

# OpenFOAM Case-Study Project

FOSSEE, IIT Bombay

## 3D Simulation of Flow Inside a Counter-Flow Vortex Tube

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## Synopsis

This study presents the 3D simulation of the flow inside counter flow vortex tube also known as Ranque–Hilsch Vortex Tube (RHVT), using open source environment of *OpenFOAM*. The vortex tube is a device which separates the compressed inlet gas into stream of hot and cold gases with no moving parts and complex geometry. They are mostly used as cooling devices and used in application for spot cooling. The main objective of this study was to develop and computational environment inside *OpenFOAM* for simulating flow inside the RHVT and perform different analysis. The geometry for the problem was taken from a reference study and generated using *FreeCAD* with some modification. Mesh generation was done using *snappyHexMesh* utility of and two solvers were tested for the problem formulation i.e. *rhoSimpleFoam* and *sonicFoam*. Due to the presence of reverse flows at inlet and outlet, *rhoSimpleFoam* was later discarded and problem was computed using *sonicFoam* solver. For the chosen geometry, with inlet velocity of  $200\text{m/s}$ , cold outlet pressure of  $1e^5\text{ Pa}$ , hot outlet pressure of  $1.15e^5\text{ Pa}$  and cold mass fraction of around 0.73, the total and static temperature at hot outlet is found to be  $299\text{k}$  and  $298\text{k}$  while at cold outlet  $294\text{k}$  and  $261\text{k}$  respectively. Special care was taken for the max courant number, turbulence parameter setup and mesh generation as they diverged the solution and increased the computational time significantly. The post processing was done using open source platform line *Paraview* and plots were generated using *MATLAB*.