Analyzing the Topological Properties of 3D STL Files

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Introduction

Related Works

Background

Simplicial Homology

Persistent Homology

Triangulation

Background on the STL Filetype

Methods, Main Method

1. Creating a Mesh from an STL File
2. Creating and Modifying an Alpha Complex
3. Computing a Persistence Diagram

Creating a Mesh from an STL File

Creating and Modifying an Alpha Complex

Computing a Persistence Diagram

Methods, Implementation

1. Creating STL Files with FreeCAD
2. Parsing the STL File Data
3. Creating a Constrained Delaunay Triangulation with `meshpy`
4. Creating and Modifying an Alpha Compplex with `gudhi`
5. Filtration Construction with `gudhi`
6. Persistence Diagram Construction

Creating STL Files with FreeCAD

Parsing the STL file Data

Creating a Constrained Delaunay Triangulation with meshpy

Creating and Modifying an Alpha Compplex with gudhi

Filtration Construction with gudhi

Two Cubes with Three Pockets Moving Closer

Cube with Equilateral Triangle Hole

Rectangular Prism Ring with Cut

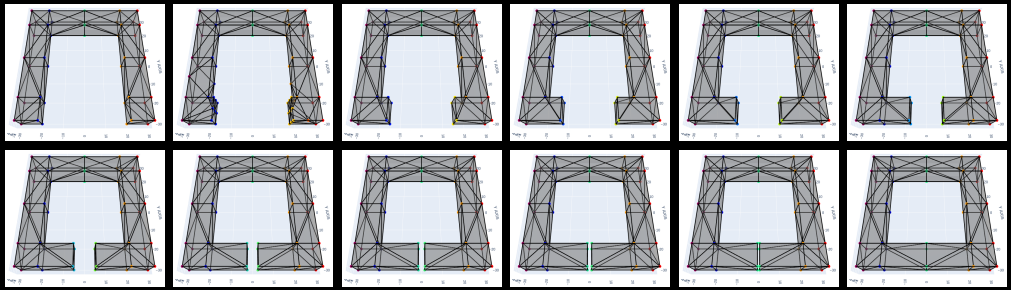

Figure: MeshPy Plots displayed with Plotly of a rectangular prism ring with a cut that decreases to the original shape.

Rectangular Prism Ring with Cut

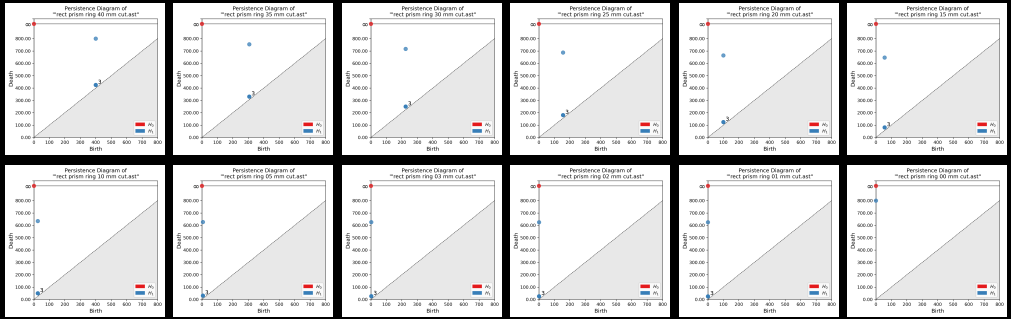

Figure: Persistence Diagrams of a rectangular prism ring with a cut that decreases to the original shape.

Conclusion

Future Work

Thank You!