Recurrence Neural Networks For Peg In The Hole Insertions Task

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Assembly tasks are common in manufacturing lines. Preforming assembly tasks by robots can significantly increase the plants productivity. A major challenge for robotic assembly is perform the assembly despite position uncertainties.

In this research we developed a new method, estimating the relative distance to the target, using force and torque measurements, and changing the robot trajectory accordingly. To demonstrate the method, we examined the peg-in-hole task.
Estimating the relative distance from a single measurement can be ambiguous. To deal with this problem, we developed an estimator that utilizes previous data, using recurrent neural networks (RNNs). RNNs are special neural networks (NN) that include previous outputs as part of the current inputs. Several RNN models were tested, including Long-Short-Term-Memories (LSTM) which received the best performance. To our knowledge, our work is the first to test RNN on physical simulation and on-robot experiment for peg-hole relative distance estimation.

The algorithm was developed and tested using data taken from simulation and real hardware (UR5e robot) experiments, using different sizes of pegs and holes. In simulation, the robot successfully inserted 19 mm round peg into 20 mm rectangular hole, increasing the success rate to 98%, while overcoming initial position uncertainties of 2-3mm. Using the real robot, 9-19 mm pegs were inserted to 10-20 mm holes with 94-100% success rate. Therefore, we can say that our method effectively decreases the presented challenges.

Note: the seminar will be given in Hebrew