

# UC Berkeley AUTOLAB Team Report

## 1 Sept 2018

### Preliminary Round of the HSR Home Chore Challenge Competition: "Task to Tidy up Toys"

#### Problem:

In a simulated environment, Given room with childrens blocks scattered on floor, use the HSR to find, grasp, and deposit as many blocks as possible into a box.

#### Summary:

Surface decluttering is an important application for service robots in a broad variety of unstructured environments such as home, office and machine shops. We are committed to robot learning from simulators and adapting these policies to perform real world tasks. An emerging class of robot mobile manipulators such as the Toyota HSR hold promise to enhance safety and efficiency in homes and workplaces. Some related examples include robotic butler in unstructured environments with HERB in [1], and PR2 [2]; combining grasping and pushing primitives in decluttering lego blocks with PR2 [3]. We build upon these results in this competition to tidy up toys spread randomly across the room. Our strategy comprises of moving the basket next to the pile of the toys, recognizing the object locations from onboard image sensors, and depositing them turn by turn in the basket, before moving the basket to the next pile of objects. Doing so, we are able to tidy up 5 different areas of the room for a total of 16 blocks.

#### Results: [\(video\)](#)

The average timing of our approach (accounting for real-time factor of 0.11):

- 5.30 for moving the basket next to the pile of objects,
- 4.45 for detecting, navigating and grasping the block
- 5.05 for returning and depositing the block

We were able to scale this approach to handle 16 blocks in 2 hours and 58 minutes.

#### Challenges:

Despite doing exceedingly well in the competition, we identified the issues below that would be useful for other participating teams and also help improve the simulator in future:

1. *Navigation* -- we measured that abnormal navigation behavior (overshooting target, drifting endlessly) occurs when desired position is greater than the distance of 1.8 meters.
2. *Grasping* -- the grasping works better when the movement of the base is restricted
3. *Depositing* -- the robot often needed to re-localize with respect to the box

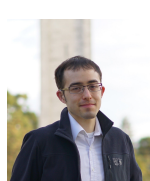
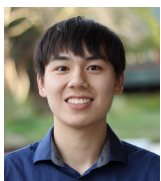
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**Team Repository:** [https://git.hsr.io/ajay\\_tanwani/hhcc-challenge/](https://git.hsr.io/ajay_tanwani/hhcc-challenge/)

**Team Members:** (from left to right)

Grant Wang, Zisu Dong, Jonathon Lee, Daniel Seita, Michael Laskey, Ajay Tanwani, Ken Goldberg



## References:

- [1] S. S. Srinivasa, D. Ferguson, C. J. Helfrich, D. Berenson, A. Collet, R. Diankov, G. Gallagher, G. Hollinger, J. Kuffner, and M. V. Weghe, "Herb: a home exploring robotic butler", *Autonomous Robots*, vol. 28, no. 1, p. 5, Nov 2009.
- [2] J. Bohren, R. B. Rusu, E. G. Jones, E. Marder-Eppstein, C. Pantofaru, M. Wise, L. Msenlechner, W. Meeussen, and S. Holzer, "Towards autonomous robotic butlers: Lessons learned with the pr2," in *IEEE International Conference on Robotics and Automation*, 2011, pp. 5568–5575
- [3] M. Gupta, J. Muller, and G. S. Sukhatme, "Using manipulation primitives for object sorting in cluttered environments," *IEEE Trans. Automation Science and Engineering*, vol. 12, no. 2, pp. 608–614, 2015