HAAG Weekly Report

Nikita Angarski – 3D Modeling

Week 10

Time-Log

- What did you do this week?
  - Met with Dr. Porto to discuss preliminary testing results and see if there were any mistakes with the implementation.
  - Fixed the code to correctly do the testing registration methods against manually placed points (and got good results, for the same task, our method beat the traditional cpd by 14%!). The testing was edited to make the vanilla pycpd method plot the 53 manual points with the included transform_point_cloud method, while the PCA method is tested by transforming the same points using tps registration.
  - We did our 3rd Seminar for the seminar program.
- What are you going to do next week
  - Expand the testing to include all the included mouse skull samples to have a more robust dataset test data.
  - Meet with Dr. Porto once more to see where else we can push the experiment to get more results to compare against.
  - Also potentially implement Steve's method of keeping the transformation within PCA space and repeat the testing process with this new method.
- Blockers, things you want to flag, problems, etc.
  - It looks like we're on a good track, I want to get a good explanation together that explains the theory behind how we're testing.

Abstracts:

A Novel 3-D Point Cloud Registration Method with Quaternions Optimization and Data Snooping

https://ieeexplore.ieee.org/document/10915648

Abstract: Various algorithms derived from the errors-in-variables (EIV) model are always commonly used for estimating transformation parameters in three-dimensional (3-D) point cloud registration, which is attributed to the flexible and robust nature of its mathematical framework. Despite the effectiveness of conventional methods in handling a range of transformation problems, limitations may arise when dealing with scenarios that involve large rotation angles and arbitrary scale ratios. Moreover, the presence of complex external environmental variables can introduce outliers in datasets, which significantly affect registration outcomes. To tackle these challenges, we propose to abstract the transformation model of point cloud registration as a generalized EIV model, utilizing quaternions to represent spatial rotation parameters. Subsequently, we introduce a sensitivity analysis-based data snooping algorithm to identify outliers. Unlike previous studies, our method employs a new algorithm utilizing quaternions to improve computational efficiency, removing the requirement for exact initial parameter values at the beginning of iterations. Additionally, the proposed algorithm utilizes sensitivity analysis to build test statistics, with the goal of improving outlier detection and enhancing resistance to their negative effects. Our method has demonstrated superior efficiency and precision compared to traditional methods in both simulations and real experiments.
Index Terms—Point cloud registration, quaternions, data snooping, outliers, sensitivity analysis

What did you do and prove it

Link to Seminar youtube: https://youtu.be/TmGJExZNt30

Link to updated suite commit: https://github.com/Nikitos1865/pycpd-Porto/commit/08f0415162c3fa6d3126d2a196a7e510dff5f8e8