Flow past an Elliptic Cylinder

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Abstract

The aim of this project is to study the variation in coefficient of discharge with time for the flow past an elliptic cylinder in laminar and turbulent regimes between a time interval of 30s<t<60s, as well as to generate the vorticity plots at the end of simulation time for the respective regimes. For simplicity in this study we have simulated a 2D incompressible flow using the pimpleFoam transient solver in OpenFOAM and adopted the k-ε RAS (Reynolds-Averaged Simulation) model to simulate the turbulent flow regime.

1. Introduction

The flow of fluids past immersed bodies is essentially studied for applications for fluidization phenomena in packed bed reactors. An important aspect of such a flow is the presence of drag force, which acts in the direction of flow exerted by fluid on the solid body. The quantitative measure of drag is coefficient of discharge defined by

$$Cd \equiv \frac{F_d/A_p}{\rho u^2/2}$$

Where u is the velocity of approaching stream, A_p is the projected area and F_d is the drag force.

Vorticity has been defined as the curl of velocity vector i.e. $\omega = \nabla * V$ and has been defined for 2D flows only.

The parameter of the k-ε turbulent model have been calculated using the following:

$$I = 0.16 * Re^{-\frac{1}{8}} \qquad k = \frac{3 * (I * U_{avg})^2}{2} \qquad \epsilon = \frac{0.164 * k^{1.5}}{0.07d}$$

I= Turbulent Intensity *k=turbulent kinetic energy* *ε=turbulent dissipation*

The above correlations have been established for fully developed turbulent flows.