

# **Mid-term report on Solving the Incompressible Navier Stokes Equation using the DEAL.II Finite Element programming software**

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## **Objective:**

- This project aims to implement an incompressible Navier-Stokes equation solver in deal.II Finite Element software using the supported libraries. Especially to implement the alpha-generalized formulation of stabilized incompressible Navier-Stokes which was developed for the FEM course last semester.
- Further non-intrusive uncertainty analysis will also be conducted if the testing and verification is finished within time.

## **Progress:**

- Deal.II is a large software requiring multiple dependencies like PETsc, p4est, Trilinos and others. Due to installation issues (specifically when 'make install' could not find the p4est installation flag), instead of installing deal.II separately, a docker image has been in use for now. It is a simple process which requires installation container called docker which hold an image of latest build and works as a fully developed software.
- This image is being used to work on the tutorials and examples to get better hands-on experience on using the software and its related packages.
- Most of the study is being done to understand how NS equations can be substituted like for like in C++.

## **To do:**

- To finish up the proper implementation of solver generated for FEniCSx to deal.II with proper test cases by March. The solver will be tested first for 1D Poiseuille flow for validation.
- More test cases will be added if time permits.
- Implement GitHub Actions for CI/CD testing in the deal.II GitHub repository
- After the model is proved robust, non-intrusive uncertainty analysis will be done to further add to the project.
- After which the overall project will be properly documented.