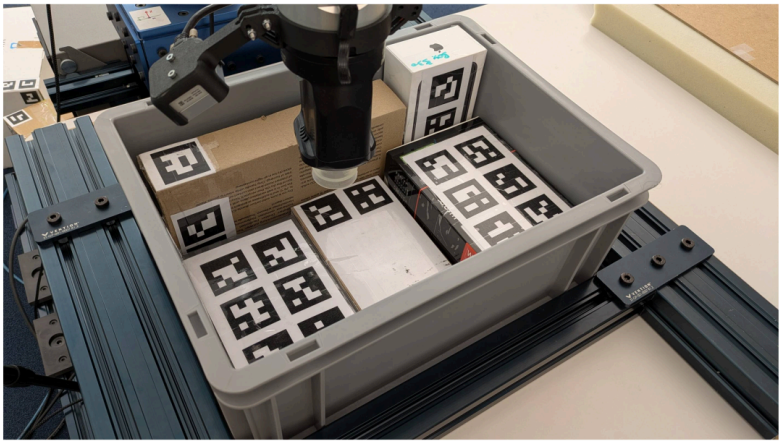
Reinforcement learning for robotic 3D bin packing

Motivation:



Many industrial assembly tasks require high accuracy when manipulating parts, e.g., when inserting an object somewhere, such as a box that we would like to put in a bin. Here, the tolerances that are required can vary wildly. While industrial manipulators are generally accurate in a controlled setting, as soon as the environment is not as structured as we would like it to be, we need to leverage feedback policies to correct for inaccuracies in estimation, and unexpected/unmodeled effects.

The setting we are interested in in this work is robotic bin packing, i.e., enabling a robot to pick objects (initially boxes/parcels), and (the focus of this work) placing them in a box, where other previously placed object possibly obstruct the placement.

Goal:

We want to train a policy to pick and place parcels using a combination of simulation and real world residual reinforcement learning. Placing parcels in a box requires relatively high accuracy both in perception and in execution and is nontrivial, as picking up a box slightly inaccurate (compared to the desired position) needs to be compensated when we place a part. Further, the vacuum grippers we use are difficult to model, and do not establish a perfectly rigid grasp, thus allowing the box to move in possibly unexpected ways.

In previous work, we learned a policy purely in the real world from demonstrations. Now, we want to explore leveraging simulation to learn a more generalizable policy and build on this previous work to learn a policy for boxes of various shapes, weights and other characteristics. In order to do so, we first want to leverage simulation to explore different observation spaces, and to learn a policy that can deal with different scenes and boxes. In a second step, we want to use this in the residual reinforcement learning setting to transfer it to the real world.

We then want to transfer this policy to the real world via residual learning and human in the loop learning.

Interested?

For further information or to apply for this project, please contact Valentin Noah Hartmann (*valentin.hartmann@inf.ethz.ch*) with your CV and transcripts.