

16-848 Spring 2018: References for February 7

The topic for today was manipulation planning. We started by taking a quick look at this paper to help make the point that robotics researchers have been looking at some specific manipulation problems (e.g., finger gaiting) for quite some time.

Han, Li, and Jeffrey C. Trinkle. "Dextrous manipulation by rolling and finger gaiting." In *Robotics and Automation, 1998. Proceedings. 1998 IEEE International Conference on*, vol. 1, pp. 730-735. IEEE, 1998.

<http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=677060>

Our main focus, however, was this paper from the computer graphics community, which used a sampling based search to fill in plausible hand motions given motion of the wrist and object (taken from a motion capture system).

Ye, Yuting, and C. Karen Liu. "Synthesis of detailed hand manipulations using contact sampling." *ACM Transactions on Graphics (TOG)* 31, no. 4 (2012): 41.

http://yutingye.info/SIG12_files/SIG12ye_preprint.pdf

<https://www.youtube.com/watch?v=x8c27XYTLTo>

The same group had previously introduced the following paper, which demonstrates less complex finger motions, but does produce changes in hand configuration which are meant to signal the effort that the hand is utilizing to perform a task. The interesting (and, it turns out debatable) assumption is that the hand should attempt to maintain equilibrium torques throughout the task.

Liu, C. Karen. "Dextrous manipulation from a grasping pose." In *ACM Transactions on Graphics (TOG)*, vol. 28, no. 3, p. 59. ACM, 2009.

<https://www.cc.gatech.edu/~karenliu/Manipulation2.html>

We then turned to the following paper, which differs from the previous research in that it searches for a control policy rather than sampling contacts.

Andrews, Sheldon, and Paul G. Kry. "Goal directed multi-finger manipulation: Control policies and analysis." *Computers & Graphics* 37, no. 7 (2013): 830-839.

<https://www.sciencedirect.com/science/article/pii/S0097849313000599>

<https://www.youtube.com/watch?v=XKLhoHB2RfE>

This paper from the Georgia Tech group followed a year later, and demonstrates manipulation of object configuration on the palm of the hand:

Bai, Yunfei, and C. Karen Liu. "Dexterous manipulation using both palm and fingers." In *Robotics and Automation (ICRA), 2014 IEEE International Conference on*, pp. 1560-1565. IEEE, 2014.

<https://www.youtube.com/watch?v=KBDTrmXOF4o&feature=youtu.be>

At the end of our class, I showed results from these papers:

Mordatch, Igor, Zoran Popović, and Emanuel Todorov. "Contact-invariant optimization for hand manipulation." In *Proceedings of the ACM SIGGRAPH/Eurographics symposium on computer animation*, pp. 137-144. Eurographics Association, 2012.

<https://homes.cs.washington.edu/~todorov/papers/MordatchSCA12.pdf>

https://www.youtube.com/watch?v=mhr_jtQrhVA

Bai, Yunfei, Wenhao Yu, and C. Karen Liu. "Dexterous manipulation of cloth." In *Computer Graphics Forum*, vol. 35, no. 2, pp. 523-532. 2016.

https://www.youtube.com/watch?v=_H_PllvL3-k

The following paper is also worth checking into:

Sundaralingam, Balakumar, and Tucker Hermans. "Relaxed-Rigidity Constraints: In-Grasp Manipulation using Purely Kinematic Trajectory Optimization." *RSS 2017*.

https://robot-learning.cs.utah.edu/_media/project/sundaralingam_rss_2017-in-grasp-opt.pdf

<https://www.youtube.com/watch?v=Gn-yMRjbmPE>