

Assignment1: Point Cloud Registration

February 18, 2023

1 Your goal

- Given a sequence of point cloud scans, you need to implement ICP algorithm to find the transformation between these frames. Other than ICP, you can also implement NDT(Normal Distributions Transform) for the point cloud registration.
- After implementing one of these algorithms, you can estimate the relative transformation between these frames, and recover the complete absolute trajectory of the sensor by concatenating relative transformations. Finally, you need to reconstruct the whole 3d map by transforming all the point cloud scans into the same coordinate system.
- Visualize the recovered 3d point cloud map during the offline check.

Briefly, what you need to show us is sensor trajectory and reconstructed 3d map.

Note that both ICP and NDT are okay, but if you choose to implement NDT, you can get a 10% bonus.

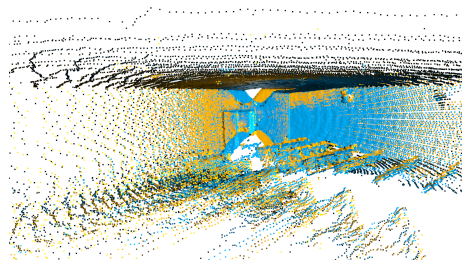


Figure 1: visualzaiton of two aligned point cloud

2 Data

Download All the data is in a zip file named “hw1_dataset.zip”. Please download it from Piazza.

Format The zipped file contains files named by “frame_{id}.xyz”. In “.xyz” file, each line has 3 numbers representing the xyz coordinate of point cloud data in “frame_{id}” (the unit is meter).

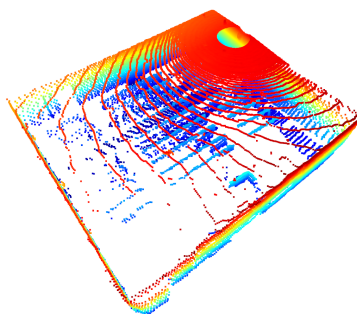


Figure 2: single frame point cloud visualization

3 Implementation requirements

- Both C++ and Python are acceptable.
- You can only use third-party libraries for matrix computation (i.e. numpy and Eigen) and visualization (i.e. Open3D or OpenGL).
- Please do not use an off-the-shelf point cloud registration function or nearest neighbor point identification. You may use any kind of advanced data structure, but you are to implement the actual algorithm by yourself.

4 Submission requirements

- Deadline: 9th of March 23:59.
- Submit your solution code with a one-page summary of your code (structure and usage) and results as a zip to the TA.
- Make sure the email has the header “CS284: HW1: Your Name”
- We would then arrange a meeting after the deadline in which we would ask each one of you to come in for 10 minutes to demonstrate your solution on your own computer.

- If submitted after the deadline but still within 24hrs, a 50% penalty is applied. If submitted more than 24hrs after the deadline, a zero score will be given.

5 Other information

- About NDT details, please refer to materials in Piazza *The normal distributions transform: a new approach to laser scan matching*.
- Feel free to ask questions in Piazza but make sure not to ask any question directly about the solution, or to even reveal a part of your solution to others. Do not just copy past code from the solution. Instead, you need to make sure that your question is taken out of the context of this homework and formulated in a general way.