הטכניון – מכון טכנולוגי לישראל

הפקולטה להנדסת מכונות

סמינריון

הנך מוזמן/ת להרצאה סמינריונית של הפקולטה להנדסת מכונות, שתתקיים ביום ה׳ 22.12.16 (כב׳ בכסלו, תשע״ז), בניין דן-קאהן, קומה 0, אודיטוריום 1 , 14:30.

ירצה: אוריאל נוסבוים

מנחה: פרופ׳ יורם הלוי

מנחה שותף: ד״ר מירי וייס-כהן, אורט בראודה

על הנושא:

Optimization And Guidance Of Redundant Systems

The seminar will be given in Hebrew

להלן תקציר ההרצאה:

Redundant manipulators are the group of mechanisms which is defined by the notion that a fully defined task–space trajectory does not fully define the mechanism joints, hence also state-space, trajectory. This special feature of redundant systems allows us to further constrain the system or in other words – achieve more goals with our systems. In this work redundancy will be used mainly to minimize energy consumption by the system while in some cases an additional task of perfect tracking will also be required and achieved. A unique state-transformation will be presented that enables order reduction that eventually leads to both energy minimization and perfect tracking.

Optimal control has been extensively used in such problems in the past. Given a reference trajectory, it is possible to use the redundancy to achieve certain goals. When using optimal control methods it is required to define a cost function in the system state-space and a representation of the dynamics and trajectory constraints that can affect the generated control policy. It is also possible but not mandatory to define the boundary conditions for the problem. Once the cost function and constraints have been established the optimal solution (if exists) is computable.

However, a higher level of optimization may require the system to produce the optimal reference trajectory for the optimal control since it is common that the parts of the task being handled by the system are not defined. In such cases, the system itself must possess a built-in ability to analyze the problem given initial partial information and synthesize a viable solution based on a pre-given set of criterions and logic.

Evolutionary Computation and especially genetic algorithms (GA) are a useful tool for dealing with such problems. This research combines GA and optimal control theory in order to achieve head to toe solutions for optimal path planning and execution for dynamic systems. Decision variables are determined by the GA and then turned over to the optimal control algorithm which solves the problem and creates a candidate solution. This process is then repeated and candidate solutions evolve and improve until a sub-optimal solution is derived.

The algorithm will be demonstrated on a redundant X-Y manipulator with degrees of freedom movement constraints which is required to choose an optimal path for a given task (e.g. “cut 20 holes in a metal plate, no tracking trajectory is pre-defined”).

בברכה,

פרופ״מ שמואל אוסובסקי

מרכז הסמינרים