Anna Zhao

CSCI 2240: Advanced Computer Graphics
Capstone Abstract

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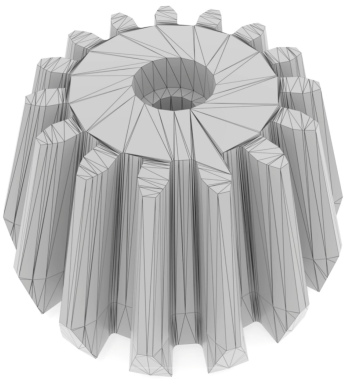
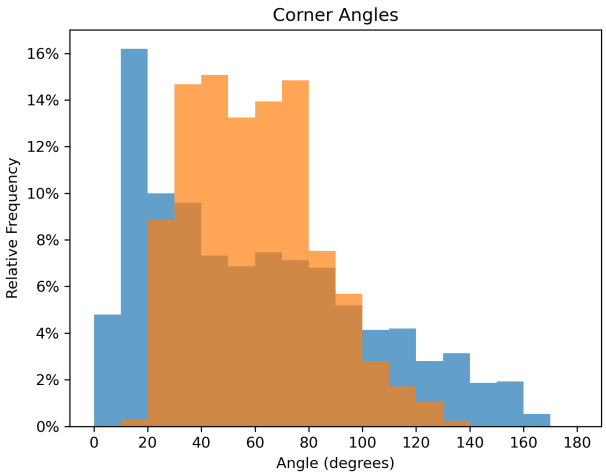


In 3d computer graphics, objects are almost always represented using polygonal meshes. These meshes are used to represent objects in programs for gaming and animation, and when manifold, can host a variety of operations such as deformation. However, the meshes created to accurately represent the geometry of certain objects are not always ideal for mathematical computations which require more uniform triangulations and other features such as cotangent angles. The mesh to the right is an example of a poorly generated mesh since it has many long and skinny triangles that are unideal for computations. While we can achieve better uniformity by increasing the number of triangles that make up the mesh, this can increase computation times drastically and is not efficient for real time applications such as in gaming.

For my capstone assignment, I implemented a featured called intrinsic triangulations that allows you to retriangulate meshes independent of the extrinsic geometry. By allowing surface triangles to bend over edges of the original mesh, we are able to retriangulate the mesh into much more mathematically friendly triangles using much fewer faces and while also preserving the original geometry. By using something called a signpost data structure, we can create a relative positioning of each vertex with it's neighboring vertices to perform computations independent of any absolute positions. This is what allows our triangles to bend over physical edges, as intrinsic vertices have no absolute positioning.

We were able to successfully retriangulate many bad meshes with much better triangle angle bounds such as the two shown. In the case of the cactus, the graph shows the distribution of angles with the blue representing the original mesh and the orange representing the intrinsically triangulated mesh, showing that we are able to achieve much more usable meshes with our methods.


Corner Angles
16%
14%
12%
10%
8%
6%
4%
2%
0%
Relative Frequency
0
20
40
60
80
100
120
140
160
180
Angle (degrees)