

Project Proposal

Computational Geometry (CS478)

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1. Project

Since we are undergraduate students, our project topic will be “Implementing Two 3D Convex Hull Computation Algorithms and Comparing Their Performance”. The purpose of this project is to create a program that calculates and visualizes the three dimensional convex hull of a given set of points in 3D space using two different algorithms and to compare the performance of these two approaches. The algorithms that will be compared are the Gift Wrapping Algorithm and a 3D Sweep Hull Algorithm for computing Convex Hulls and Delaunay Triangulation by David A. Sinclair.

For both algorithms, visualization is not limited to only the result of the algorithm but all major steps taken during its execution will be visualized too. Since the number of points can be too high, points will be added in bigger steps like %10 of the points at once.

The set of points used by the program will be generated randomly. However, the number of points and the distribution to be used for the creation of the points will be obtained from inputs to the program. On top of this, the program will have the option for magnifying and moving the created Voronoi Diagram. Boundaries of polygons belonging to the generated 3D convex hull will be drawn and the visualization of the 3D convex hull can be done both as a wireframe and as polygon shading according to user input.

Comparison of the program will examine 3 factors: preprocessing time, memory used, and query time after preprocessing. The test cases will go up to as many as one million points to make sure of the efficiency.

2. Technologies to use

Since a significant part of David A. Sinclair’s algorithm’s implementation in C++ can be found in his paper, we have decided to pick C++ as our choice of language, OpenGL as our graphics API, and ImGui, a C++ UI library, for user interface. We also plan to use GLFW, GLAD, and GLM helper libraries for their utility and less boilerplate code without helping the core of the project.