

Venturial: Generating CFD Workflows in Python

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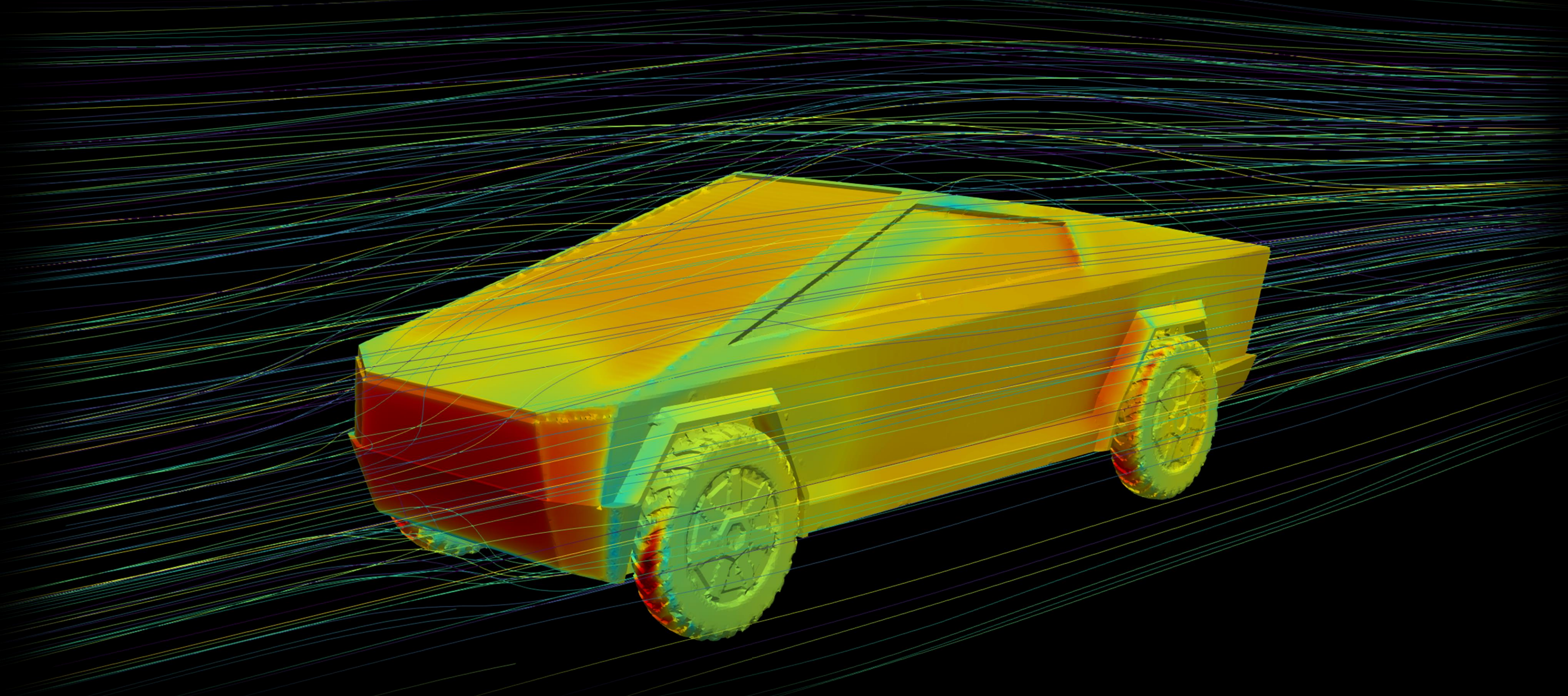
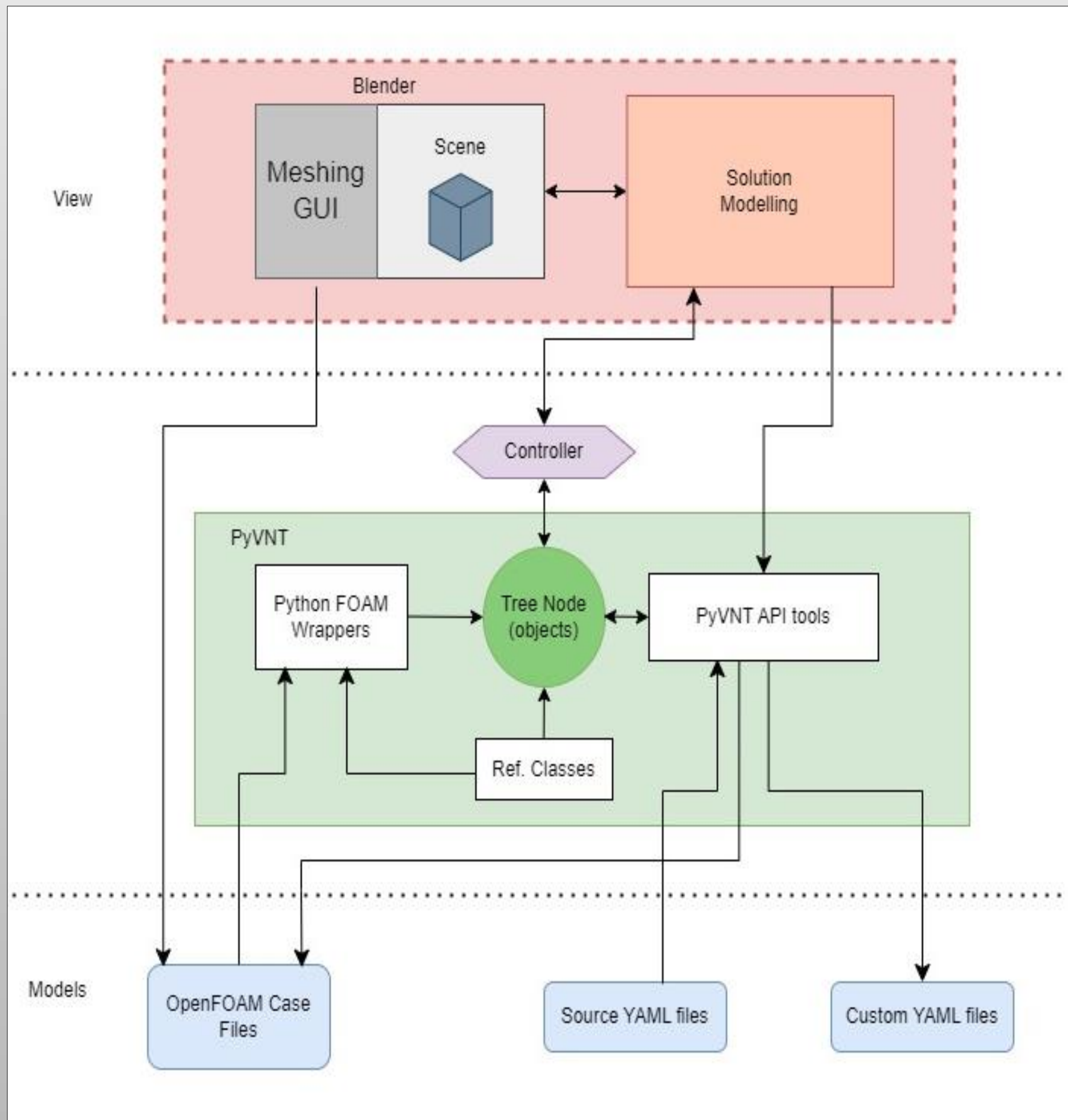
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INTRODUCTION

- A comprehensive tool for end-to-end CFD is absent from the Python ecosystem.
- Venturial envisions to provide a complete, agile, and reversible CFD application workflow within Python.
- Venturial has several entry points:
 1. A graphical interface for meshing and solution modelling.
 2. PyVNT: A library for scripting OpenFOAM cases in Python.
 3. A Python API to modify default solution models for custom CFD applications.
- Venturial has an easy-to-understand data-structure relatable to an OpenFOAM dictionary.
- PyVNT offers reusability, and interoperability with other Python tools.

VENTURIAL’S DESIGN

- Venturial has a reflexive object model.
- Venturial tools have call-backs to PyVNT’s API methods that control the Tree Node data-structure.

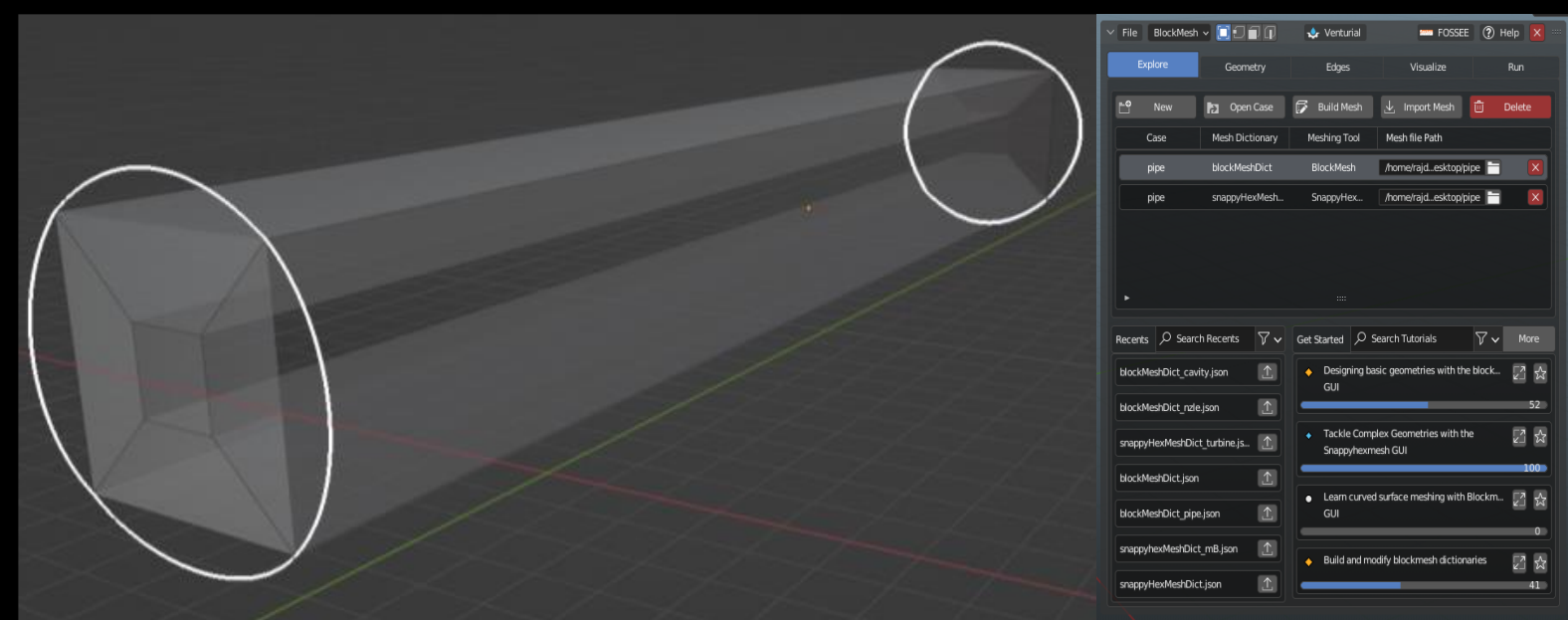


Airflow around Tesla Cyber truck ^[1]

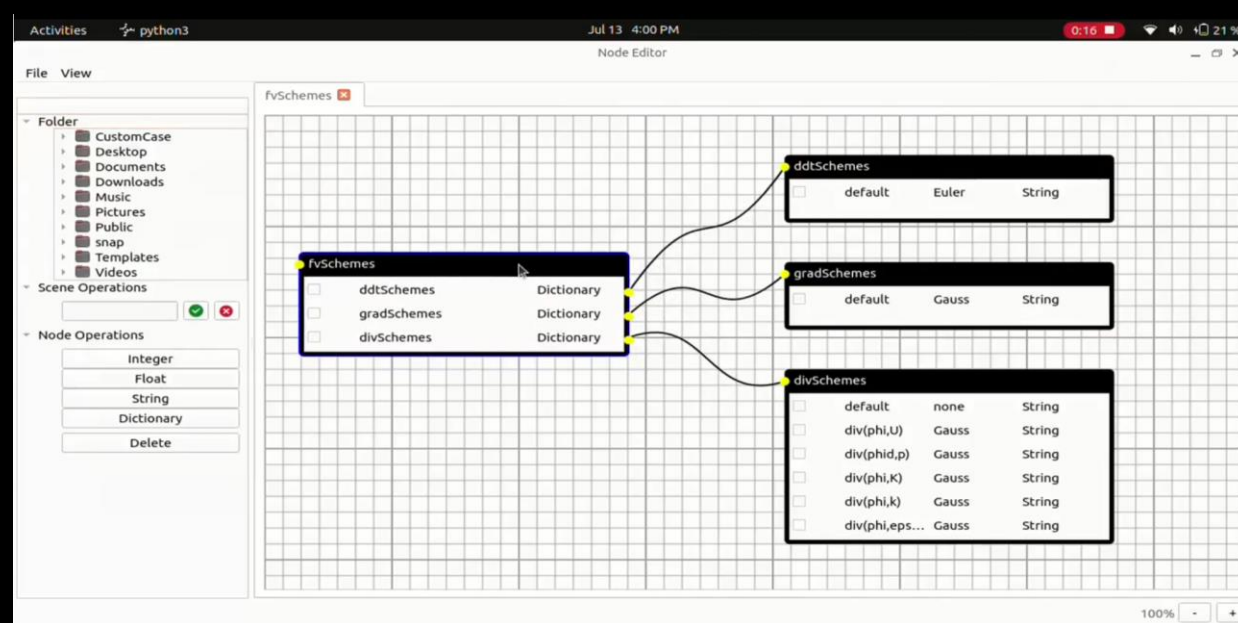
Venturial is an open-source suite of interactive **Python** tools for *Computational Fluid Dynamics (CFD)*.

Venturial is a tool based on **OpenFOAM** (a C++ based software for continuum mechanics)

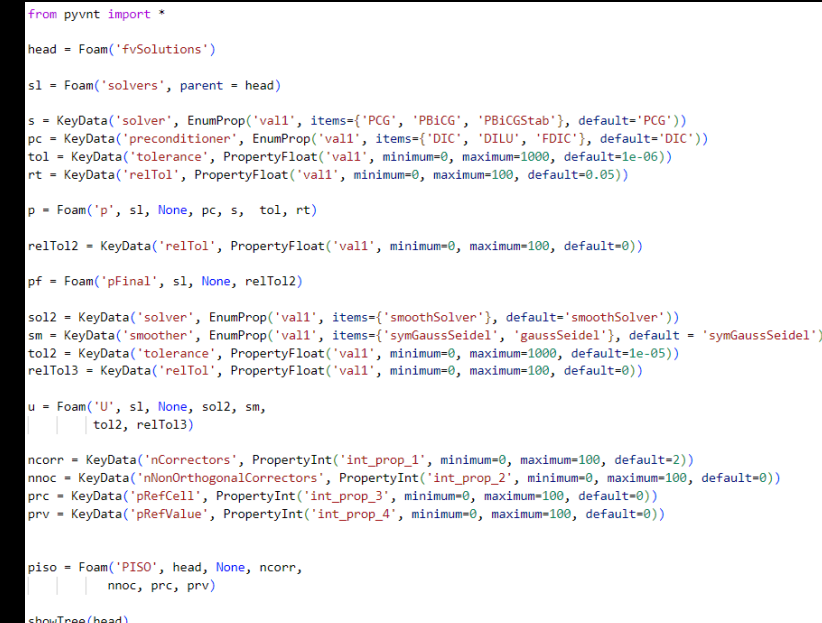
Features



Interactive mesh tool in Blender

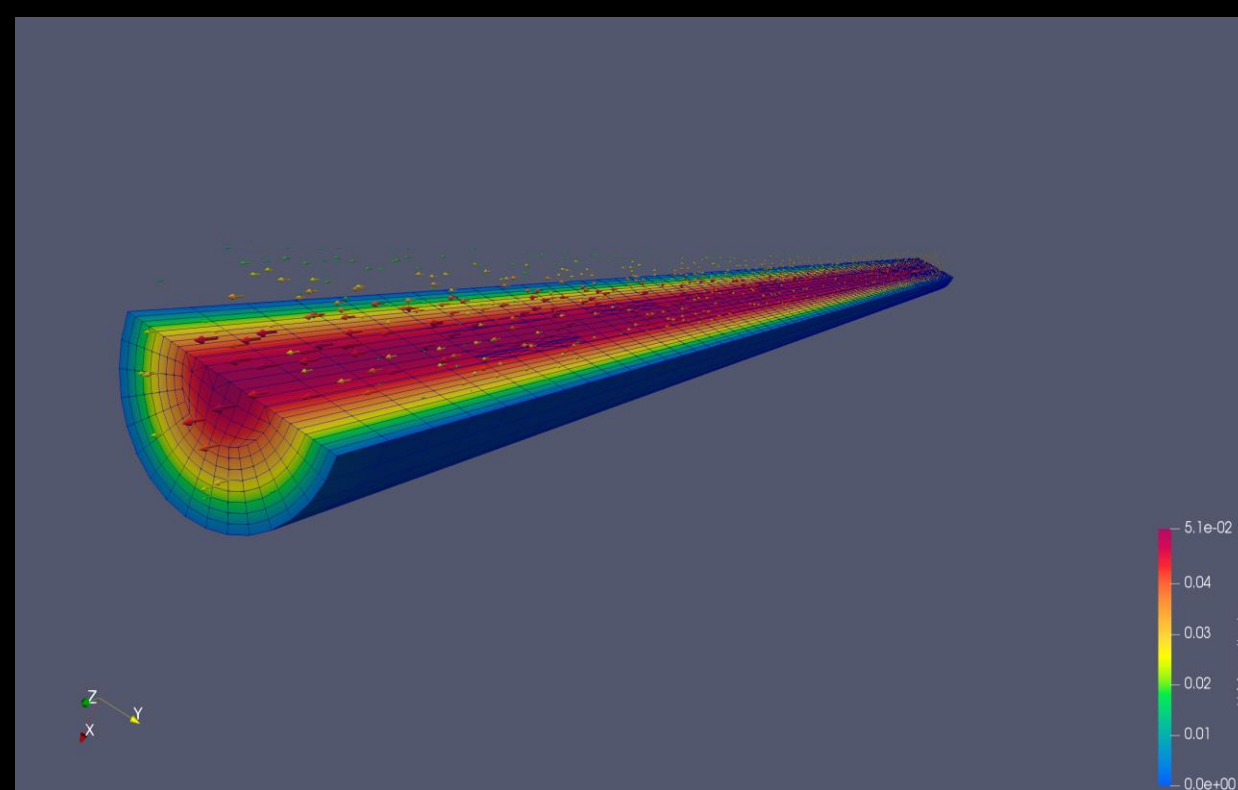
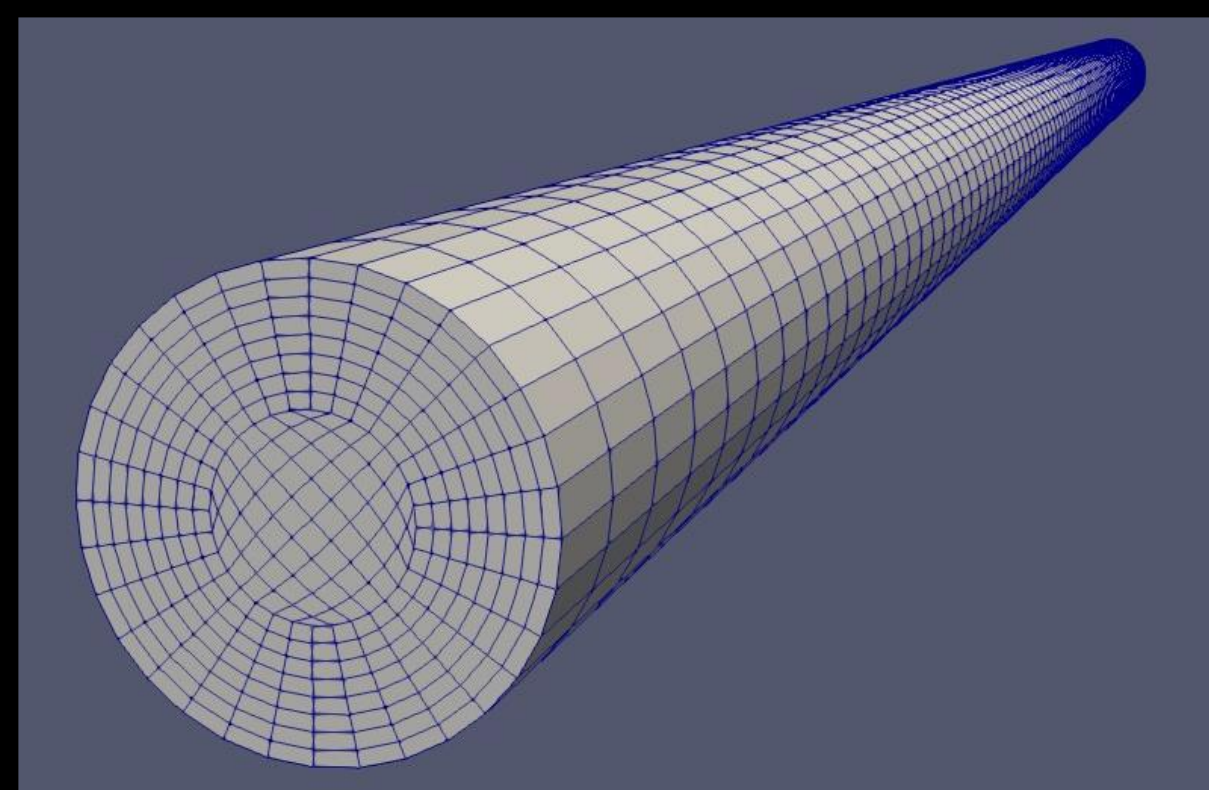


Interactive Solution Modelling



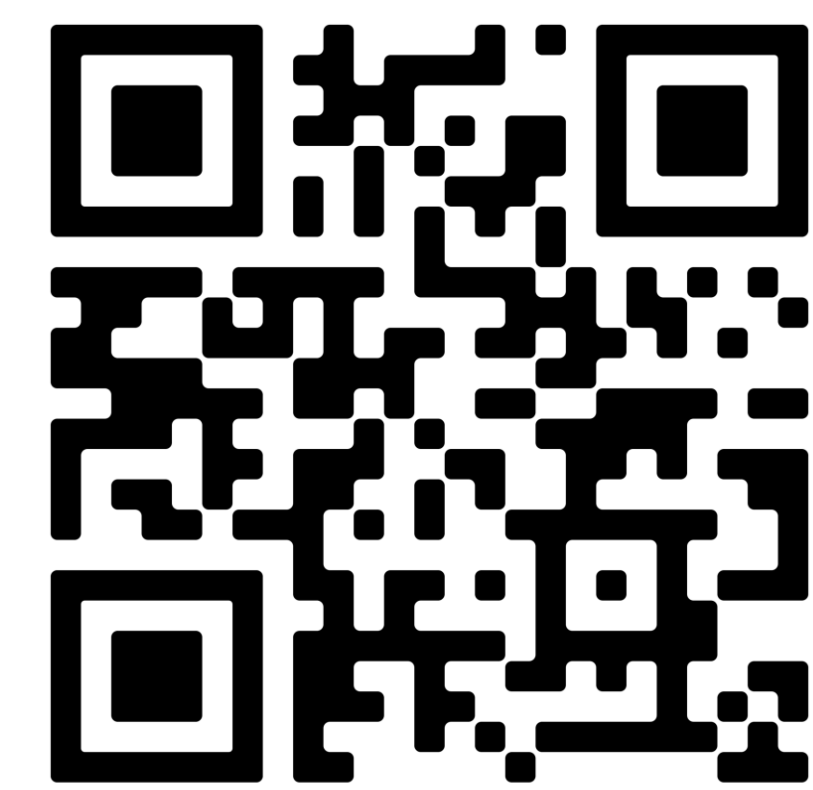
Scripting via PyVNT ^[2]

OpenFOAM case



Post-processing on Paraview

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CFD-FOSSEE
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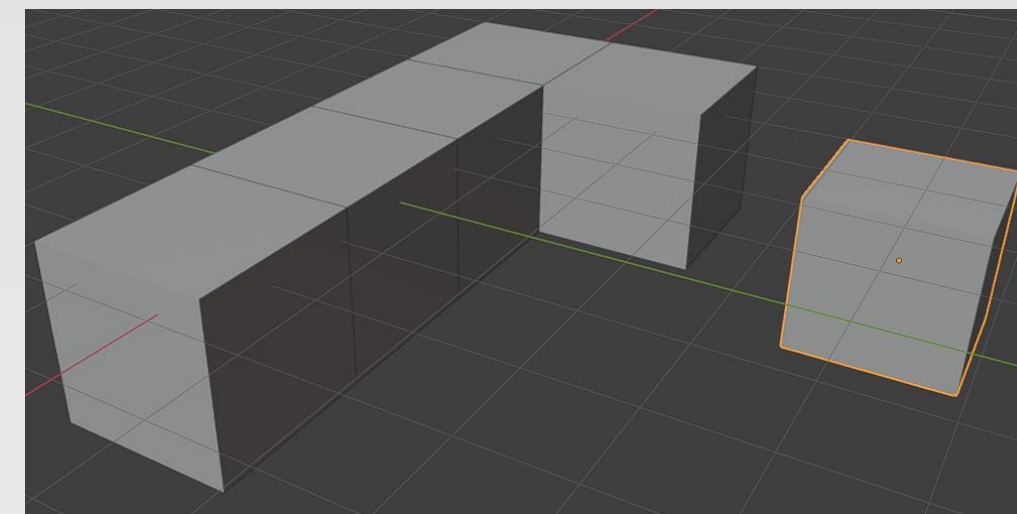
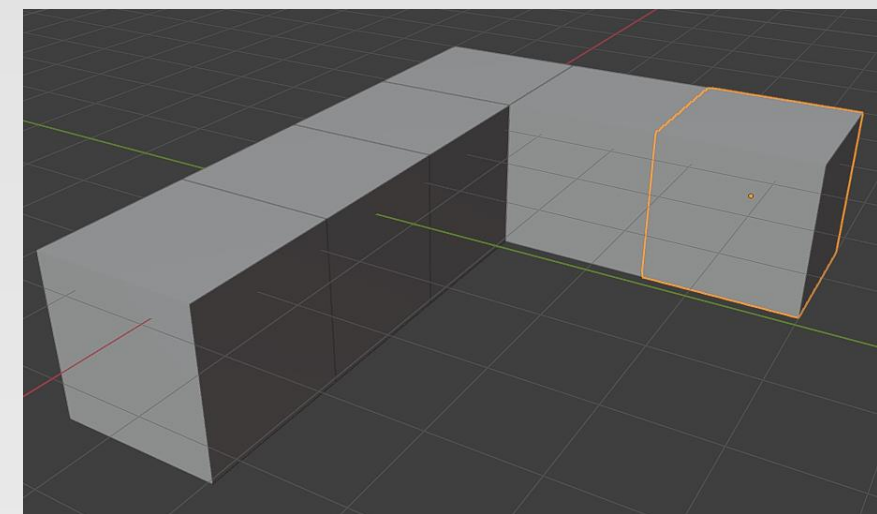


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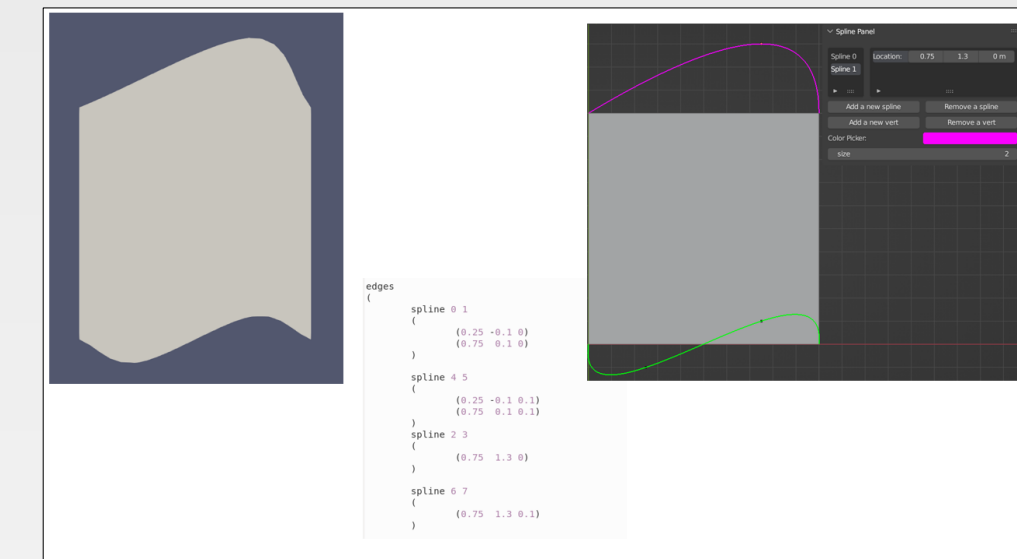
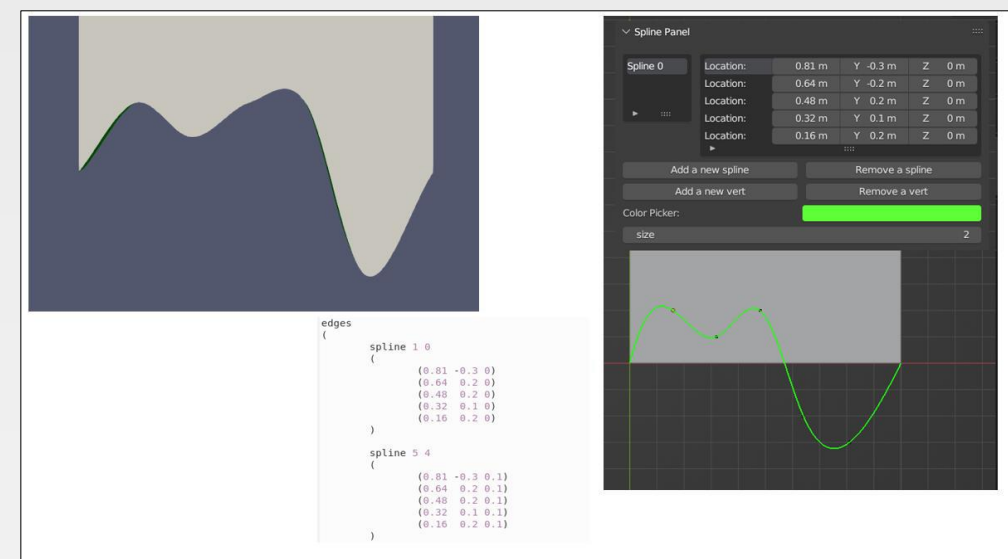


USING VENTURIAL

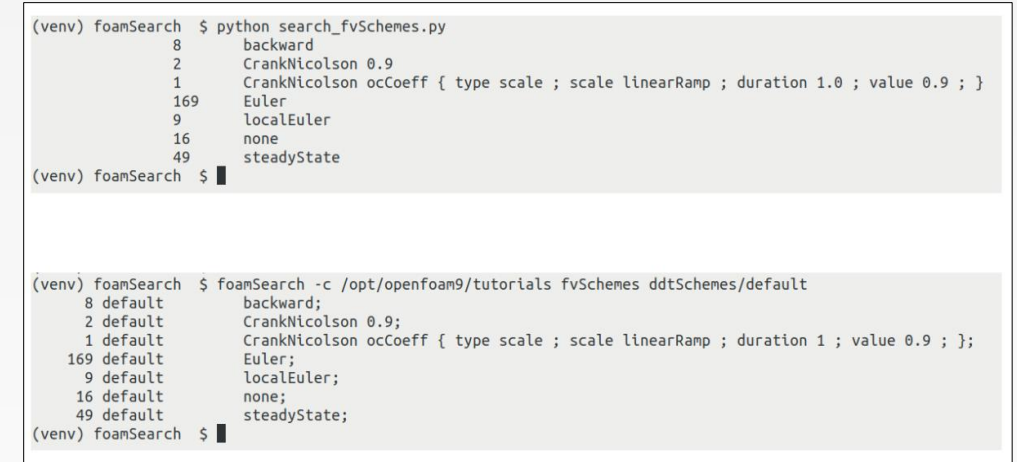
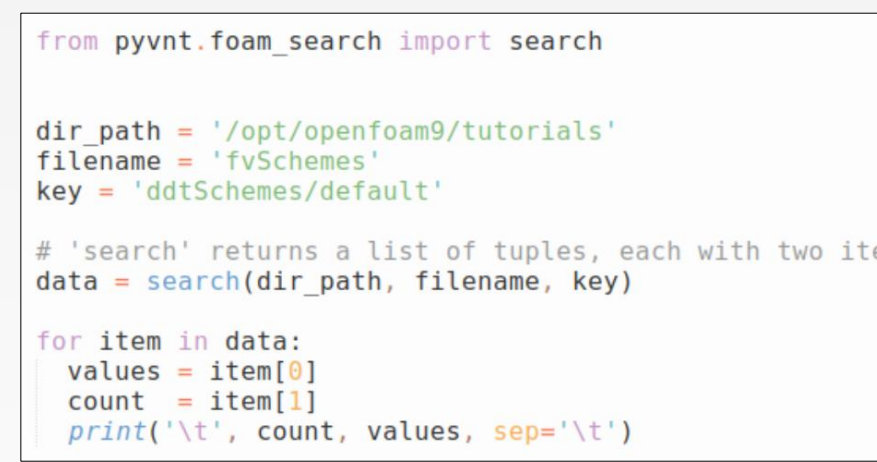
Venturial’s workflow provides an interactive method of implementing OpenFOAM’s case building features. Venturial supports interactive Blockmesh composition and decomposition.



Venturial also supports all types of curved edges



PyVNT provides API wrappers for OpenFOAM’s case management tools:



Venturial has several other tools (such as a Snappyhexmesh UI, and solver customization utilities) that can be used together to address complex CFD applications.

CONCLUSIONS

Historically, Venturial was developed as a tool to promote GUI-driven learning of CFD in academia. Since then it has transitioned towards a general - purpose, simulation enabling tool. Venturial has been presented at SciPy India 2021, 18th OpenFOAM Workshop 2023, and IEEE T4E 2023 conference. The CFD-FOSSEE development team also conducts tutorial workshops^[3], and welcomes collaborations to achieve future goals.

ACKNOWLEDGEMENTS

The authors sincerely thank FOSSEE, present and past contributors for their painstaking efforts in developing the project. We are also grateful to the funds provided by National Mission through ICT (NMEICT), Ministry of Education (MoE), and Govt. of India to the FOSSEE project.

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