. In contrast to the classic quasi-statically walking robots that remain stable along the gait cycle, dynamic walking robots maintain only orbital stability. Stability and robustness of dynamic robots are investigated by analysing the Poincaré maps and Region of Attraction (RoA) of the resulting limit cycles.

Our proposed gait controller is based on a central pattern generator (CPG) that produces a periodic set of torque pulses applied to the robot joints. While the open loop CPG controller produces stable walking, we demonstrate that incorporating reflexes greatly enhances its robustness as quantified by the region of attraction.

A prototype mono-pedal robot was designed and built to demonstrate the CPG controller. The implementation involves Series Elastic Actuation (SEA), which facilitates the control of the applied torque, while exploiting the natural dynamics of the system and providing inherent compliance. Low-level motor control was implemented using standard feedback control and loop shaping design techniques. The mono-pedal robot was mounted on a treadmill to investigate its steady state performance and perturbation rejection.

A Reinforcement Learning algorithm was applied for optimizing the CPG parameters to maximize robustness while minimizing control effort. The algorithm applies a 'Policy Gradient' method to modify the controller parameters in the direction that maximizes an objective function. We show how the well-known REINFORCE algorithm can be modified to match our unique case, by using a parameter perturbation approach rather than the traditional action perturbation approach. A technique that facilitates learning from simulations, known as Grounded Action Transformation, was applied to enhance safety and reduced hardware wear. We demonstrate that the performance of the mono-pedal robot improves as learning progresses.

.

בברכה,

פרופ"א שאול אוסובסקי

מרכז הסמינרים