

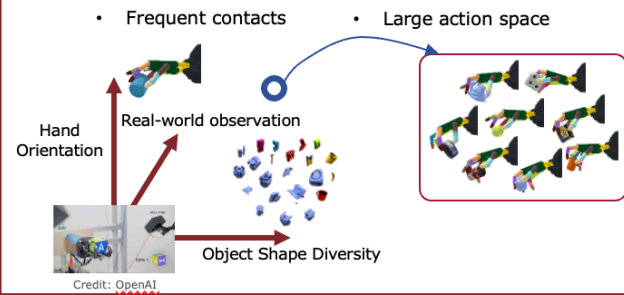


A System for General In-hand Object Re-Orientation

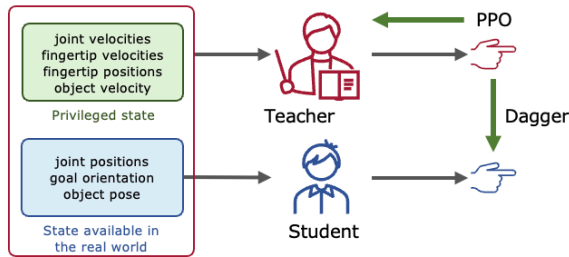
Tao Chen Jie Xu Pulkit Agrawal
Improbable AI Lab, Massachusetts Institute of Technology



What makes in-hand manipulation challenging?



How to reorient many objects?

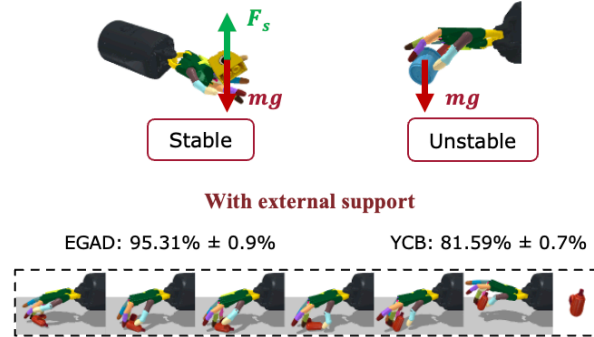


Hand faces upward

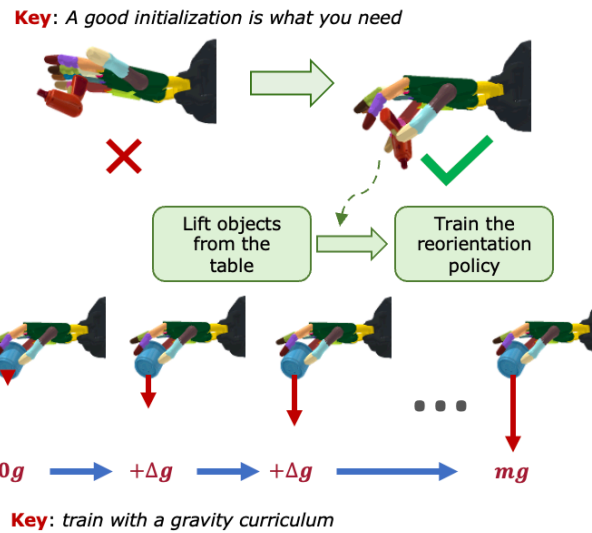
Success Rate (%) RNN Policies	Teacher	Student	Zero-shot test on unseen dataset
EGAD	95.95 ± 0.8	91.96 ± 1.5	68.82 ± 1.7 (YCB)
YCB	80.40 ± 1.6	81.04 ± 0.5	96.41 ± 1.2 (EGAD)



How to reorient objects with the hand facing downward?

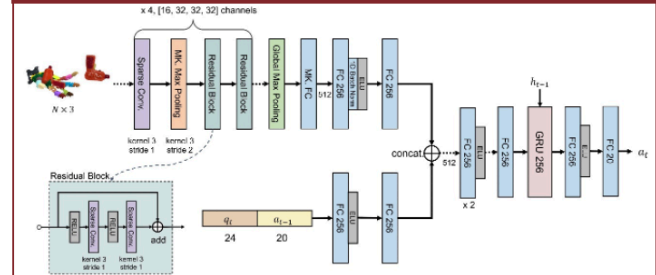


Without external support



Success Rate (%) RNN Policies	Teacher	Teacher with g-curriculum	Student
YCB	52.81 ± 1.7	74.74 ± 1.2	67.33 ± 1.9

Student policy using vision



Object	Success Rate (%)	Object	Success Rate (%)
025_mug	89.67 ± 1.2	065-d_cups	68.32 ± 1.9
072-b_toy_airplane	84.52 ± 1.4	073-a_lego_duplo	58.16 ± 3.1
073-c_lego_duplo	50.21 ± 3.7	073-e_lego_duplo	66.57 ± 3.1

- One vision policy for one object • Hand faces upward

One Surprising Finding

- The commonsense skill of re-orienting objects can be learned **without knowing object shapes.**

Future Work

- Transfer the policies to the real world
- Train a robust vision policy for many objects