FLUID FLOW ANALYSIS OVER A SYMMETRIC AIRFOIL PITCHING AT LOW FREQUENCIES

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Manoeuvring of ships, airplanes and other automobiles uses elements like rudders, flaps and ailerons to achieve some predetermined motions. The dynamic characteristic of the automobile under consideration depends upon the shape and position of these elements which has a time dependent motion with respect to the flight.
Most of these objects have fixed wings and as and when required the elements have relative motion at low frequencies. On the other hand birds and some sea animals have flexible wings, which move at a rapid rate to achieve the desired motions. In both the cases study of fluid dynamics on objects moving at either high frequencies or low frequencies becomes utmost important aspect.
Aerodynamic characteristics like dynamic stall, thrust generation and flow field (because of the pitching motion of the aerodynamic structures) is of most importance in understanding and designing of these structures.
In the present work, we study the fluid dynamics of airfoil pitching at very low frequencies to understand the time dependent aerodynamic characteristics. This is carried out in OpenFOAM, an open source software, having the capabilities to simulate variety of flow conditions apart from compressible, in-compressible flows. Dynamic meshing capability along with in-compressible dynamic mesh solver PIMPLEFOAM is used to simulate the fluid dynamic behaviour over a pitching airfoil. Six-degrees of freedom rigid-body motion method is utilized to model the airfoil as springs for this aero-elastic case.
A NACA-0012 symmetric airfoil is chosen for this purpose and is pitched at very low frequencies and moderate Reynolds Number. Low frequencies are chosen to mimic flow equivalent to steady state conditions at a particular angle of attack. The results obtained from the will be compared to standard results obtained by experimentation being carried out at low speed wind tunnel.