CIS 565 Final Project
CUDA Based 3D Descriptors for Object Recognition

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1 Motivation

Features are critical in traditional computer vision for many tasks like object recognition and tracking, and there are numerous algorithms out there such as SIFT, SURF, BRIEF, ORB, etc. However, most of the algorithms are developed for usage in 2D image space while today's need and focus has gradually shifted to the 3D world. With the availability of various sensors and increasing need from real-world applications such as self-driving and drones, 3D object recognition and tracking are definitely exciting fields to explore. Nowadays most recently published papers use deep learning to approach this problem and have gained exciting achievements. However, due to the nature and time constraint of a class project, I still choose to navigate the more traditional side of computer vision. This way, I can understand 3D data better since point clouds are generally very different from images. Besides, deep learning often suffers from low speed and high memory usage. People have spent a lot of efforts deploying their models into embedded system.

2 Method

I've decided to implement and experiment with two or three different descriptors depending on time: Point Feature Histograms Descriptors, Rotational Projection Statistics Features, Globally Aligned Spatial Distribution Descriptors. I picked these three because there are existing cpu based implementation of these on PCL library so I can use them as a testing baseline.

3 Milestone

The project will be separated into couple stages:

- Running PCL sample code (1-2 days)

- Write own cpu implementation (1 week)

    - I/O parsing (1 day)
    - Points Down-sampling (1 day)
    - Common Code (3-5 days)

- Write GPU implementation (2 - 3 weeks)

    - Key Points Association (3-5 days)
    - Finding Correspondence between Model Descriptors and Scene Descriptors (include rejection) (1 week)
    - Cluster Found Correspondence (3-5 days)

- Test to perform point cloud aggregation or real time recognition (Time permitted)

4 Reference

http://pointclouds.org/documentation/tutorials/rops_feature.php#rops-feature
http://pointclouds.org/documentation/tutorials/registration_api.php#registration-api
Y. Guo, M. Bennamoun, F. A. Sohel, M. Lu, J. Wan, and N. M. Kwok. A comprehensive performance evaluation of 3D local feature descriptors. IJCV, 116(1), 2016.