Project Proposal
Robot Manipulation

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1 Introduction

"The ability of a robotic manipulator to grasp and manipulate objects depends on the kinematic structure of the arm, on its location in the physical space, on the relative location of the objects with respect to the arm, and on environmental restrictions".[1] And our task here is that, given an area with objects that need to be manipulated,we will have to find out which is the best position and orientation for the robot so that the biggest number of objects can be reached in its dexterous workspace

1.1 Team name

ManipulatOIR

1.2 Project title

Optimal Inverse Reachability

1.3 Names of members

Name	Git Id
Dharmin Bakaraniya	DharminB
Vajra Ganeshkumar	vajrag
Hossam Mohammed	Hibrahim1

2 Available software packages (or available approaches)

- Reuleaux[4] [8]
- Extend move_base_to_manip[7]
- Implementing our own wrapper on *Moveit!* using concepts of[2] [3] or[5]

Our research provided us only one ready to use package. According to a ROS forum question[6] Reuleaux is the only package available for Optimal inverse reachability.

3 A small qualitative comparison

Table 1: Qualitative Analysis

Reuleaux	Extention	Our Wrapper
C++	Python	Python
moveit_ikfast	moveit	moveit
ready to use	Not implemented	Not implemented

4 2 Best approach

1. Reuleaux
2. Extend move_base_to_manip

5 Work plan

5.1 Goals and checkpoints

- Figure out Reuleaux package and how to use it

- Figure out move_base_to_manip and how to use it
- Build an extension for move_base_to_manip
- Run these in simulation
- Run these on real youbot

5.2 By when does it need to be done

- By the end of April, we will finish some literature reading related to the topic.
- In May: Design our software and/or figure out available software packages
- By the end of June 2nd Week -Testing software on simulation and actual robot.

5.3 Who is the responsible person for it

All the team members will work on literature survey. Reuleaux package will be tested by Vajra. The programming for extention will be done using Pair programming in order to minimize errors and maximize productivity. Testing will be done individually on simulation. Testing on real robot will be done while everyone is present.

References

[1] Porges, Oliver, et al. "Reachability and Dexterity: Analysis and Applications for Space Robotics." Workshop on Advanced Space Technologies for Robotics and Automation-ASTRA. 2015.

[2] Abdel-Malek, Karim, Wei Yu, and Jingzhou Yang. "Placement of robot manipulators to maximize dexterity." International Journal of Robotics and Automation 19.1 (2004): 6-14.

[3] Park, F.C.; Brockett, R.W., Kinematic dexterity of robotic mechanisms, International Journal of Robotics Research, v 13 n 1 Feb 1994 p 1-15

[4] Makhal, Abhijit, and Alex K. Goins. "Reuleaux: Robot Base Placement by Reachability Analysis." 2018 Second IEEE International Conference on Robotic Computing (IRC). IEEE, 2018.

[5] Rastegar, J.; Singh, J.R., 1994, New probabilistic method for the performance evaluation of manipulators, ASME Journal of Mechanical Design, v 116 n 2, pp. 462-466.

[6] Ros forum question for inverse reachability

[7] ros move_base_to_manip

[8] ros reuleaux