NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE
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Versatile Grasping for Shelf Placement of FMCG items

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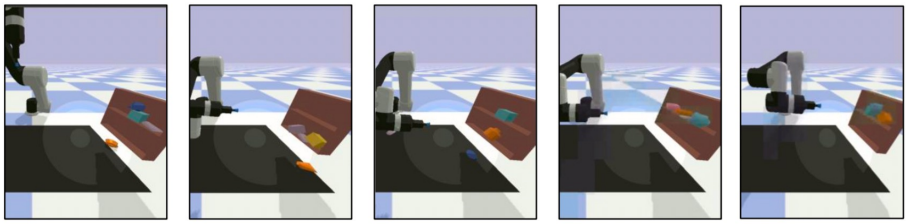
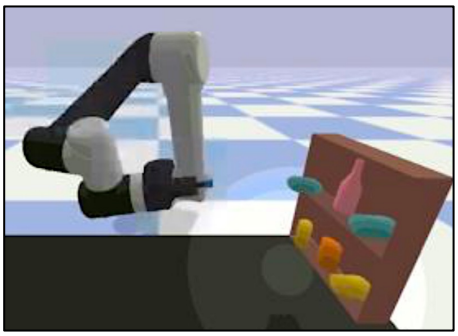
Objective

This project extends the novel model structure of Transporter Networks beyond tabletop actions performed on extruded 2-dimensional solid objects utilizing 3 Degrees of Freedom (DoF). These extensions are based on the development of an agent capable of performing shelf-placement of FMCG items with 6-DoF movements on two distinct axis planes.





Pipeline

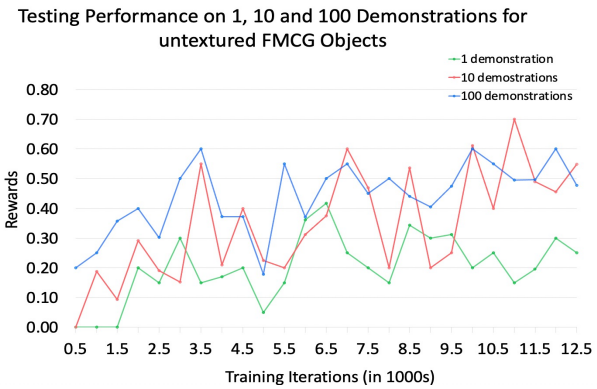
Selected a model and network suitable for the problem of shelf-placing based on literature review and experiments

Designed a shelf placement scenario and created a scripted oracle proving expert demonstrations to enable the agent to train on imitation learning

- Implemented a shelf
- Created a dataset of FMCG objects
- Partitioned the volume within the shelf to generate FMCG items
- Goal placement positions unpacked by the Oracle agent, and placement performed
- Positioned two cameras capturing the workspace and shelf
- Captured top-down RGB-D images after every action of the Oracle agent
- Generated and merged 3D point clouds from the depth images

Extended the Transporter Networks for shelf placing with FMCG objects, ensuring agent movement with 6-DoF

- Configured separate heightmaps and colormaps formed on normal planes
- Used pose estimation transformations to calculate Euler angles
- Passed the angles as labels for agent training



Results

The results obtained confirm the successful extension to 6-DoF, with the agent's performance being similar on untextured FMCG objects and industry-benchmarked YCB objects, achieving **0.7** and **0.65** maximum rewards in respective scenarios. It has been demonstrated that the agent performs significantly well even when textured objects are used, achieving **0.4** maximum rewards.