MECHANICAL ENGINEERING STUDENT SEMINAR

Thursday, March 16 2023 at 13:00, D. Dan and Betty Kahn Building, Auditorium 1.
Online: https://technion.zoom.us/j/94535713980

Machine Learning tools to integrate Impedance Control and Blind Search for assembly tasks

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There has been much effort in recent years to automate the process of assembly tasks. One of the biggest challenges in applying robots to perform assembly tasks is the presence of uncertainties in position. My work integrates impedance control and blind search algorithms to reduce the search time and improve the speed of a simple assembly task involving peg insertion (known as peg-in-hole (PIH)). The parameters of the impedance control were learned using Reinforcement Learning to handle minor position uncertainties between mating parts. Impedance control is a hybrid between position and force control methods. The core idea behind this control method is modeling the end effector (EEF) of the robot as a mass-spring-damper system. The impedance parameters determine the trade-off between position and force tracking. This enhances the ability to handle uncertainties, which can cause large interaction forces under position control, or result in missing the target under force control.

Impedance control can facilitate assembly task only when there is a partial overlap between the peg and the hole. However, in the likely event that there is no overlap between the mating parts, additional methods are needed to bring the peg close enough to the hole to enable impedance control to be effective. There exist two main approaches to overcome large position uncertainties: vision and blind search algorithms. Vision algorithms are often ineffective in tight and obscure environments and are associated with a higher cost and increased level of complexity. Therefore, my work focuses on blind search algorithms as a more cost-effective and adaptable alternative. Although search algorithms are commonly used for the localization of the hole, they are generally slow, which makes their use rather impractical. This research demonstrates that by integrating the search algorithm with impedance control and detecting early overlap between the parts, assembly time can be reduced significantly.

Note: the seminar will be given in English

Seminars Coordinator: Assoc. Prof. Matthew Suss.