הטכניון – מכון טכנולוגי לישראל **הפקולטה להנדסת מכונות**

סמינריון

הנך מוזמן/ת להרצאה סמינריונית של הפקולטה להנדסת מכונות, שתתקיים ביום ב' 9.02.15 (כ' בשבט, תשע"ה), באודיטוריום 1 בבניין דן-קאהן, קומה 0, בשעה 14:30.

יוצא: אלכסנדרינה יבסטרחין

מנחה: פרופ'/ח מרים זקסנהויז

על הנושא:

Local Stability Analysis of Hybrid Systems via Saltation Matrix with applications to simple walking and jumping robots

להלן תקציר ההרצאה:

Hybrid systems are dynamical systems that involve continuous dynamics interrupted by discrete changes in state and/or vector field. Hybrid systems appear in many different disciplines, including mechanical systems, power systems, electrical circuits, and traffic control.

Walking robots can be described as a hybrid dynamical system with continuous dynamics during the swing phase and discrete transition at the impact with the ground. Such systems are naturally characterized by Poincare maps associated with specific discrete events in the cycle. The eigenvalues of the Poincare map characterize the stability of the walking gaits, however, their analytic computation is challenging. Hence, eigenvalues are usually computed by perturbing the limit cycle and numerically integrating the dynamical equations until the next intersection with the Poincare section.

The numerical method is prone to numerical errors when the perturbation is small, and is inaccurate due to non-linearities when the perturbation is large. Furthermore, it does not provide insights into the effects of system or control parameters on gait stability.

The research investigates an analytical approach for obtaining the linearized Poincare map for hybrid systems with discontinuities in both the flow and the state, based on the Saltation Matrix, which describes the linear part of the Discontinuity Mapping.

I applied this method for obtaining the linearized Poincare map and investigating the stability of simple models of walking and running, i.e. the one dimensional (1D) hopper, and two-dimensional (2D) compass biped, with different types of controllers. I demonstrate that the resulting eigenvalues agree well with numerical results, especially when the flow is linear, as in the case of 1D hopper. In the case of the compass-biped, which is characterized by non-linear flow, the agreement can be improved by approximating the effect of the continuous flow using piece-wise linearization.

בברכה,

פרופ'/א אמיר שפע

מרכז הסמינרים