סמינריון

הנך מוזמן/ת להרצאה סמינריונית של הפקולטה להנדסת מכונות שתתקיים ביום ד' 08.12.21 (ד' בטבת, תשפ"ב), בשעה 13:30 ב – אוד' 1, בנין דן קהאן, קומה 0.

מרצה: סהר תדהר

מנחה: פרופ' יורם הלוי

על הנושא:

Optimization of Motion in Systems with Redundancy

The seminar will be given in Hebrew

תקציר ההרצאה :

Every system with more Degrees of Freedom (DoF) than constraints, has an infinite number of solutions, located on a certain limited manifold. Since those solutions can be chosen at will, they can be the result of optimization with respect to some given cost function. In this research, we focus on the path planning problem, which is very relevant to various applications in robotics and control.

We wish to find the optimal path of a mechanical system with redundancy, as it moves between pre-determined paths. Our cost function is the energy consumed by the system during this motion. The problem is solved by a Bi-Level solution scheme, with the higher level being a Genetic Algorithm which finds the optimal values for constant decision variables, namely the order of execution, and the direction and entry point for each of the aforementioned paths.

The lower level is an optimization of the motion itself, which is the time functions of all DOF and control signals. This is done analytically using Optimal Control theory, and with a newly proposed Finite Elements approximation, made for reducing computation times without affecting the optimality of the solution too much. The Finite Elements solution is a uniform mesh with 3^{rd} order polynomial basis functions, which converts our constrained dynamic optimization problem into a static quadratic problem for a finite number of variables, with linear constraints.

Previous works in this field have optimized the motion of a linear system without coupling between the DOF in perpendicular directions. In this research, we solve the optimization problem for a system with full coupling between all the DOF. In addition, we will avoid using some previously used assumptions that limit the solution space unnecessarily. Finally, as previously mentioned, we add a new approximated method to solve this problem, which has a numerical advantage with little loss in optimality.

Case studies are shown and discussed for an X-Y robotic manipulator with different complex tasks, with a demonstration of the small deviation from optimality and the great improvement in computation times while using the proposed method.

בברכה,

פרופ"ח אתי סאס

מרכז הסמינרים