Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

2D CFD study of Darrieus type straight single bladed VAWT using OpenFOAM ASMELASH HAFTU, SHIVASUBRAMANIAN GOPALAKRISHNAN, PRABHU RAMACHANDRAN, Indian Institute of Technology Bombay — Vertical Axis Wind Turbines (VAWTs) employ one or more, straight or curved blades which rotate parallel to the axis of rotation. Blade arrangement creates complex aerodynamics and unsteadiness in the flow. The objective of this study is to demonstrate a CFD model for simulating VAWT blade traversing circular orbit and describe the unsteady aerodynamics data. The model geometric configuration consists of rotor-core and turbine diameters as 1.5m and 1.22m respectively for NACA0015 airfoil with chord length 0.1542. Inlet velocity of water 0.091m/s yields a blade Reynolds number of 67,000 for a tip speed ratio equal to 5. Our mesh independent test suggests about 200k cells (snappyHexMesh), compromising between accuracy, stability, and cost. The pimpleDyMFoam (compatible with moving meshes) is a suitable pressure based OpenFOAM solver for the unsteady 2D simulation with second-order accuracy in space and time. Nondimensional normal and tangential force components were computed and compared well with the experimental work of Oler JW. et al. (1983). The methodology presented here can be used as a guideline for design, and CFD analysis of single to multi-bladed VAWTs with fewer cells than reported earlier.

Asmelash Haftu Amaha
Indian Institute of Technology Bombay

Date submitted: 01 Aug 2019 Electronic form version 1.4