

Human-Informed Trajectory Generation for Push Planning



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Push Planning

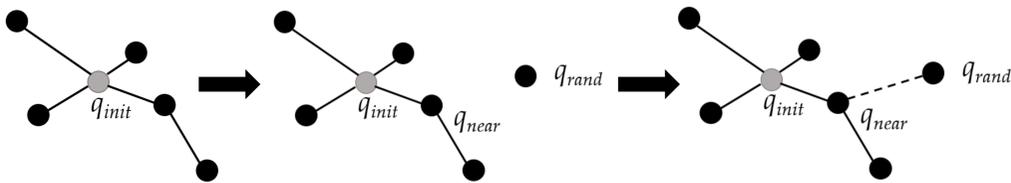
Push Planning is a form of manipulation planning that involves pushing objects.



Why do we need push planning?

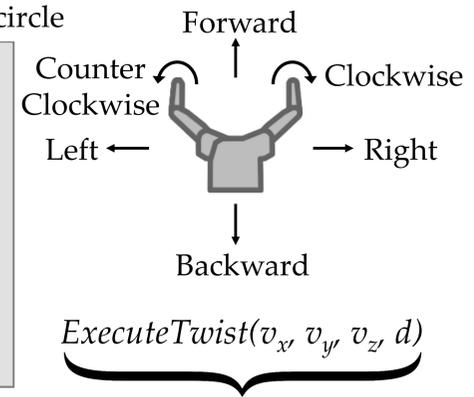
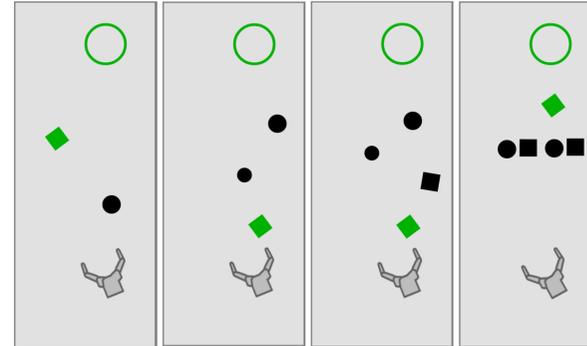


Rapidly Exploring Random Tree (RRT) is one solution, however, it is time consuming in a large state space because we can't solve the two-point boundary problem since the system is non-holonomically contained.



User Study

Task: Push the green object into the green circle

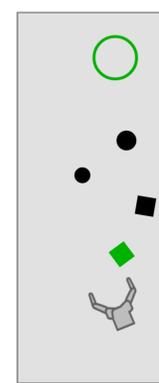
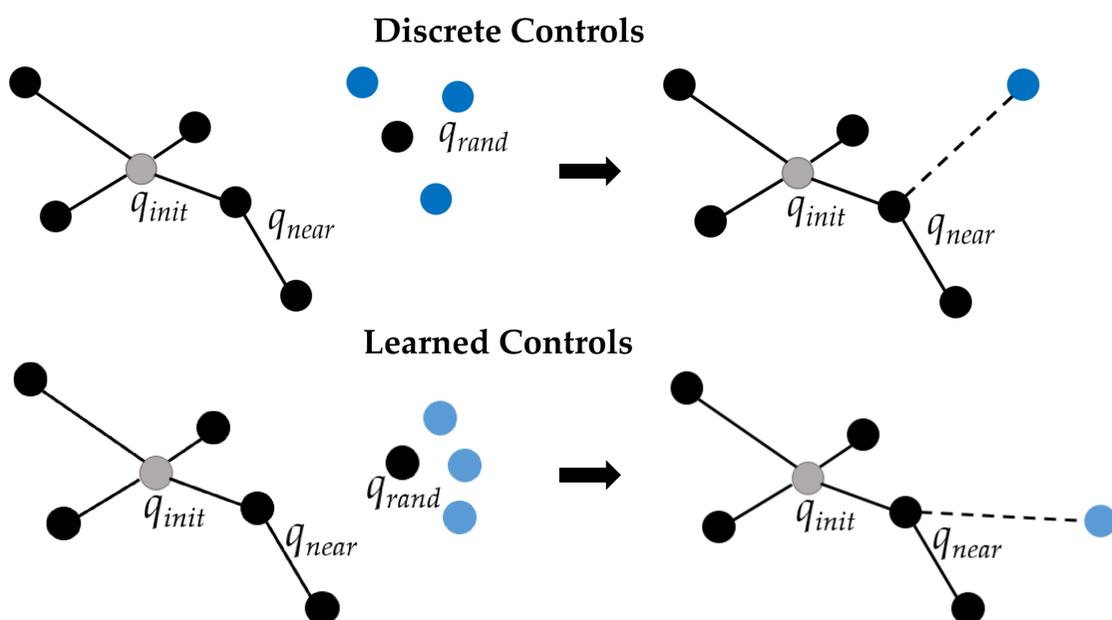


Common Strategy: Find the path that achieves the goal the least amount of time

$ExecuteTwist(v_x, v_y, v_z, d)$
Control

Using human judgement to bias the RRT growth will focus the search on relevant areas of state space thereby reducing planning time and increasing success rate.

Learned Controls vs. Discrete Controls to Bias RRT Growth



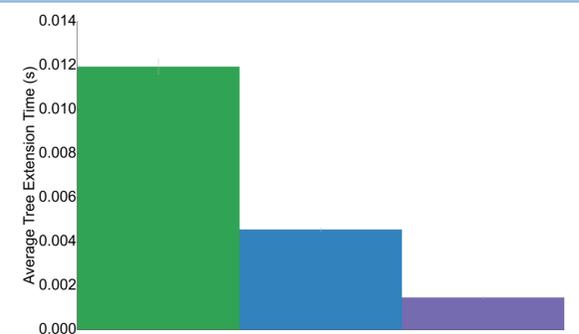
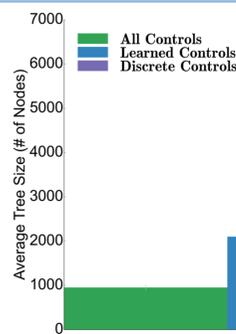
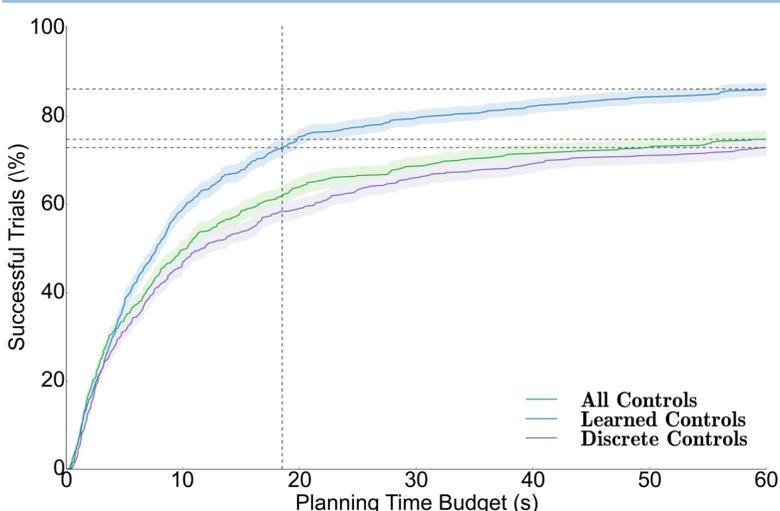
Extract Features

Random Forest

Predict Control

$ExecuteTwist(v_x, v_y, v_z, d)$

Biased RRT Growth Reduces Planning Time and Increases Success Rate



H1: Biasing the RRT growth using learned control selection will increase success rate.



H2: Biasing the RRT growth using learned control selection will decrease planning time.

Future Work

Guided Expansive Space Tree



$$weight = \frac{(order)^\gamma}{(\#neighbors)^\alpha \cdot (out-degree)^\beta \cdot (A^*cost)^\delta}$$

- User Studies with 7DOF Robot Arm
- Using different classifiers
- Implementing various tree extension methods