CSC 476 – Program 3 – Due May 24th 11:59pm

Mesh simplification

Please note that as with all programming assignments this program should be done **individually**! You may talk to one another about the program, but you may not look at someone's working code!

This assignment requires you to complete a mesh simplification program using edge collapse to decimate a mesh using the specified metric (see below). Please note that you have been provided with a base mesh class that includes all the necessary neighborhood information that you will need to evaluate the specified edge metric.

Your mesh simplification program will need to read in a mesh (in the .m format) and then Simplify that mesh to three different target sizes (specified by the number of faces of the mesh) – the exact meshes to be used and the target number of faces will be released shortly, but you can expect that we will start with a high resolution mesh and then you will simplify it to close to one half, one third and one fourth of the starting number of faces.

Please work on this program in discrete steps. I suggest:

1) Download the mesh class and familiarize yourself with its functionality.
2) Write a wrapper program which calls the necessary functions to read in and display a mesh.
3) Integrate your transform code so that you may examine the read-in mesh.
4) Compute and print statistics about the mesh (i.e. number of faces and the average valence per vertex).
5) Compute a smoothing operator for the mesh – link the smoother with the "s" key so that each time the user hits the "s" key the mesh will be smoothed. Use the center of gravity as the new "smoothed" location for each vertex. That is, for each vertex, average all the neighbors in its 1-ring and set the new vertex position to be that average. (20 pts)
6) Evaluate the error metric per edge. Use the following metric:
   $$\frac{|V_1 - V_2|}{|N_{f1} \bullet N_{f2}|} = \frac{edge\ length}{angle\ between\ normals}$$
7) Place the edges in a priority queue based on this metric (prioritized smallest to largest – i.e. we would like to collapse small edges adjacent to planar faces first!)
8) Collapse the edge with the highest priority.
9) Compute the position for the new vertex by evaluating the following heuristic: pre-compute the average summed cost of each 1-ring for V_1 and V_2 = prev_summed_cost. Then compute the summed cost of the 1-ring for the new vertex at three different positions, V_1, V_2 or $\frac{|V_1 + V_2|}{2}$.
   Place the vertex at whichever position most closely matches the recomputed prev_summed_cost. Note that this positioning is a heuristic – you are free to experiment with similar heuristics to see if you get better results with a different criterion.
10) Re-compute the edge metric of the edges in the new 1-ring and update the priority queue.
11) Continue collapsing edges until you reach the desired number of faces. (80 pts)