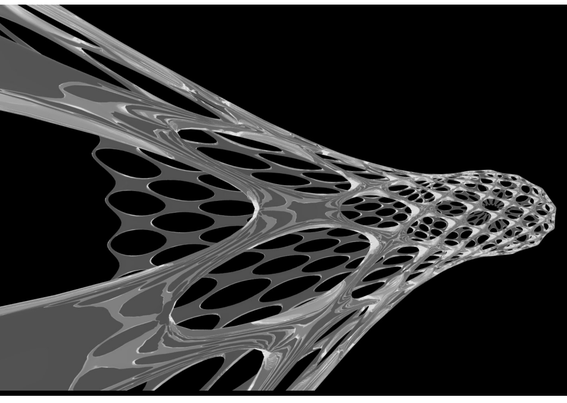

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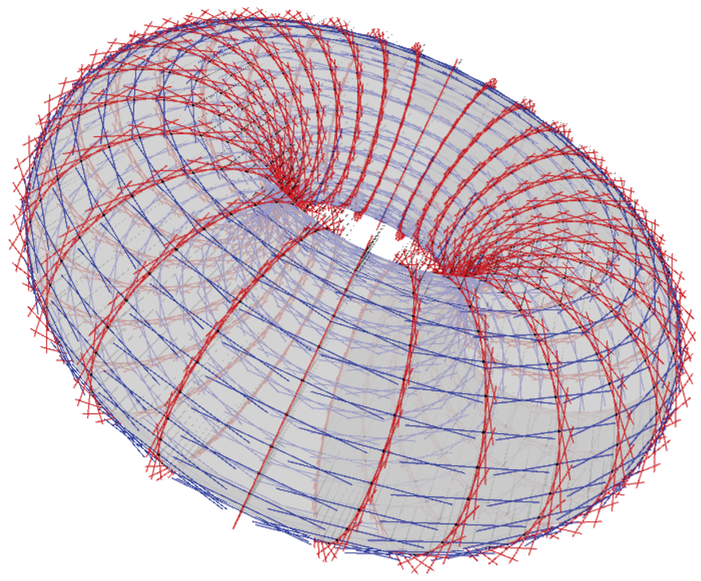
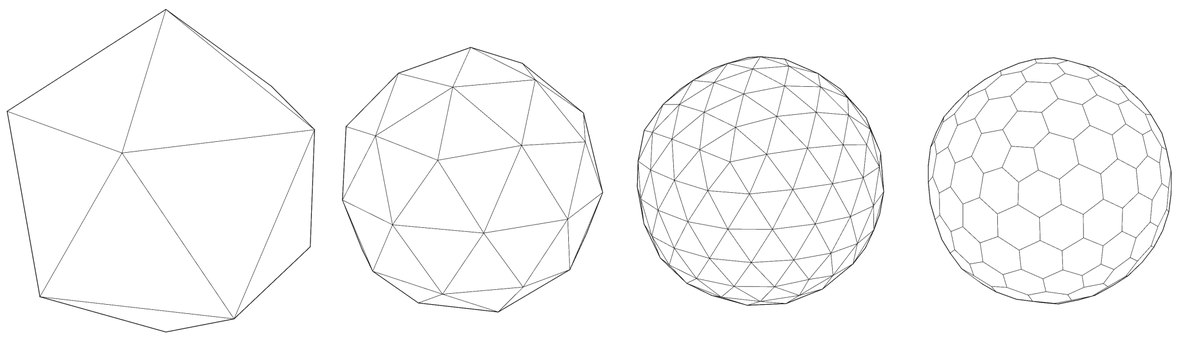
Manifold meshes

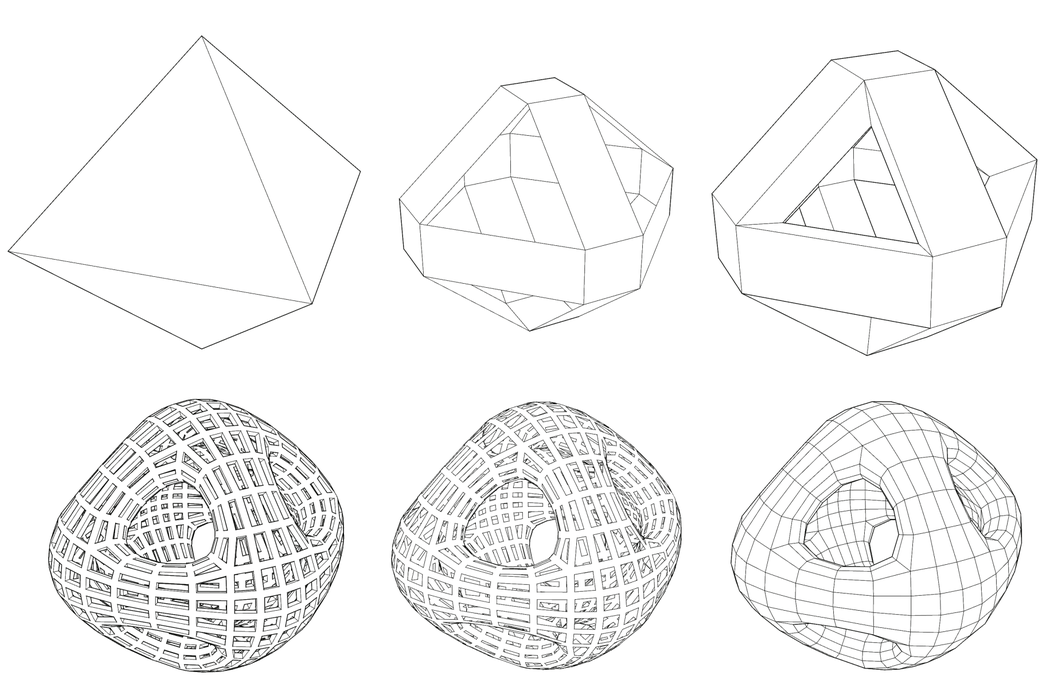
For my minor project I wrote a **Processing** library for viewing and manipulating **polygon meshes**. Meshes are used in Architectural design to represent smooth, free-form surfaces in a way which can be fabricated using common construction methods. The library was written in Java and made use of the Java-based Processing library (and its easy-to-use OpenGL rendering) to draw the mesh on the screen. The library was restricted to **manifold** meshes only – one edge may not be shared by more than two faces – and used the **face-vertex** data structure. Functions were included for the modification and analysis of meshes as well as for import/export via common plain-text formats.



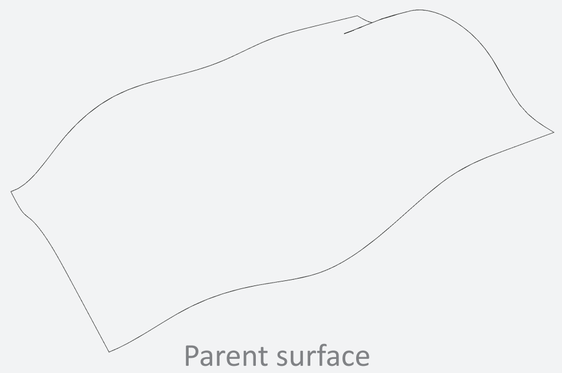
Principal directions of curvature on a torus mesh



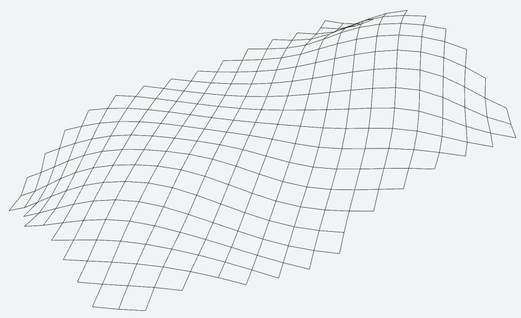
Icosahedron → Loop (2) → Conway dual



Bipyramid → Ribbon → Extrude ↓
Extrude ← Ribbon ← Catmull-Clark (2)

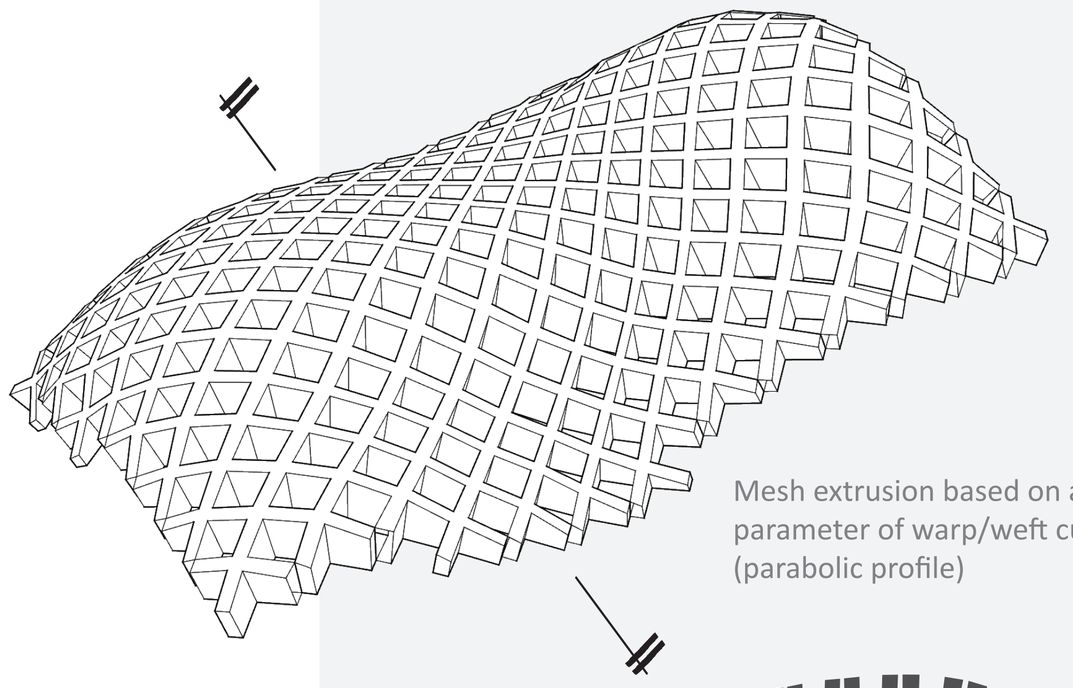


Parent surface



Surface meshing (based on Chebychev Net method)

Extraction of directional curves



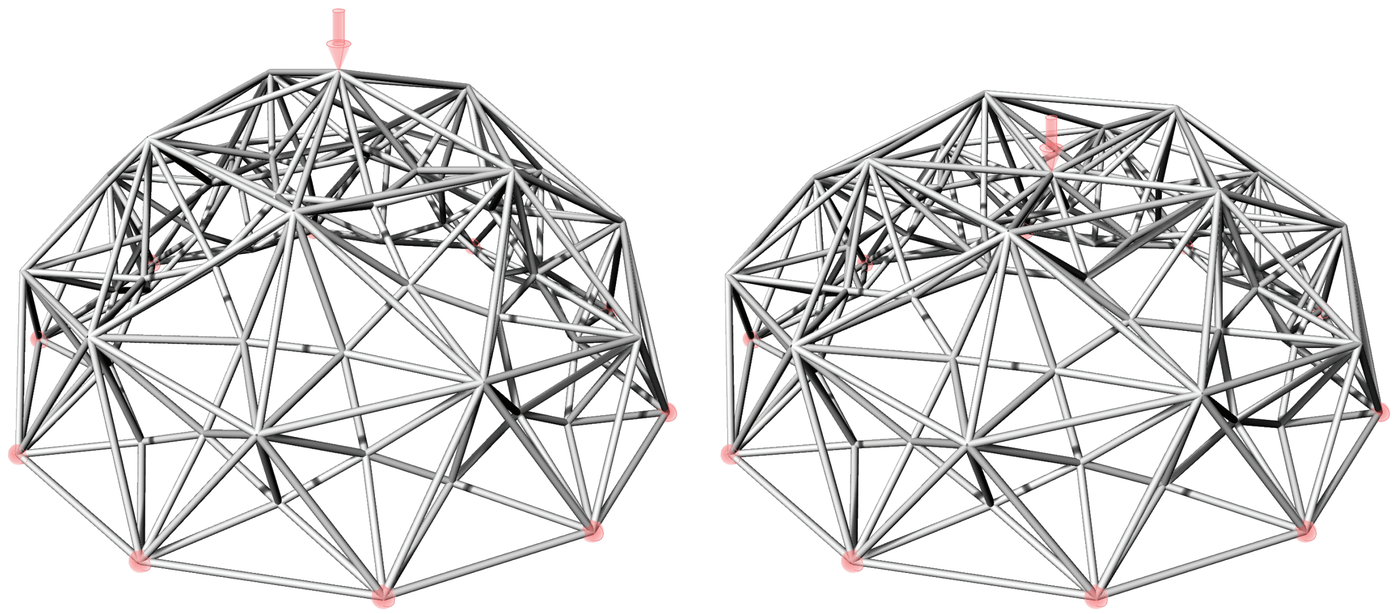
Mesh extrusion based on average parameter of warp/weft curves (parabolic profile)

Section through gridshell

Structural applications for meshes

For my major project I have developed a **custom mesh data-type** for Grasshopper which overcomes the limitations of Rhino's built-in mesh type – i.e. tri-/quad-meshes only. This utilises the **Halfedge** structure for its traversal efficiency. Using this I am able to explore the application of Conway operators and remeshing operations to the generation of structural frames.

For example a manifold mesh may be **offset**, **manipulated** (via Conway operators, etc.) and **laced** back to itself to form a **3D space-truss**.



Dual laced to offset of parent and resultant space-truss analysed
Deflections scaled for illustrative purposes