

Title: 3D Walls

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Project Description: Compute a GVNS representation of a polygonal approximation of the Minkowski sum of a planar edge graph with a vertical cylinder. Support visualization and corner operations on the resulting mesh. The planar edge graph has to support all operations like add and delete of an edge and a vertex. The 3D extrusion has to support the following corner operations, next, previous, swing.

User Manual:

- There are three modes in 2D mode. Add, delete, and view/traverse corners. Add is accessed by clicking “a.” Delete is accessed by clicking “d.” View/traverse is accessed by clicking “c.”
- In Add mode, drag on graph to make new edges and vertices. Single click on an already existing edge to split it in 2 and add a new vertex.
- In delete mode, click on vertices or edges to delete them.
- In view mode, click on a corner to view corner positions of next, swing, and current corner.
 - In view mode you can traverse edges by using the following key bindings:
 - “n” – move to next corner
 - “s” – move to swing corner
 - “u” – move to unswing corner
 - “p” – move to previous corner
 - “z” – move to z corner
 - If you click inside of a face instead, it will highlight the face and tell you the area.
- To view faces press “f.”
- To switch to 3D mode press “X”.
- In 3D mode, press “1” to show only the connected edges of the 3D extrusion.
 - In 3D mode, press “C” to select a corner. In view mode you can traverse edges by using the following key bindings:
 - “n” – move to next corner
 - “s” – move to swing corner
 - “u” – move to unswing corner
 - “p” – move to previous corner
 - “z” – move to z corner
- In 3D mode with a corner selected press “2” to show loops. The loops are drawn with cones with the tapering end pointing towards the direction of the sidewalk.
- In 3D mode press “J” or mouse scroll to zoom the screen.
- In 3D mode with the SPACE pressed, use the mouse to freely move the 3D drawing.

Method used:

For the 2D planar graph I am reusing the Assignment 4 code. I have used the GVNS data structure to store the corner information. G is the array used to store the vertices data, V is the array used to store the start corner and their corresponding vertex information, NC is the array used to store the next corner and start corner mapping and finally S stores the swing corner for each corner. This data structure allows ease of implementation of the add and delete features of the graph.

For the 3D extrusion of the planar graph, each sidewalk is used as the base for a 3D wall. So each corner in 2D planar graph is represented by 2 vertices in the 3D extrusion. One vertex is on the floor and the other vertex is offset in the Z direction by a fixed distance to create the walls. Every vertex thus defined has 3 corners minimum. 2 corners are on the corresponding walls. The third corner is on the ceiling or floor. All the corner information is stored in a GVNS data structure. The walls created in such a manner will have walls that have no way of travelling from one wall to another. As GVNS data structure is most suitable to represent the representing connector graphs, we will introduce a few bridge edges which will connect the walls in the 3D extrusion. In my implementation the number of bridge edges are limited to exactly the minimum number of bridge edges required to connect all the loops. This number comes to exactly "the number of loops – 1". When introducing the bridge edges one extra corner per connecting vertex (of the edge) is introduced in the GVNS for 3D. Finally all the outer wall corners are rounded by a modified version of the code provided by the professor.