Parallel Scientific Computing And Visualization Final Project Submission

Visualization Of Stress Distribution In A Plate With Hole Of Variable Size Subjected Variable Uniaxial Load

1. **Team Members: -**
   a. **Ahamed Ali (213014006)**
   b. **Jagriti Saha (203010042)**
2. **Abstract: -**

   This project involves analysing the stress distribution in a plate with hole subjected uniaxial loading by using a suitable FEM model. This involves understanding the stress distribution taking place in the plate with a focus on the stress concentration taking place at certain points in the plate and then visualization of the same. This plate with hole problem serves a simple yet a good model for understanding stress flow phenomenon taking place and how stress concentration is taking place, so visualising this problem has its own merits.
3. **Outline: -**
   a. **For a given domain of x dimension, y dimension and hole dimension, our code develops a meshed domain.**
   b. **Developed a code of the FEM model governing the individual elements of plate with hole by making use of NumPy library, for loops etc.**
   c. **Making use of NumPy libraries create an assembly of elements and associate the results of FEM model to these elements.**

d. **Using Matplotlib visualize the data associated with these elements. And show various graphical results associated with this problem of plate with hole.**
e. **Built an interactable UI, which can be used to vary the size of hole, the magnitude of uniaxial load, the dimensions of the plate, properties of material, and the see the effect of the same on the visualization of stress distribution and stress concentration on the plate.**

4. **<u>Deliverables</u>: -**
   a. **A code that can calculate stress distribution, strain distribution, displacements in a plate with hole of given size and given uniaxial loading.**
   b. **Visualization of the stress distribution, strain distribution and displacement distribution taking place on the plate with hole.**
   c. **An interactable UI where we can alter either the size of the hole, the magnitude of uniaxial load acting on the plate, properties of the material, dimensions of the plate.**
   d. **Link to the code**
      https://github.com/JagritiSaha/Visualization-of-stress-distribution.git
5. **<u>Timeline</u>: -**
   The time line of this project is as follows:
   <u>1st Week of April</u> – A detailed study of the plate with hole problem, with particular focus on the weak form of the governing equation and numerical procedure to followed to solve the same.

2nd Week of April – Developing the code for converting a given rectangular domain with hole into a meshed domain. Photos of meshed domain created by this code,

```
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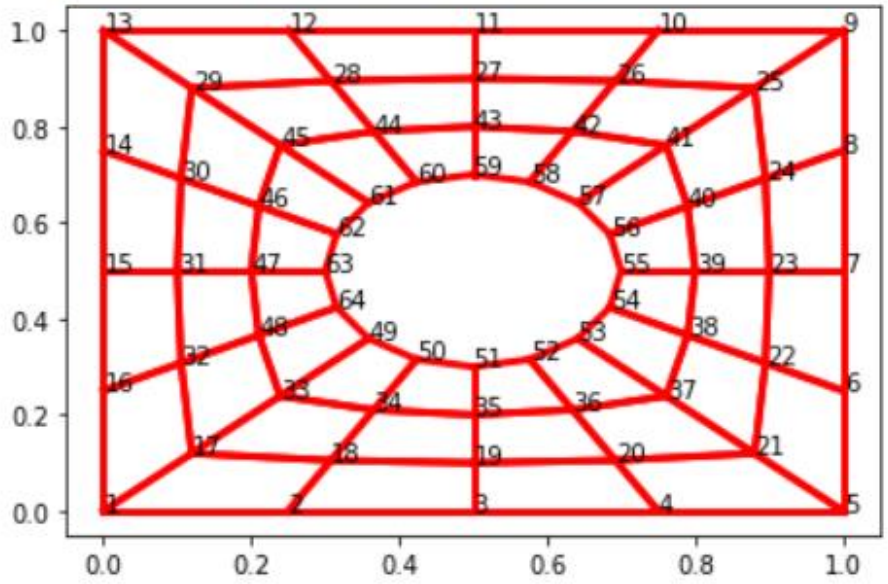
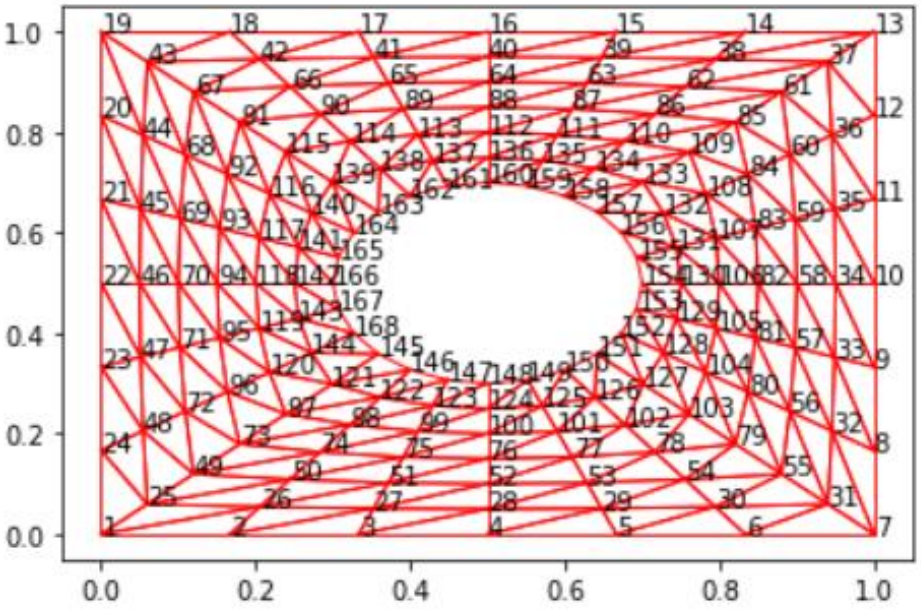
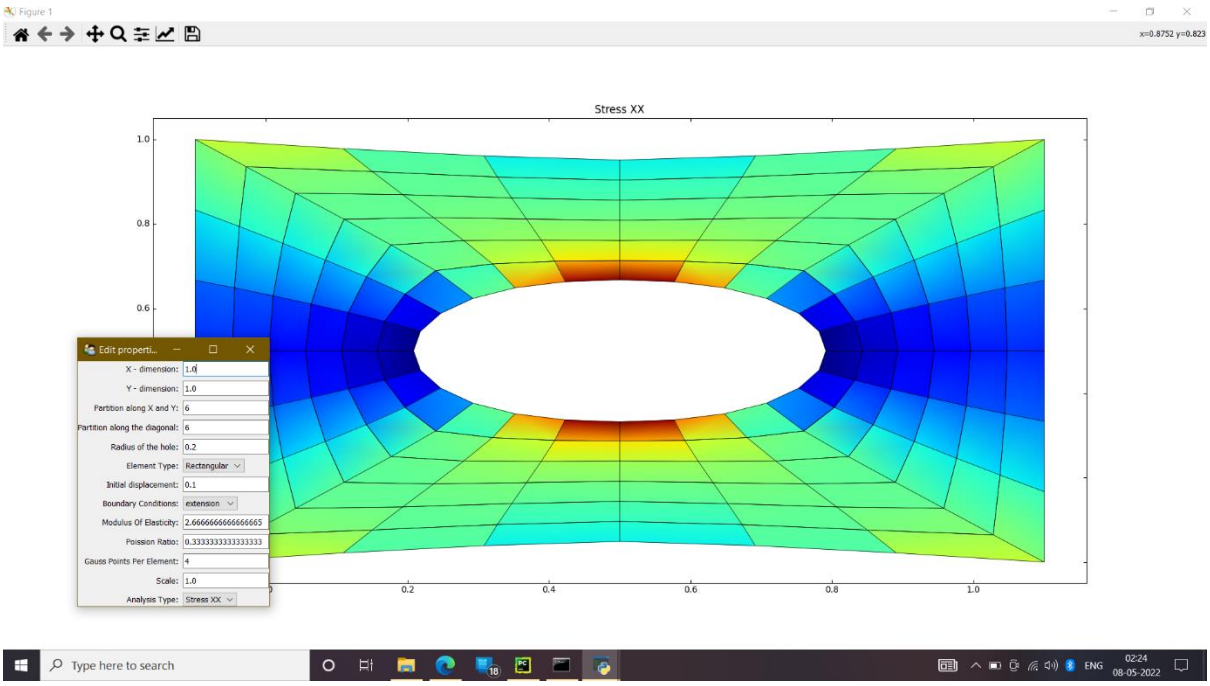


```
    plt.plot(np.array([x1, x2]), np.array([y1, y2]), 'red
    plt.plot(np.array([x2, x0]), np.array([y2, y0]), 'red
```



<u>3rd and 4th Week Of April</u> – Developed code for calculating the stiffness matrix associated with individual elements, assembling them in the global stiffness matrix, code for applying the boundary conditions.

<u>1st Week of May</u> – Developed the code for visualizing the results on Matplotlib, and developed the UI for this code by using Traits. Photos of the final project is as follows,



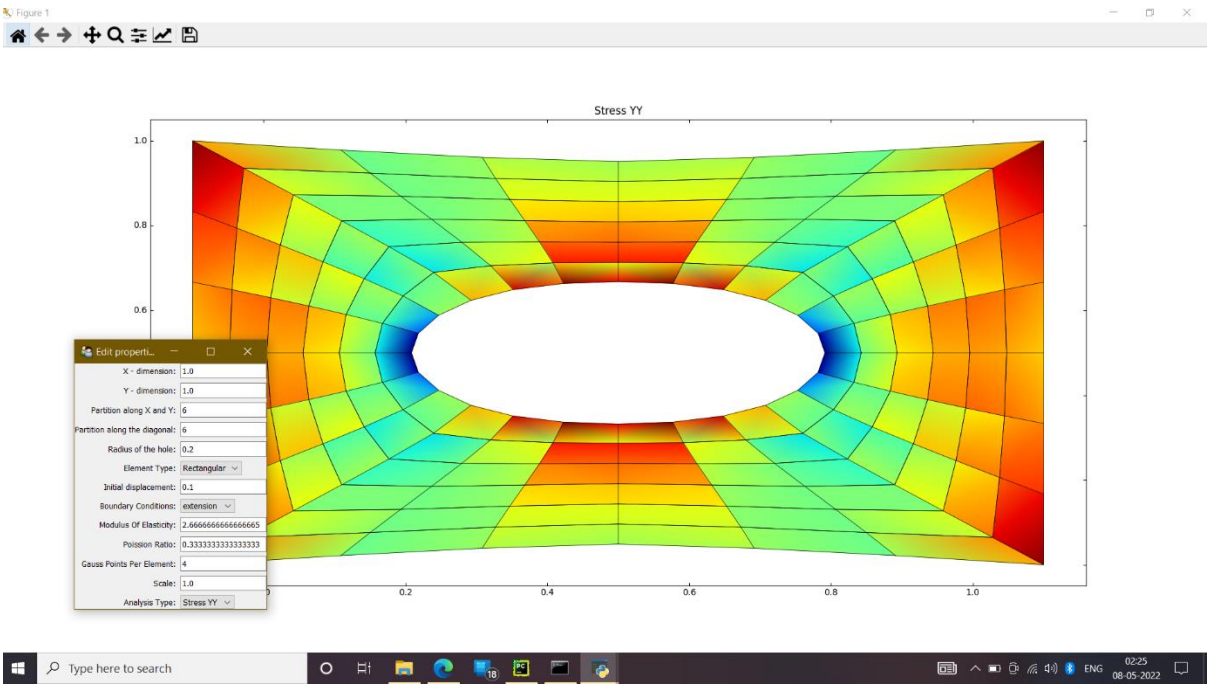


Figure 1
Stress YY
1.0
0.8
0.6
0.2
0.4
0.6
0.8
1.0
Edit properti...
X - dimension: 1.0
Y - dimension: 1.0
Partition along X and Y: 6
Partition along the diagonal: 6
Radius of the hole: 0.2
Element Type: Rectangular
Initial displacement: 0.1
Boundary Conditions: extension
Modulus Of Elasticity: 2.6666666666666665
Poission Ratio: 0.3333333333333333
Gauss Points Per Element: 4
Scale: 1.0
Analysis Type: Stress YY
Type here to search
ENG
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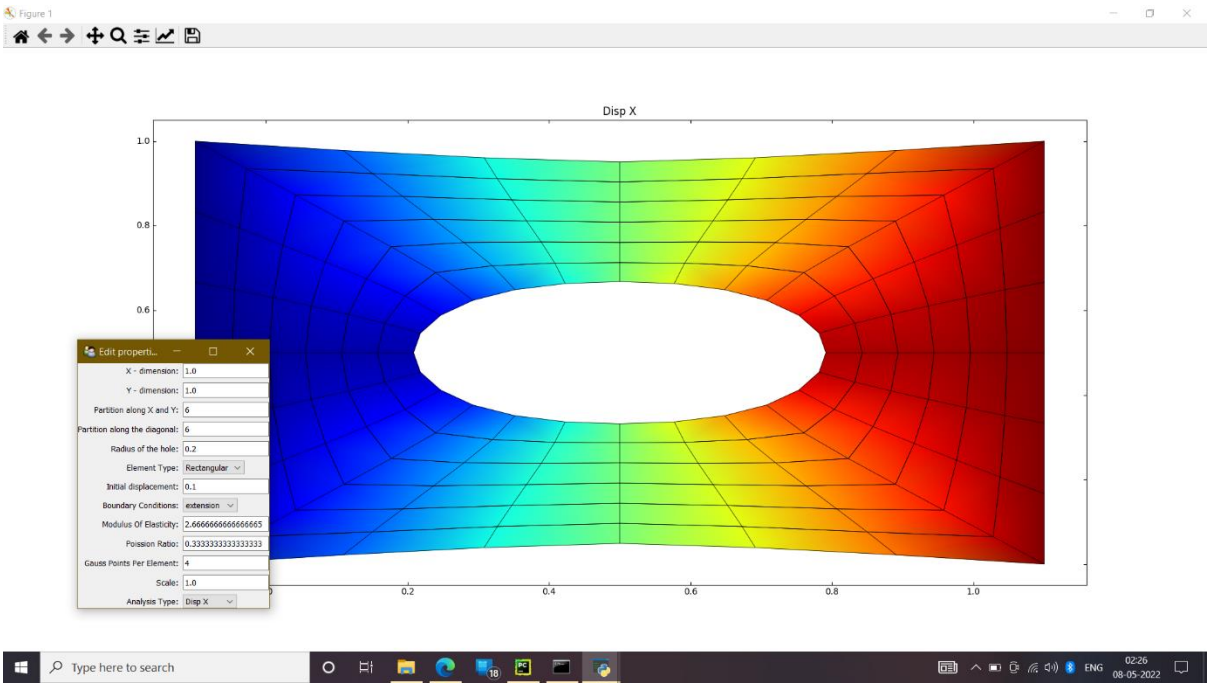
08-05-2022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Scale: 1.0
Analysis Type: Disp X
Type here to search
ENG
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