הטכניון
מכון טכנולוגי לישראל
TECHNION
Israel Institute of Technology

Faculty of Mechanical Engineering
הפקולטה להנדסת מכונות

MECHANICAL ENGINEERING STUDENT SEMINAR

Sunday, October 2 2022 at 14:30
Online:
https://technion.zoom.us/j/91008572855?pwd=Um9IQk9qc2IyMUd3SmlWTnlxeU5rZz09

Learning robotic policies for assembly tasks with non-co-aligned force/ torque sensor and optional visual sensor

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Robotic integration in all industry fields is a long-lasting aspiration. One of the most common challenges for robotic integration in production lines is handling different kinds of uncertainty. This is especially critical for assembly tasks. Assembly tasks may require high precision set-up in order to manually program a robot to insert one part into another mechanically. To lower the precision demand and make production more cost-effective, robots should be able to handle position and orientation uncertainties in the assembly set-up. This research proposes a robust solution for rigid Peg-In-Hole (PIH) insertion under uncertainties.

In this study Impedance control is used as the primary control strategy. Impedance control is a well-known method for manipulating a robot in contact-rich environments by combining forces and torque measurements with position and orientation measurements. Although impedance control was used in previous studies as a control law for assembly tasks and PIH assignments, in this study, a new approach is presented for the case that the insertion axis is not co-aligned with the force/torque sensor axis. This method alleviates the demand for the force/torque sensor position and orientation. Furthermore, the method was extended to integrate visual information for cases when a wrist camera is available.

The impedance parameters were optimized using reinforcement learning (RL). RL is a sub-field in Machine learning that aims to find the best mapping from states to actions to maximize a reward function. RL training required computer simulations of thousands of assembly attempts. The learned parameters were then examined both in the stimulation and on a real physical robotic.

Experiments with the real robot demonstrate that the proposed method successfully inserts rigid pegs despite uncertainties, achieving 83% and 100% success rates when inserting pegs with a 4[mm] radius into a 5[mm] radius hole with uncertainties of 1.5-3.5[mm] in position, without and with vision, respectively. The method also showed good generalization for inserting flexible pegs. Thus, the proposed method can facilitate the integration of autonomous robots in small and medium size industries.

Note: the seminar will be given in Hebrew

Seminars Coordinator: Assoc. Prof. Matthew Suss.