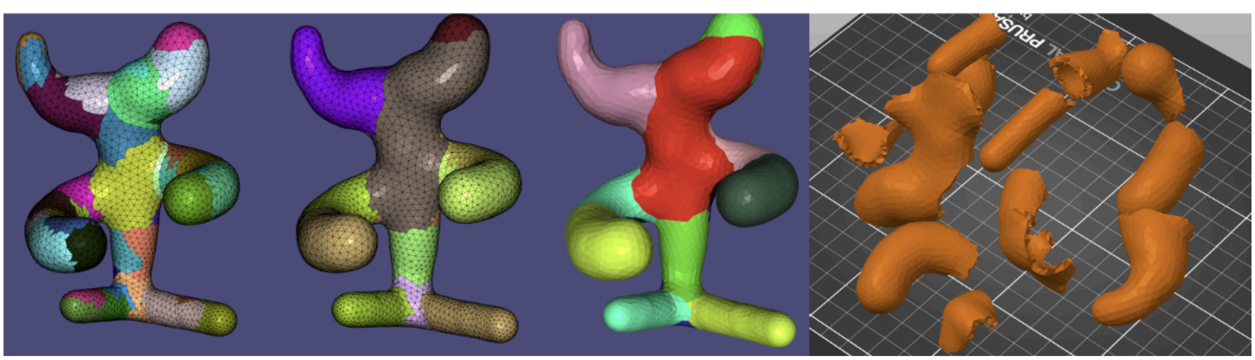
CSCI 2240 Capstone Project (Optimizing Object Decomposition to Reduce Visual Artifacts in 3D Printing)

3D printing procedures often produce artifacts like anisotropic surfaces or auxiliary supports due to the physical constraints of the printer. This paper introduces geometry preprocessing algorithms optimized to prevent artifacts. The algorithm divides printable objects (triangle meshes) into several smaller components that can be printed individually, in different directions, with fewer supports, and places cut lines dividing these components into occluded areas of the mesh to preserve its original appearance. This procedure combines aspects of both geometry processing and constrained optimization

Our pipeline which we adapted from the Eurographics 2020 paper: *Optimizing Object Decomposition to Reduce Visual Artifacts in 3D Printing* is split into four steps. First, the mesh is subdivided into many smaller components of contiguous faces. This subdivision is implemented similarly to K-means classification. That is, picking some seed mesh faces to define component groups, and then assigning all other faces to component groups based on their distance to the seed faces. The distance metric used is a weighted combination of geodesic distance and angular distance. Next, these subcomponents are assigned a printing direction. The printing direction for each component is chosen to minimize supports (artifacts) and align with the printing direction of nearby subcomponents (preserving the mesh's appearance). The choice of printing direction for each component is an ILP (Integer Linear Programming) optimization problem. Adjacent subcomponents with the same printing direction are grouped into larger components to be printed. Then, once the larger components have been optimized for printing direction, they may still feature jagged edges on the boundary of multiple components. In this step, mesh faces on the boundary of printable components may be assigned different components to smooth out edges. This is another ILP optimization problem. Lastly, the printable components need to be turned into objects with discrete thicknesses that can be printed. The objects can be converted into either hollow shells or solid objects by converting the mesh into a tetrahedral object and propagating the triangle mesh splits to the tetrahedral mesh.



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