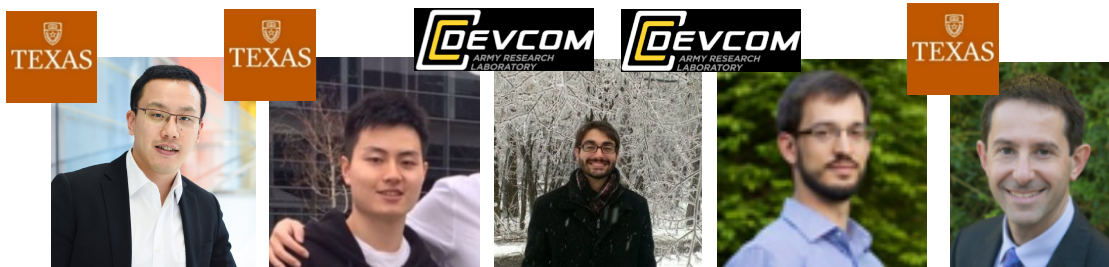


APPLD: Adaptive Planner Parameter Learning From Demonstration

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LfD for Improved Robot Navigation

Motivation: Deploying an autonomous navigation system in a new environment is not as straightforward as it may seem.

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ROS Navigation Tuning Guide

Kaiyu Zheng

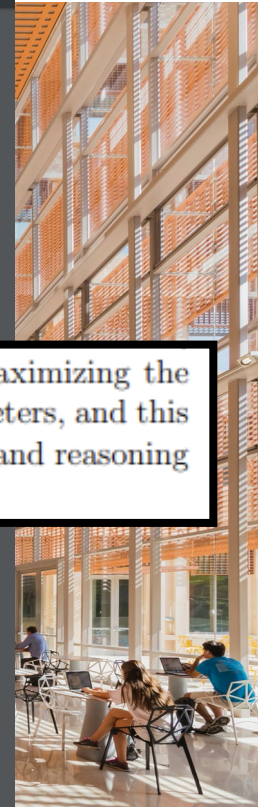
September 2, 2016*

by processing data from odometry, sensors and environment map. Maximizing the performance of this navigation stack requires some fine tuning of parameters, and this is not as simple as it looks. One who is sophomoric about the concepts and reasoning may try things randomly, and wastes a lot of time.

when setting the value of key parameters. This guide assumes that the reader has already set up the navigation stack and ready to optimize it. This is also a summary of my work with the ROS navigation stack.

Topics

1. Velocity and Acceleration
2. Global Planner
 - (a) Global Planner Selection
 - (b) Global Planner Parameters
3. Local Planner
 - (a) Local Planner Selection
 - (b) DWA Local Planner
 - i. DWA algorithm
 - ii. DWA forward simulation
 - iii. DWA trajectory scoring
 - iv. Other DWA parameters
4. Costmap Parameters
5. AMCL
6. Recovery Behavior
7. Dynamic Reconfigure
8. Problems



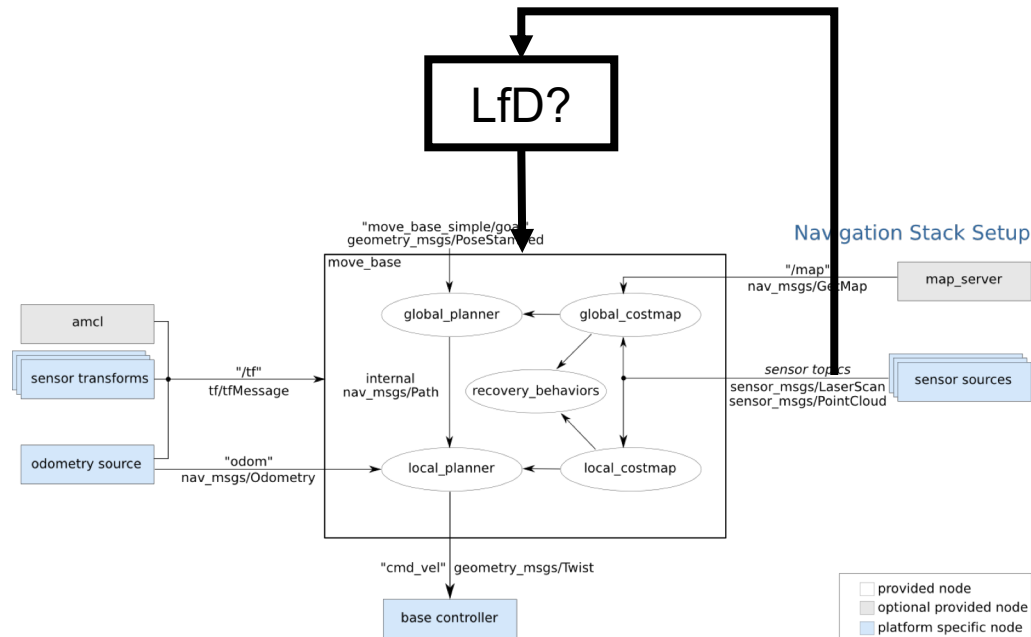
LfD for Improved Robot Navigation

Inspiration: Humans do this effortlessly.



LfD for Improved Robot Navigation

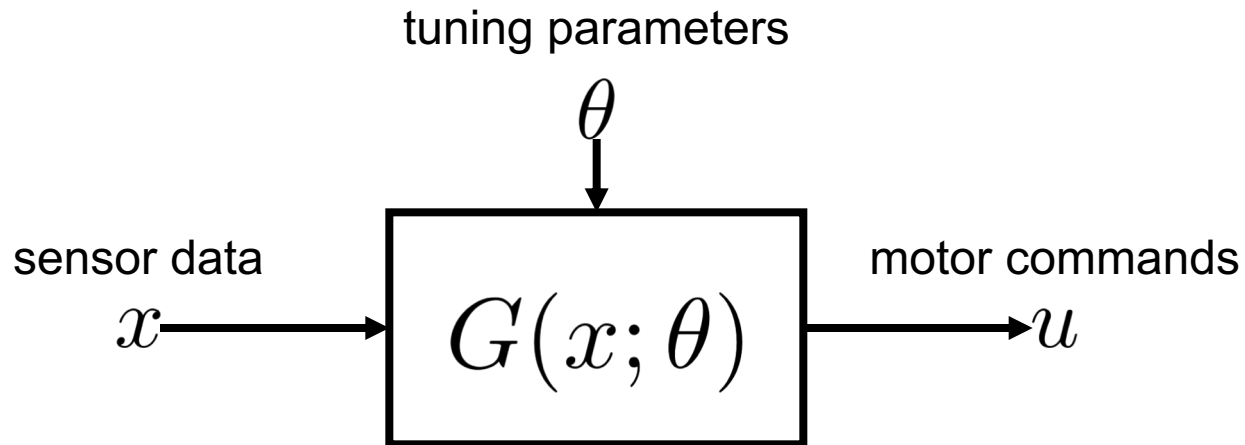
Central Question: Can we squeeze more robust performance out of our existing navigation systems using LfD and limited human interaction?



ROS `move_base` navigation stack

LfD for Improved Robot Navigation

Proposed: Use behavioral cloning to “tune” any navigation stack.

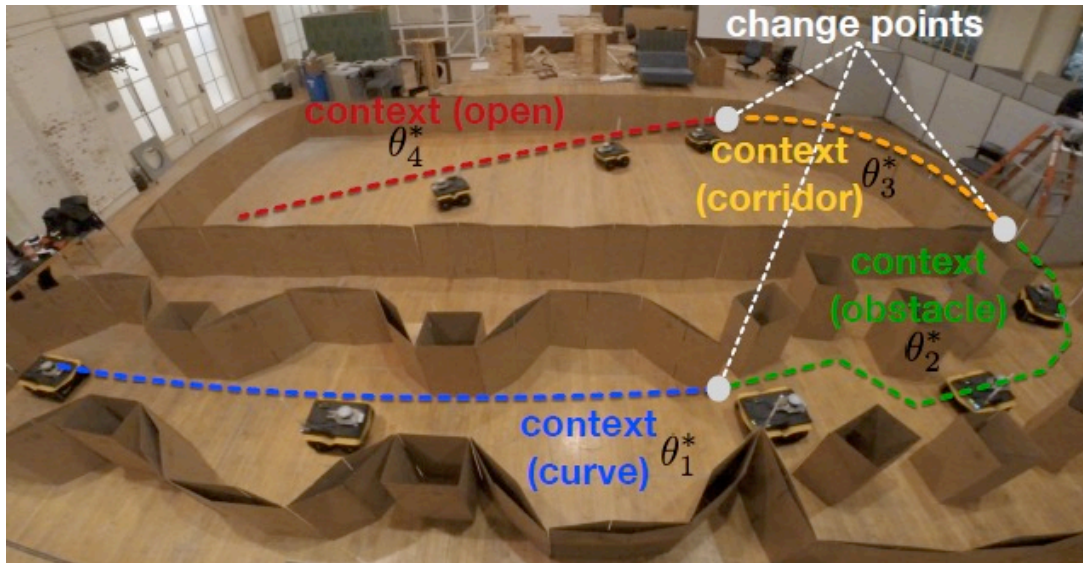


Behavioral Cloning: Learn parameters from a demonstration using supervised learning.

$$\theta^* = \arg \min_{\theta} \sum_i \ell(G(x_i; \theta), u_i)$$

LfD for Improved Robot Navigation

Context Problem: Humans exhibit qualitatively different navigation behaviors in qualitatively different environments.

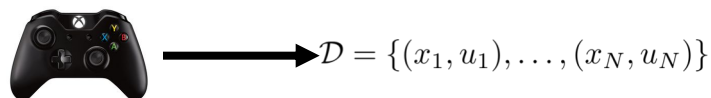


$$\{\theta_1^*, \dots, \theta_K^*\}$$

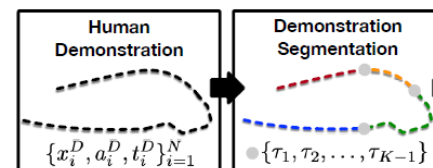
LfD for Improved Robot Navigation

APPLD: Adaptive planner parameter learning from demonstration

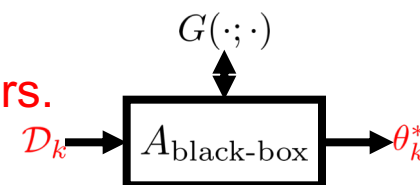
1. Collect demonstration.



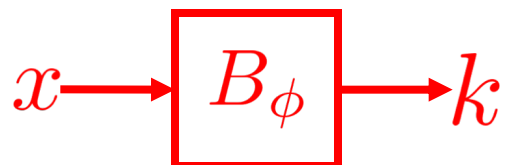
2. Perform automatic demonstration segmentation.



3. Use black-box optimization to find set of optimal parameters.

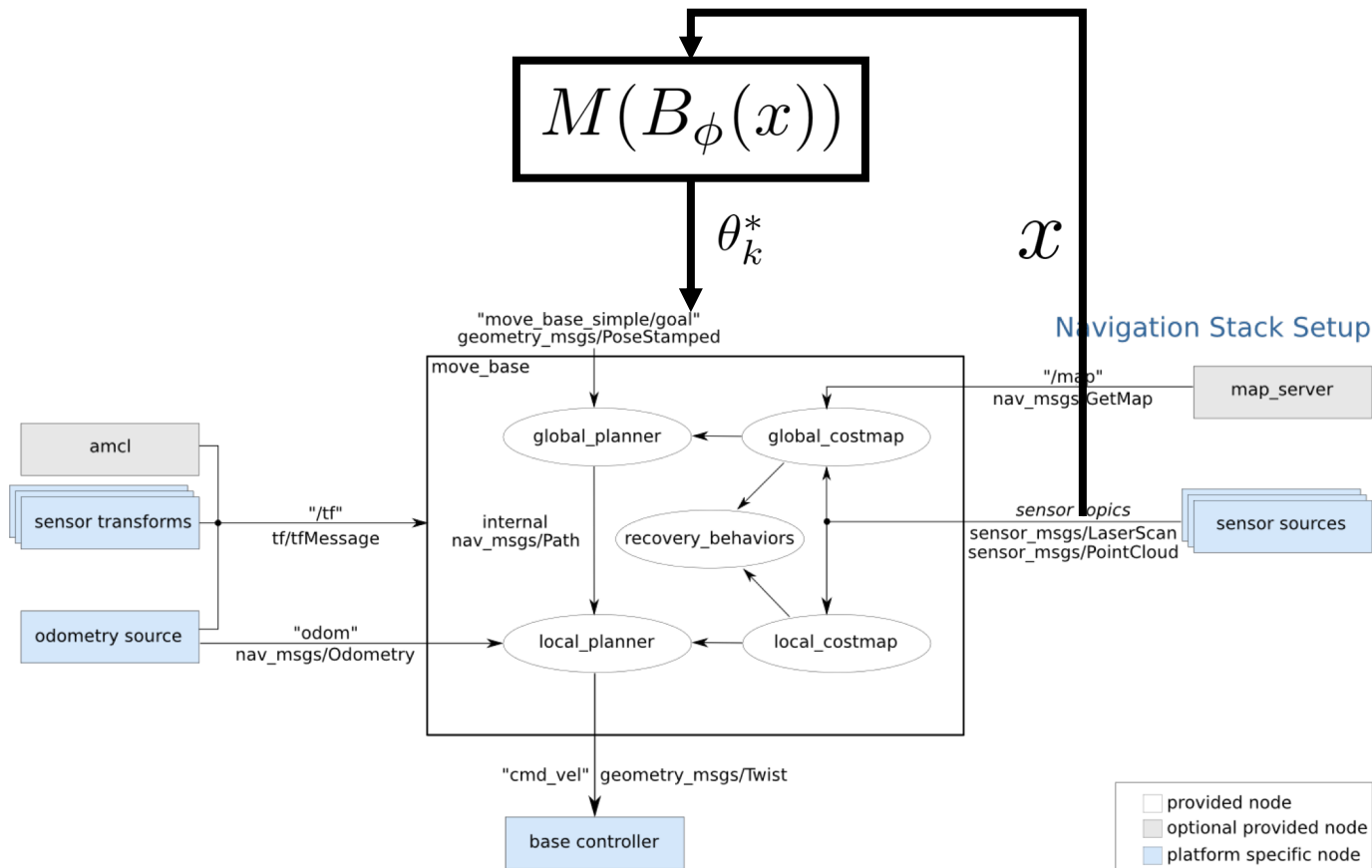


4. Use supervised learning to train a context predictor.



LfD for Improved Robot Navigation

APPLD Deployment



LfD for Improved Robot Navigation

Experiments



Robot: Clearpath Jackal (Velodyne Puck lidar)



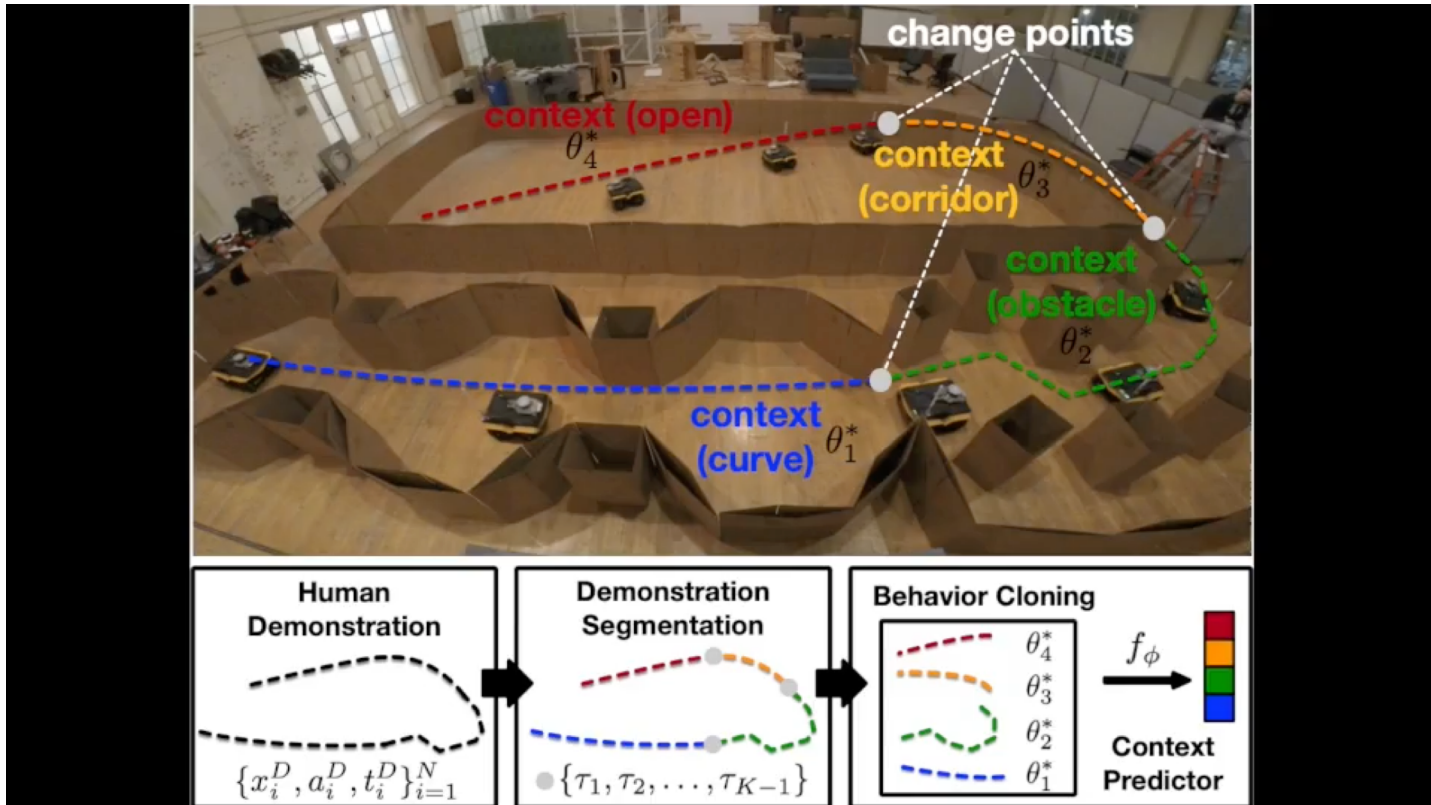
Human: An author (Xbox wireless controller)



Environment: Challenging obstacle course

Results

APPLD: Deployment in demonstration environment



Results

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Different robot, navigation stack, and environment

