Robotic gripper design with Evolutionary Strategies and Graph Element Networks

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Problem setting

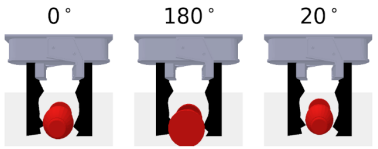
Motivation: most grippers in industy use either sub-optimal flat fingers or are hand-designed by humans.

	Gripper eval.	Gripper gen.	Differentiable	Matches reality
Simulation	Fast	Fast	No	Somewhat
Real world	Slow	Very slow	No	Exact
Learned model	Fast	Fast	Yes	Good in-dist. Bad out-of-dist.

Our approach:

1. Optimize a good gripper with evolutionary strategies in simulation while training grasp model
2. Collect small amount of real data on the proposed gripper to adapt the model to the real world
3. Differentiate through learned model to fine-tune gripper in the real world

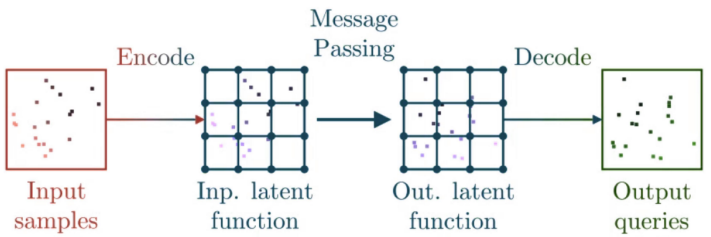
Designing in simulation



In simulation we specify:
- Set of objects to grasp
- Grasp conditions: policy, shaking, angles

We use simulation for two criteria:
- Evolutionary Strategies to optimize grippers
- Train neural models to predict grasps

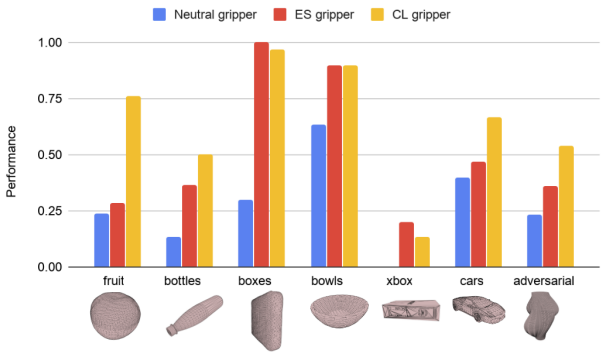
Graph Element Networks (Alet et al. '19)



Combining ideas from GNNs, Attention and Finite Element Methods

Improving default grippers

Curriculum learning provides further gains by gradually increasing shaking speed.



Resulting grippers