MECHANICAL ENGINEERING STUDENT SEMINAR

Monday, April 24 2023 at 14:00, D. Dan and Betty Kahn Building, Auditorium 1.
Online: https://technion.zoom.us/j/98944377032

Learning Two Sequential Agents for USB Assembly with Position and Orientation Uncertainties via Reinforcement Learning

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In recent years, robots have been integrated into various industries to enhance productivity and handle more complex manufacturing tasks. Nevertheless, assembly tasks are still a major challenge for robotic applications, especially in the presence of uncertainties in the position and orientation of the mating parts. This research proposes an automatic methodology for designing a robust controller that accomplishes robotic assembly tasks despite pose uncertainties. In particular, this study focuses on Universal Serial Bus (USB) connector assembly application.
The proposed approach combines three control strategies: spiral search, twisting, and impedance control. Whereas spiral search and twisting are blind search strategies, impedance control exploits the force and torque measurements to adapt the robot's motion.
To achieve high performance, the proposed approach divides the task into two phases: searching and insertion. Control parameters for these two phases were optimized using reinforcement learning (RL) of two agents, one for each phase, in a single training. RL is a machine-learning paradigm that aims to maximize a reward function by finding the best mapping from state space to action space. This study sequentially combines the two agents in the RL algorithm to maximize both the solution's optimality and sample efficiency.
In contrast to standard implementations of RL, the agents were trained to optimize constant control parameters that are independent of the environment state rather than optimize a state-dependent policy. This approach reduces the computation complexity and memory storage and improves generalization.
The learned parameters were examined in simulated and physical robotic environments. Experiments on the physical robot (UR5e) demonstrated high performance for USB assembly despite uncertainties in pose, achieving a 98% success rate with a 3.6-second average duration. The experimental results demonstrate that the proposed method addresses the challenge of autonomous assembly tasks

Note: the seminar will be given in Hebrew

Seminars Coordinator: Assoc. Prof. Matthew Suss.