Explanation :

The project is to make programmable foam with a 3D printer. We'll have a STL file(it's a scanned seat) who will be converted in lattice(Gyroid) and will select some area to have the parts less or more hard.
Some attached pictures

Before create the application we must work on mathematical algorithm. It's the goal of this project.

Above, just to explain you the application :

The goal of this application is to allow the user to import an STL file (stereolithography format), select a specific area using shapes like splines, rectangles, or squares, and convert the selected area into a Gyroid structure.

Key Features:

1. **STL File Import:**

- The user can load an STL file into the application for processing.

2. **Area Selection:**

- The user can select a specific area of the model using various selection tools:

  - **Spline** for freeform shapes.

  - **Rectangle or square** for geometric selections.

- The default selection view is a **top-down view** to make it easier to interact with the model.

3. **Gyroid Conversion with Custom Parameters:**

- After selecting an area, it will be converted into a **Gyroid structure**.

- Each selected area can have **custom parameters** to control features like density, size, or other Gyroid properties.
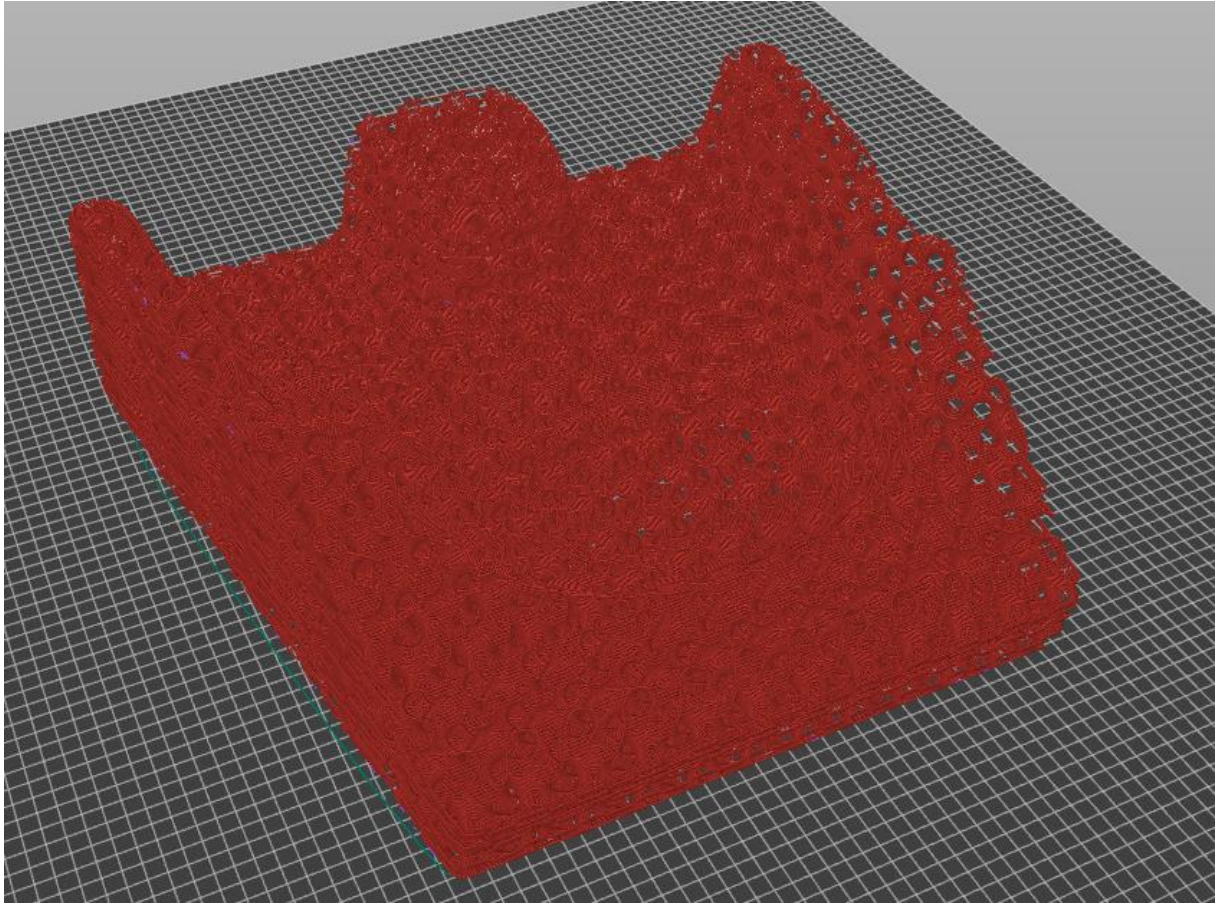
4. **Smooth Gradient Transition between Areas:**

- When there are multiple areas with different Gyroid parameters, the application will generate a **smooth gradient transition** between the zones to avoid abrupt changes in the structure.

The project and requirement

We are going to create a gyroid lattice intended for the fabrication of 3D-printed parts. The main objective is to optimize this gyroid so that it is easily printable with an FDM 3D printer.

Here is an example to illustrate.

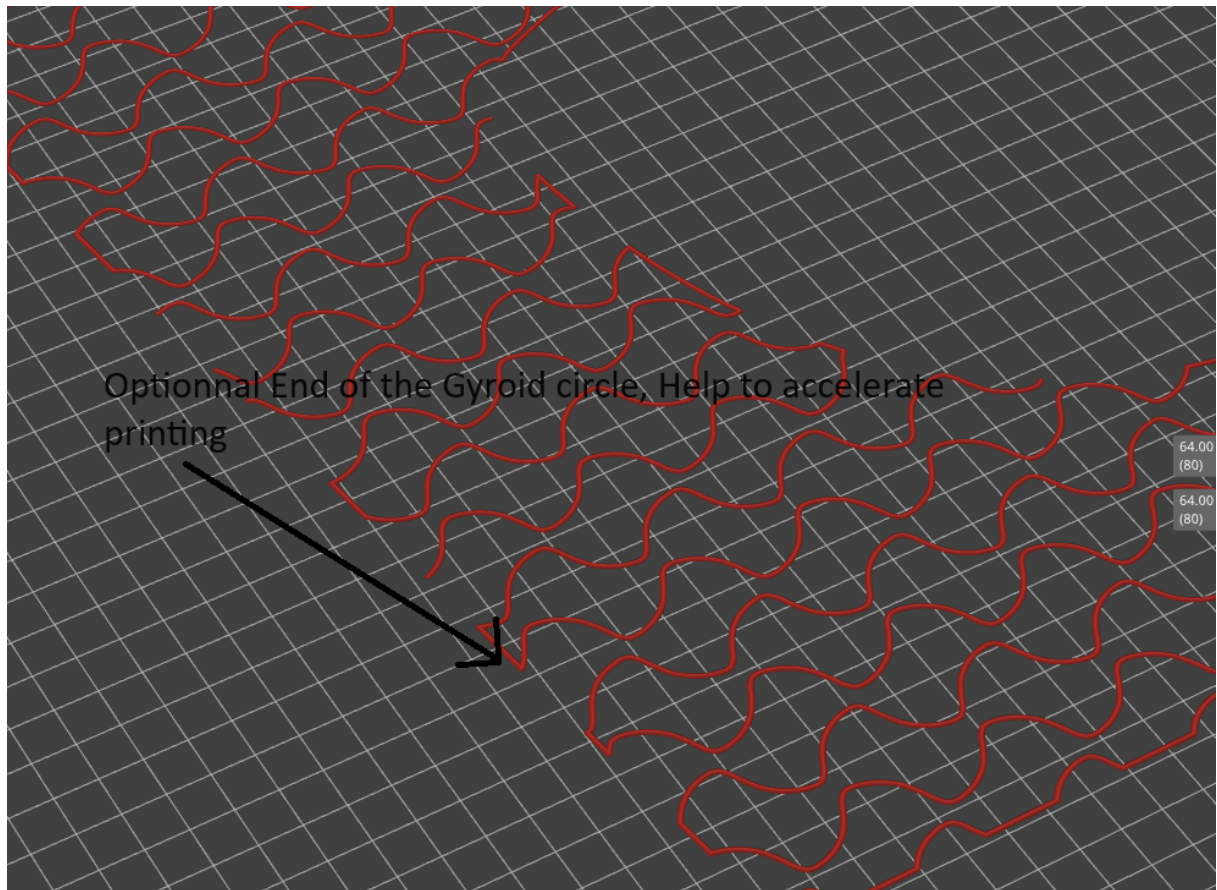Regarding the algorithm, you can base it on the existing code from Prusa Slicer.
https://github.com/supermerill/SuperSlicer/discussions/981
https://github.com/prusa3d/PrusaSlicer/blob/master/src/libslic3r/Fill/FillGyroid.cpp

It is essential to be able to adjust the thickness of the gyroid according to the diameter of the nozzle used (for example: 0.4 mm, 0.8 mm, 1.2 mm, etc.). An image is attached for reference.

Gyroid wire 0.4 or 0.8mm or 1.2mm...
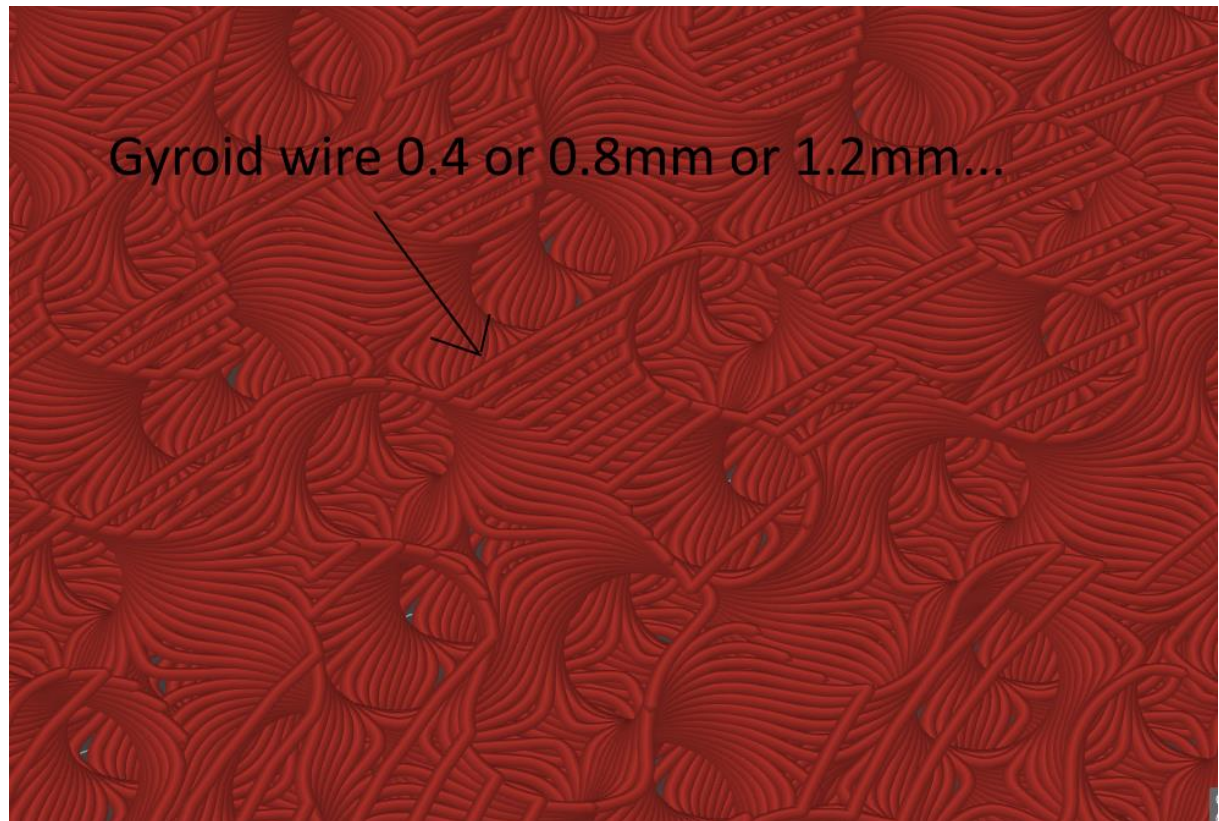
Improvement of the algorithm for better 3D printing and increased speed.

Optionnal End of the Gyroid circle, Help to accelerate printing

64.00
(80)

64.00
(80)

The cell of Gyroid can be adjusted to have less or more hard.

Smooth transition

As explained in the application, user select different area of the STL.each will have cell size different, between each area, there must have a smooth transition.

Create smooth transition between gyroid different density

Different density
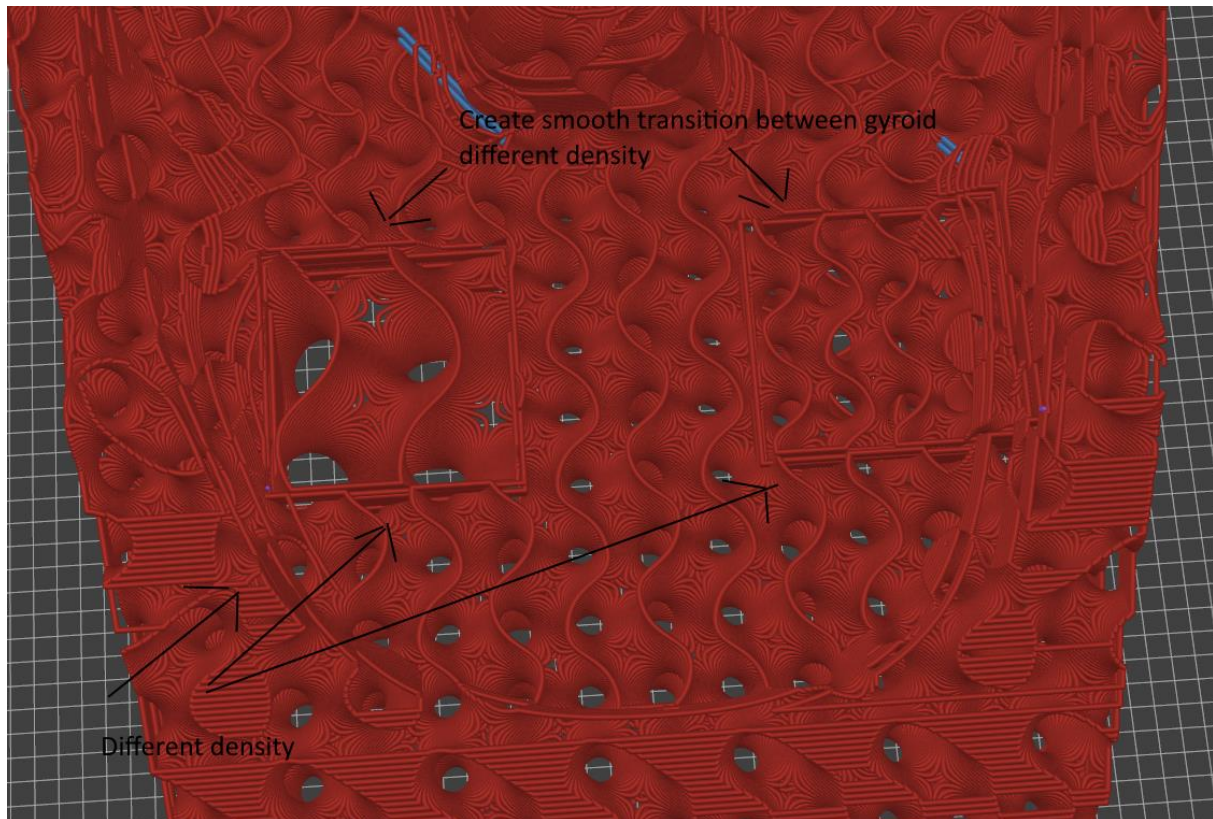
Matlab

The algorithm must be visualize with Matlab(or other you can propose)

We must be able to import STL, have the ability to modify Gyroid parameter(size of unit cell) , size of wire, radius or line on gyroid side and export the Stl generated.

I can provide you STL file if needed.

Let me know if you have question.