

# A Tutorial for Vento4Airfoil 2025

Prof. SungKi Jung, Ph.D.

*Universidade Federal do ABC,  
Aerospace Engineering, Centro de Engenharia, Modelagem e Ciências Sociais Aplicadas,  
Rua Arcturus 03, 09606-070, São Bernardo do Campo, São Paulo, Brazil.  
E-mail: sungki.jung@ufabc.edu.br*

March 2025

Vento4Airfoils 2025

Computational Fluid Dynamics Tool for Airfoils

CFD program for airfoils in two-dimensional compressible and viscous flow regimes

Modeling

NACA 4 Series (ex: 4412):  
Chord Length (in meter):

Flight Conditions

Static Pressure (pascal):  
Mach Number:  
Angle of Attack (degree):  
Temperature (Kelvin):

Solver

☐ Explicit

☒ Implicit

CFL Number ( $0 < CFL < \infty$ ):  
Convergence Criteria (Density):  
Number of Iterations:  
Reporting Interval (ex: 10,20,...):

Technical Descriptions

- NACA 4 series airfoil generator

- Structured grid

- Transfinite interpolation for grid deformations

- Roe solver

- 2nd order and Van Albada's limiter

- Green-Gauss theorem for gradients

- Local time marching (Steady state)

- 5th stage Runge-Kutta explicit time step

- LU-SGS implicit time step

- Spalart-Allmaras turbulence model

- Tecplot style for visualization

- Non-dimensional chord length for  $C_p$

Developers & Contributors

CFD & Grid Deformation Solvers:

- S.K. Jung

Graphic User Interface:

- J.V. Marchi Z.

Validations:

- E.H. Tukairim

Generate input file

Run

1

# 1 Introduction

This program is fully tested on Ubuntu 24.04.2. The technical descriptions for this program are briefly shown in the Graphic User Interface windows. To download this program, access url: <https://github.com/sungki-jung/CFD4Airfoils>, then download the following folders and files”

- folders: bin, db, outputs
- files: GUI

# 2 Start the Program

Once you downloaded the folders and files, put the files and folders into any place in your computer. Then, find out **GUI** file as shown in fig. 1.

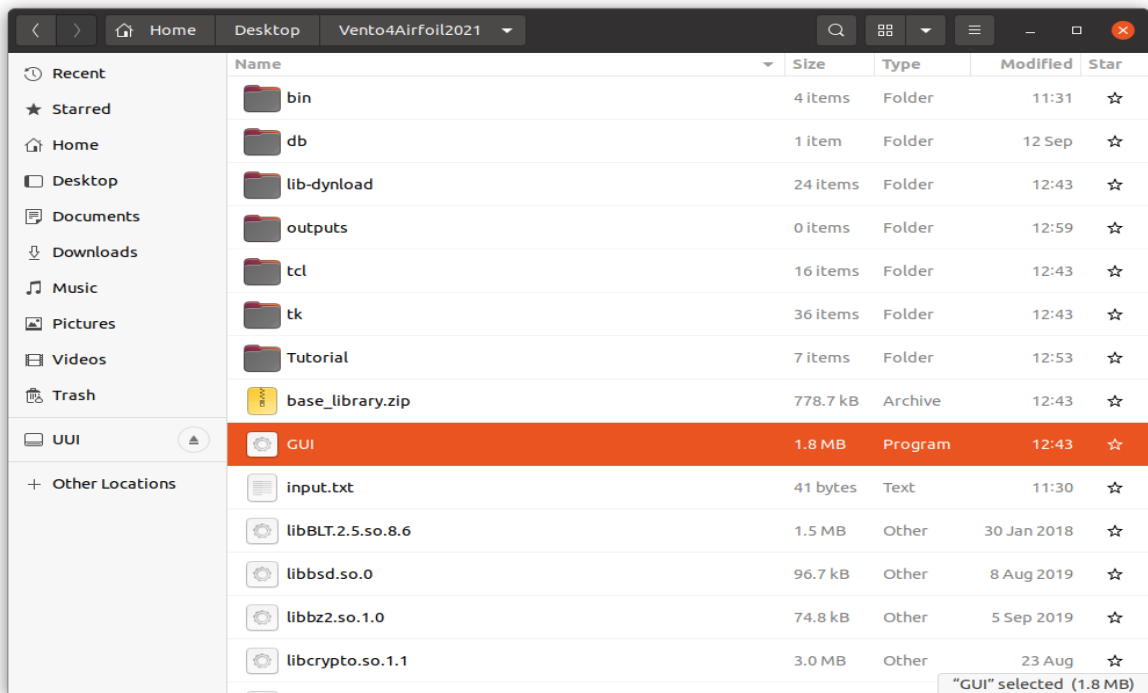


Figure 1: Program files and folders.

Open the terminal in **Vento4Airfoil2025** folder as shown in fig. 2.

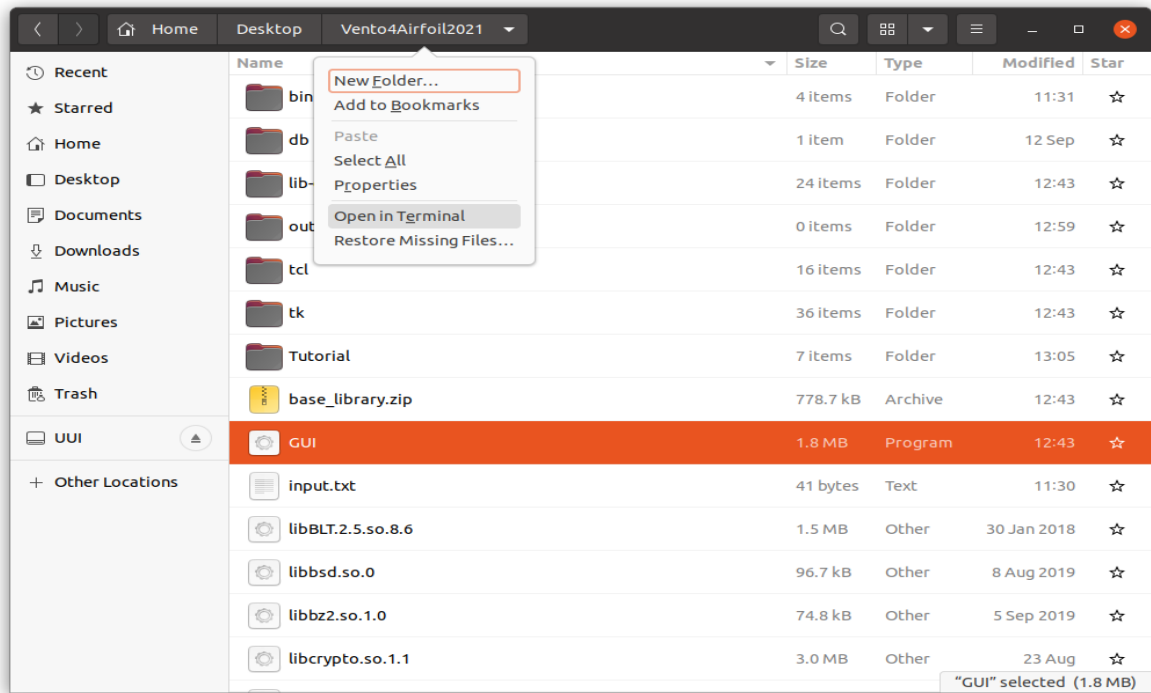


Figure 2: Terminal in **Vento4Airfoil2025** folder.

The terminal windows are shown in fig. 3. Execute the **GUI** file (type `./GUI` on the terminal as shown in fig. 3 then hit "enter" on your keyboard).

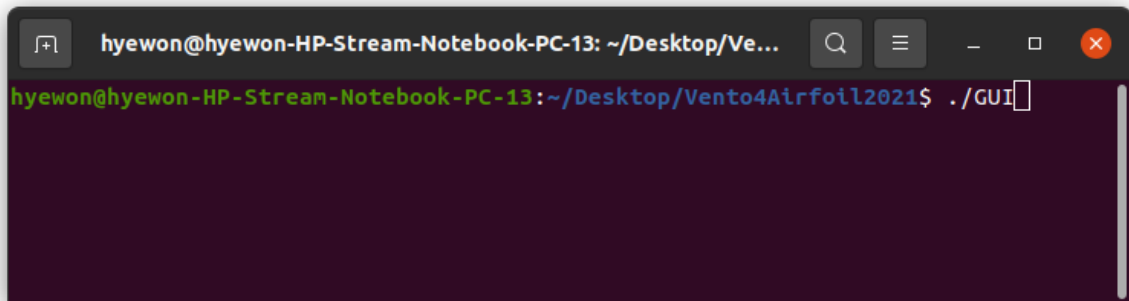


Figure 3: Terminal window.

### 3 GUI for Vento4Airfoil 2025

Insert all parameters as shown in fig. 4.

Vento4Airfoils 2025

Computational Fluid Dynamics Tool for Airfoils

CFD program for airfoils in two-dimensional compressible and viscous flow regimes

Modeling

NACA 4 Series (ex: 4412):

Chord Length (in meter):

Flight Conditions

Static Pressure (pascal):

Mach Number:

Angle of Attack (degree):

Temperature (Kelvin):

Solver

☐ Explicit ☒ Implicit

CFL Number ( $0 < CFL < \infty$ ):

Convergence Criteria (Density):

Number of Iterations:

Reporting Interval (ex: 10,20,...):

Copyright @ 2025 ACA Lab.

Generate input file

Run

Technical Descriptions

- NACA 4 series airfoil generator
- Structured grid
- Transfinite interpolation for grid deformations
- Roe solver
- 2nd order and Van Albada's limiter
- Green-Gauss theorem for gradients
- Local time marching (Steady state)
- 5th stage Runge-Kutta explicit time step
- LU-SGS implicit time step
- Spalart-Allmaras turbulence model
- Tecplot style for visualization
- Non-dimensional chord length for  $C_p$

Developers & Contributors

CFD & Grid Deformation Solvers:

- S.K. Jung

Graphic User Interface:

- J.V. Marchi Z.

Validations:

- E.H. Tukairim

```
hyewon@hyewon-HP-Stream-Notebook-PC-13: ~/Desktop/Vento4Airfoil2021
hyewon@hyewon-HP-Stream-Notebook-PC-13:~/Desktop/Vento4Airfoil2021$ ./GUI
GRID GENERATION IS COMPLETED!
ITERATIONS, DENSITY, U-VELOCITY, V-VELOCITY, ENERGY, NU, RES, CL, CD
10  0.36063E-03  0.74938E-01  0.62330E-01  0.11003E+03  0.74250E-09  0.18535E-03  0.56566E-01  0.14804E+01
20  0.31921E-03  0.62145E-01  0.58603E-01  0.97335E+02  0.59424E-09  0.11315E-03  0.68454E-01  0.12860E+01
30  0.27358E-03  0.49845E-01  0.53518E-01  0.83472E+02  0.48264E-09  0.60919E-04  0.70809E-01  0.11782E+01
CALCULATIONS ARE COMPLETED!
```

Figure 4: Example for all parameters and Run.

Click an icon, **Generate input file**, then, click an icon, **Run**. Residuals are shown in the terminal windows (fig. 4).

## 4 Post-processing for Vento4Airfoil 2025

Once all calculations are completed, open **output** folder in **Vento4Airfoil2021** folder as shown in fig. 5. Extensions for each file in **output** folder denote the characteristics of outputs.

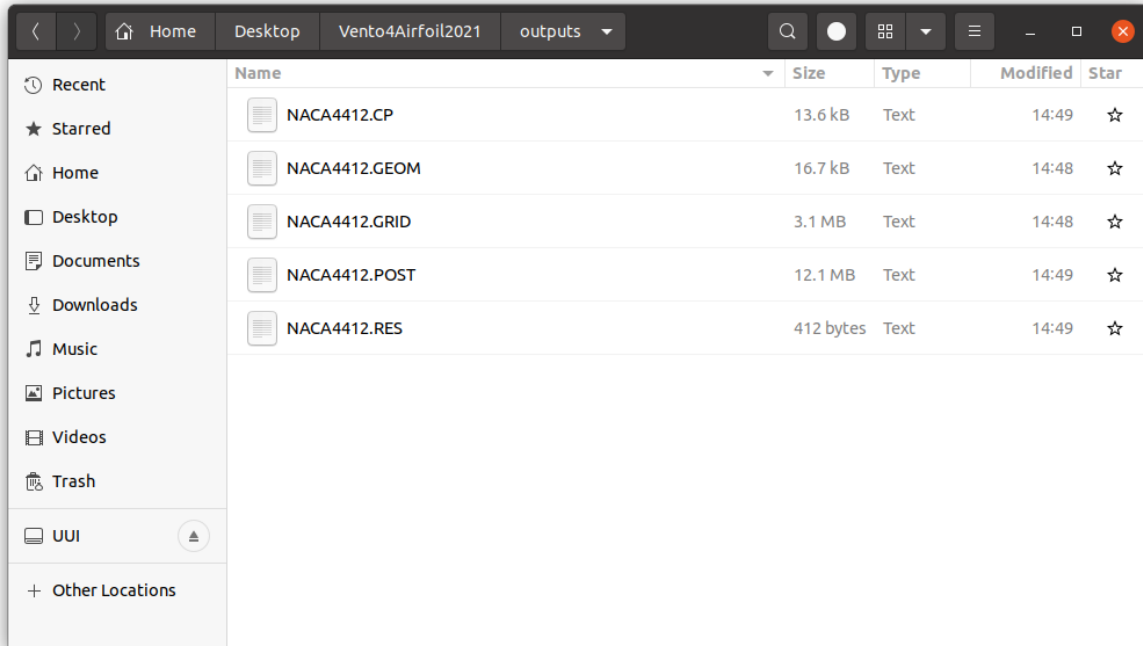


Figure 5: Outputs.

- .CP: Pressure Coefficient
- .GEOM: Coordinate values of NACA 4 series airfoil
- .GRID: Grid around NACA 4 series airfoil
- .RES: Residuals during CFD calculations
- .POST: Post-processing
- .AIR: Primitive variables of airflow

### 4.1 Preparation for Visualization

For visualization of CFD simulations, install a visualization tool, **Paraview** that is a free open-source program, on your computer. To install **Paraview**, see url: <https://jungs-odds-and-ends.blogspot.com/2021/05/paraview-for-windows.html> or you can just type “sudo apt install paraview” on the terminal of Ubuntu to install the Paraview program.

### 4.2 Visualization Using Paraview

Once **Paraview** is installed, open **Paraview** program (type paraview on the terminal). Then follow figs. 6 to 8. Note that .POST file includes all information for CFD visualization. .Post file was written in Tecplot format.

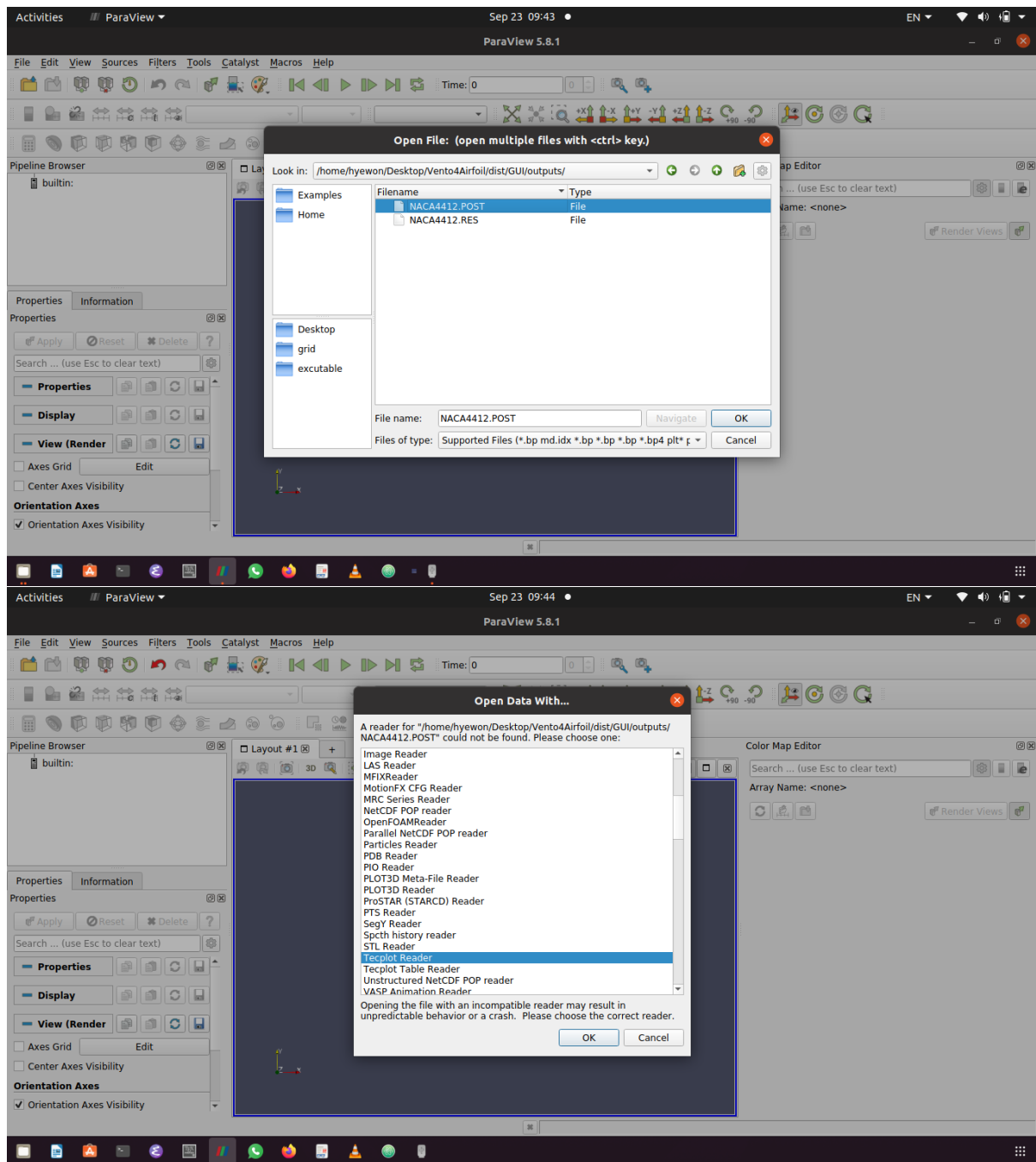


Figure 6: Select .POST file and choose Tecplot Reader in Paraview.

After you check the Tecplot format as shown in fig. 6, click **Apply** shown in fig. 7.

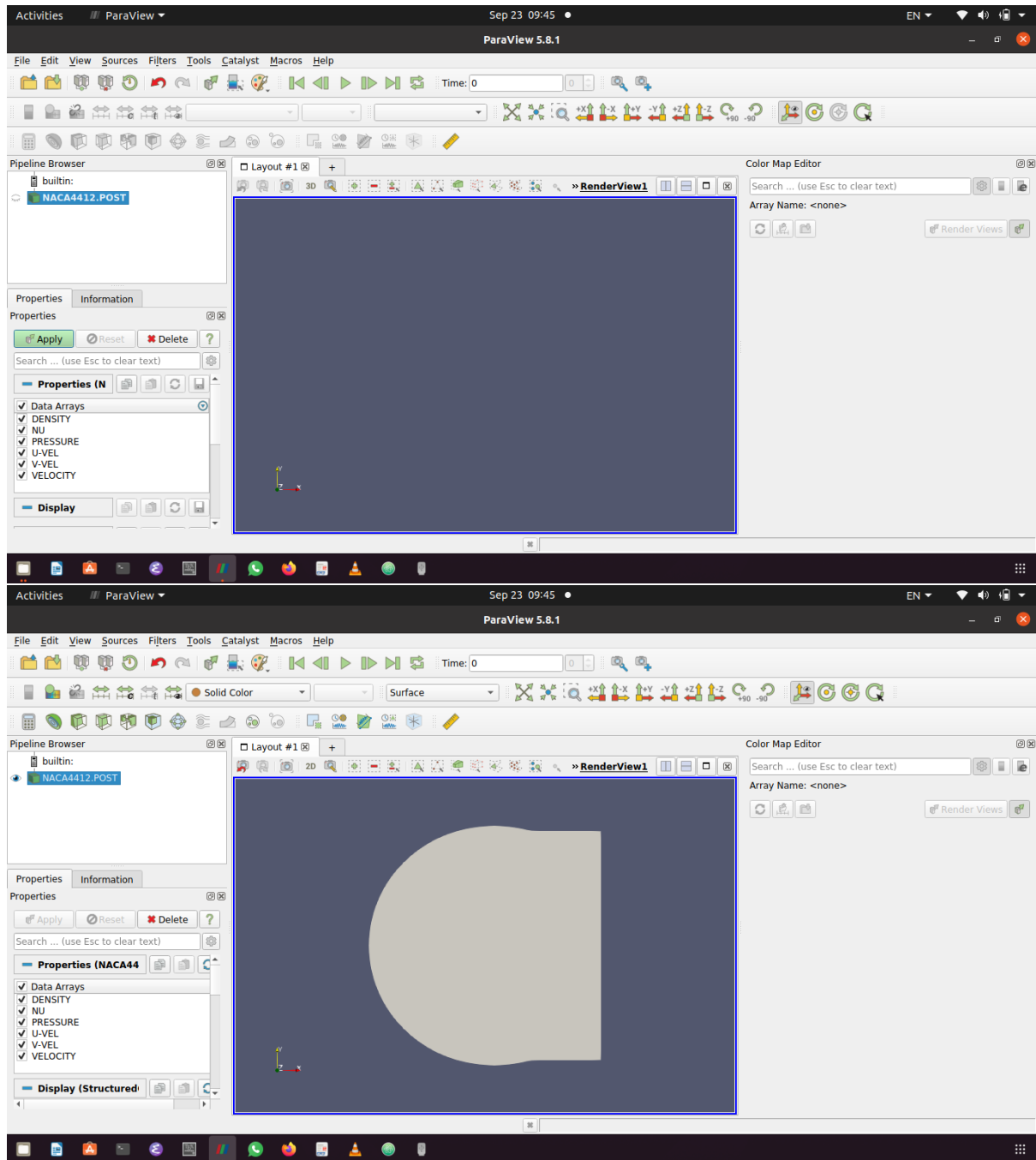


Figure 7: Apply and visualizations.

Lastly, change some options to visualize the simulation results.

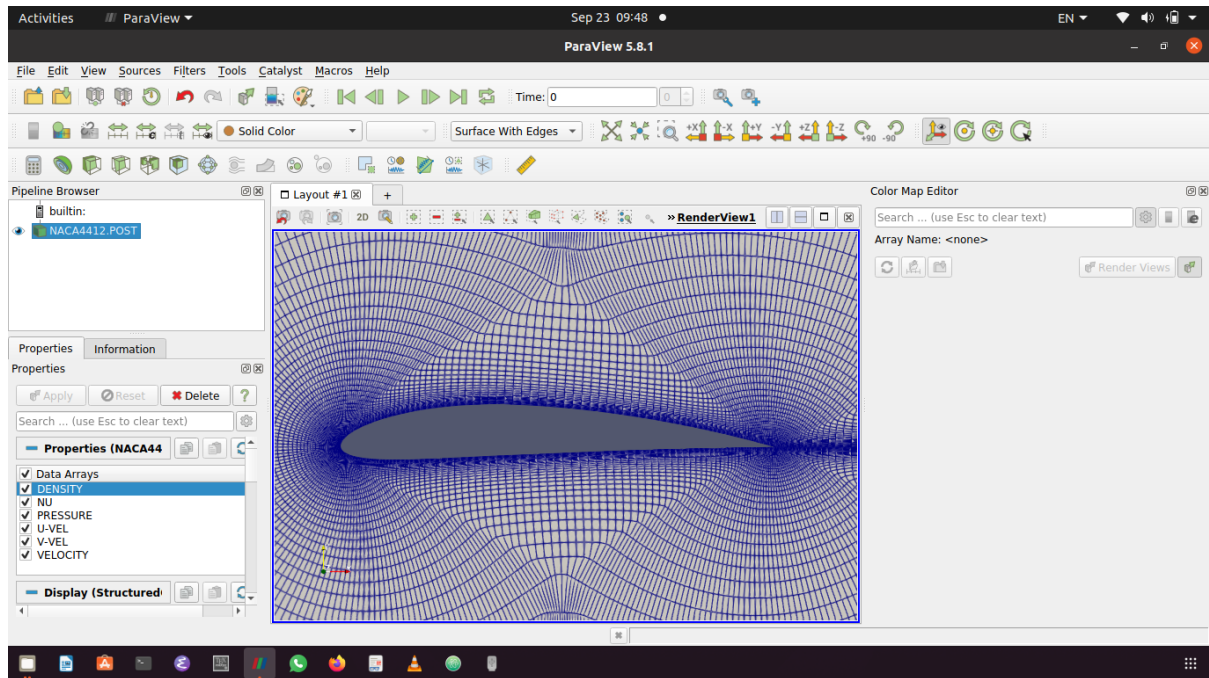


Figure 8: Options for visualizations.