FOSSEE, IIT Bombay
OpenFOAM Case Study Project
July 2026

Development of an Overset Mesh Framework for a Single-Orifice Rotary Slinger Atomizer Using OpenFOAM

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Abstract

Rotary slinger atomizers are widely used in aerospace propulsion and gas turbine combustors due to their ability to generate fine fuel droplets through centrifugal atomization. Numerical simulation of these systems is challenging because the rotating geometry requires an efficient mesh handling strategy while maintaining computational accuracy. The overset mesh technique offers an effective solution by allowing independent motion of rotating and stationary mesh regions without mesh deformation. This work presents the development of an overset mesh framework for a single-orifice rotary slinger atomizer using OpenFOAM. A two-dimensional computational model consisting of a rotating slinger disc with a single discharge orifice and a stationary background domain was developed. The rotor geometry was created using Autodesk Fusion 360, and a body-fitted computational mesh was generated and verified to satisfy the required mesh quality criteria. The final computational domain consists of a stationary background mesh combined with a rotating overset mesh, providing a robust framework for rotating flow simulations. The developed methodology establishes a reliable preprocessing workflow for rotary slinger atomizers and can be readily extended to more complex geometries. Future work will utilize the developed framework with the `interDyMFoam` solver and the Volume of Fluid (VOF) method to investigate liquid discharge, primary droplet breakup, and spray evolution under different operating conditions.