Synopsis

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Streamlining Open-Source CFD: A Comparative Study of GUI-based vs. Script-based OpenFOAM Workflows

OpenFOAM is a leading open-source tool for Computational Fluid Dynamics (CFD), extensively used in aerospace and mechanical engineering. However, its reliance on command-line scripts and text-based dictionaries often creates a steep learning curve for new users. To address these usability challenges, various Graphical User Interfaces (GUIs) have been developed, such as Helyx-OS, SimFlow, and the FreeCAD CfdOF add-on.

Conducted under the FOSSEE OpenFOAM GUI initiative, this project aims to transition standard CFD workflows from manual scripting to a visual environment using FreeCAD CfdOF. The methodology involved benchmarking standard OpenFOAM training cases by first executing them via the native script-based approach, and subsequently reconstructing them within FreeCAD. This allowed for an integrated process where geometry, meshing, and solver settings were managed through the GUI while retaining OpenFOAM as the computational engine.

To further validate the workflow, an aerodynamic airfoil simulation was performed, demonstrating the tool's capability in handling aerospace-specific problems. The study highlights that the FreeCAD CfdOF interface successfully replicates standard OpenFOAM results while significantly simplifying the setup process. These findings suggest that GUI-based workflows are effective for enhancing workflow transparency and facilitating CFD education.