

# 6.857 Final Project: Milestone 4

Sebastiani Aguirre Navarro and Rachel Holladay

November 8, 2017

## 1 Initial Results

Our goal is to use machine learning techniques to predict the probability of successfully grasping an unknown object with a robotic arm. We were forced to change our data set, for reasons explained in depth in Sec. 2, to the DexNet Network (DexNet) 2.0 data set [1]. The data set has 6.7 million synthetic point clouds with parallel-jaw grasps (a common robot hand type of two parallel fingers) and analytical grasp metrics.

The data set covers 1,5000 3D object models used in DexNet 1.0 [2] that are collected from a variety of other data bases and standardized with respect to position. Each object is paired with 2.5D point clouds, which are referred to as depth images, which are rendered with a variety of object and camera poses, where the camera intrinsics are known and used to center the depth image in a standardized fashion. Each image is a black and white 32 by 32 pixel matrix. The parallel jaw grasps were sampled with rejection sampling for antipodal point pairs. The grasps are represented by a 7 dimensional vector specifying details of the grasp center, angle, object center and gripper width. Together the depth image and grasp vector compose our input.

Our label is given by the robust epsilon quality grasp metric (defined in [3]), which is thresholded by the value 0.002 to create binary labels.

For our initial results we sampled 10,000 data points from the 6.7 million.

[RH: Describe network and initial results](#)

## 2 Risk Mitigation

One of the risks we had mentioned in a previous milestone relating to data access unfortunately became realized. Early in our project we mentioned two possible datasets, the BigBird data set [4] and the DexNet data set [1]. We elected to use the BigBird data set in conjunction with the grasp generation and labeling process package "Grasp Pose Generator (GPG)" from [5]. In attempting to create our training data, we realized that GPG did not directly use the data in the BigBird set and instead first performed a transformation that edited the depth files and generated surface normals. We were unable to find

the opensource component that performed this transformation and the author of the report (at the time of this writing) has not replied to our request.

Therefore, we have switched to using the DexNet 2.0 data set, whose data is described in further detail in Sec. 1. If we are able to use the BigBird data set, we will consider using it in conjunction or as a comparison.

**RH: explain all the drama**

### 3 Division of Labor

Rachel generated the training data from the DexNet data sets and set of the labeling mechanism. Sebastiani will set up an environment in a cloud provider with GPUs and start coding the Network In Network and Inception based models in Keras/Tensorflow and transfer learn layers of a pretrained YOLO onto our problem space. **RH: This is what we had written last time. Is it still correct?**

### References

- [1] J. Mahler, J. Liang, S. Niyaz, M. Laskey, R. Doan, X. Liu, J. A. Ojea, and K. Goldberg, "Dex-net 2.0: Deep learning to plan robust grasps with synthetic point clouds and analytic grasp metrics," *arXiv preprint arXiv:1703.09312*, 2017.
- [2] J. Mahler, F. T. Pokorny, B. Hou, M. Roderick, M. Laskey, M. Aubry, K. Kohlhoff, T. Kröger, J. Kuffner, and K. Goldberg, "Dex-net 1.0: A cloud-based network of 3d objects for robust grasp planning using a multi-armed bandit model with correlated rewards," in *ICRA*, pp. 1957–1964, IEEE, 2016.
- [3] D. Seita, F. T. Pokorny, J. Mahler, D. Kragic, M. Franklin, J. Canny, and K. Goldberg, "Large-scale supervised learning of the grasp robustness of surface patch pairs," in *SIMPAR*, pp. 216–223, IEEE, 2016.
- [4] A. Singh, J. Sha, K. S. Narayan, T. Achim, and P. Abbeel, "Bigbird: A large-scale 3d database of object instances," in *ICRA*, pp. 509–516, IEEE, 2014.
- [5] A. t. Pas, M. Gualtieri, K. Saenko, and R. Platt, "Grasp pose detection in point clouds," *arXiv preprint arXiv:1706.09911*, 2017.