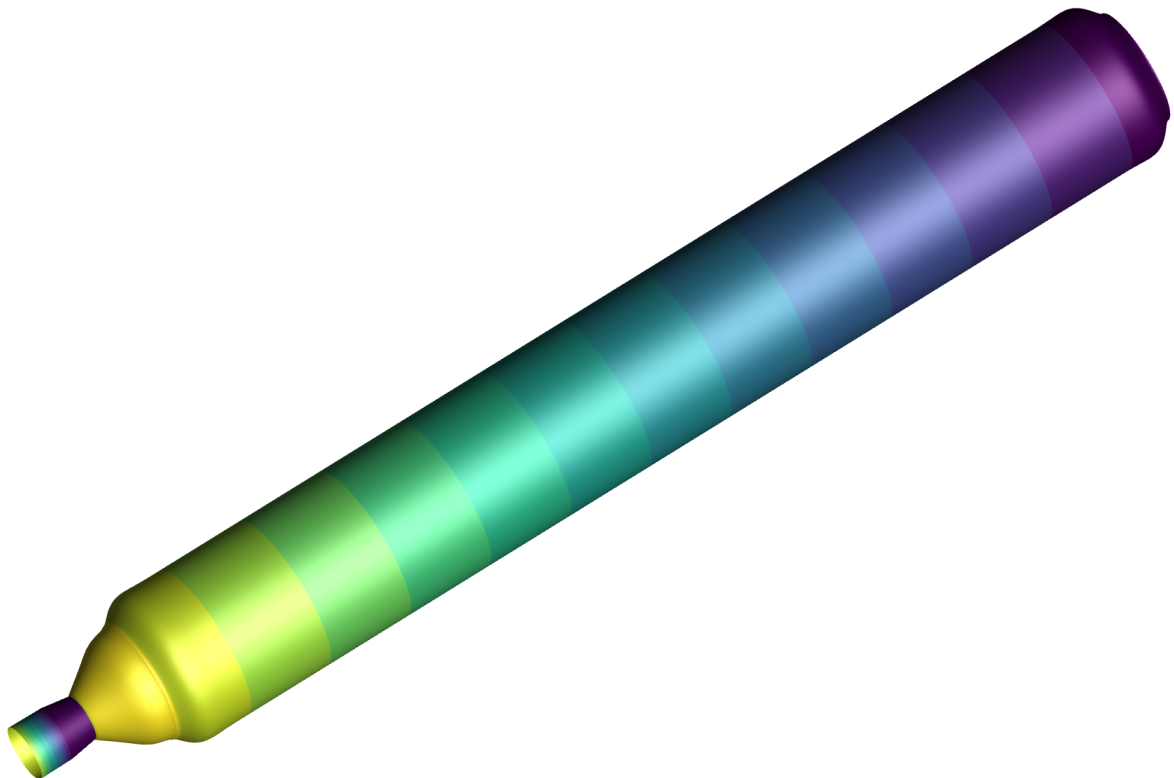# ReadMe File

Python

- Python Version: 3.11
- Libraries to install:
  - `pip install numpy`
  - `pip install pandas`
  - `pip install scipy`
  - `pip install matplotlib`

Excel File Inputs

- The entered data must be previously converted to the International System of Units to ensure their consistency and uniformity.

- Do not input data in cells with blank headers.

- The *Material* sheet aims to define the properties of materials that make up the structure.

- The *Loading* sheet is designed to receive data related to the pressure curve for dynamic analysis.

- The *Input* sheet constructs the geometry and mesh, and also defines applied pressure and constraints for static analysis.

- *Points* → Numbering of points.

- z and r → Coordinates of characteristic points of the structure.

- *thi* → Thickness of the shell at that point.

- *Discontinuity* → Insert 1 if it is a point of discontinuity, for example, a vertex, and 0 otherwise.

- *Material* → Insert 1, 2, 3, ..., n, to define the material between the point defined in this line and the next line.

- *Conditions* → Boundary conditions at the point, entering a value from 0 to 7, where:

  $0 \rightarrow$ Fixed

  $1 \rightarrow$ Vertical Displacement

  $2 \rightarrow$ Horizontal Displacement

  $3 \rightarrow$ Rotation

  $4 \rightarrow$ Vertical Displacement + Horizontal Displacement

  $5 \rightarrow$ Vertical Displacement + Rotation

  $6 \rightarrow$ Horizontal Displacement + Rotation

  $7 \rightarrow$ Free

- *Conditions1* → Boundary conditions for the points that will be created, between the point defined in this line and the next line, again entering a value from 0 to 7.

- Ne_{Total} → Total number of elements to discretize the problem for analysis.

- *Mesh Type* → Insert 1 if you want to build a mesh with a higher number of elements near points with discontinuity. Insert 0 if you want a mesh with evenly distributed elements.

- *Distance* → Calculation of the distance between the point of this line and the next line.

- $Nn \rightarrow$ Number of nodes to add between the point defined in this line and the next line.

- $Loading \rightarrow$ Value of pressure at the respective point.

- $Add \rightarrow$ Number of time intervals to add between each time frame of the pressure function defined by the user

- $Delta\ t \rightarrow$ Integration time step

Note: The cells to be filled by the user in Excel are only the colored cells; the remaining cells are derived from calculations based on the previous ones.

Code Inputs

The values displayed in the pop-up window are only suggestive.

- $Show \rightarrow$ Insert 1 if you want to visualize the graph resulting from modal analysis and 0 if you only want to save the graph. (Note: if the choice is 1, the program is paused while viewing the graph)

- $Angle\ of\ revolution \rightarrow$ Angle of revolution (in degrees) to be shown when opening files in *Tecplot*.

- $Number\ of\ revolution\ points \rightarrow$ Number of revolution points along the angle of revolution.

- $Deformation \rightarrow$ Deformation factor applied to the geometry of static and dynamic analysis. The maximum value corresponds to 5 as geometry becomes imperceptible beyond that. (Note: The deformation factor is multiplied by 100 to obtain the deformation imposed on the geometry)

It is important to note that the elapsed time since the program's initialization is entirely dependent on the number of elements chosen.