# 1 Study of OpenFoam performance for calculation of lifting surfaces in translatory and rotational motions

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The aim of the work is to study the OpenFoam performance for calculation of lifting elements. The work consists of the three following steps:

- computations of two-dimensional profile NACA63006 at angles of attack $0, 5, 10, 15$ and 20 degrees.
- computation of three-dimensional wing with aspect ratio of ten at the angle of 5 degrees.
- computations of rotating lifting system, consisting of three three dimensional wings (Fig.1), rotating with the angular velocity of $1,0s^{-1}$ in the axial incident flow of 1 m/s. The span is 5 m. The medium is water.

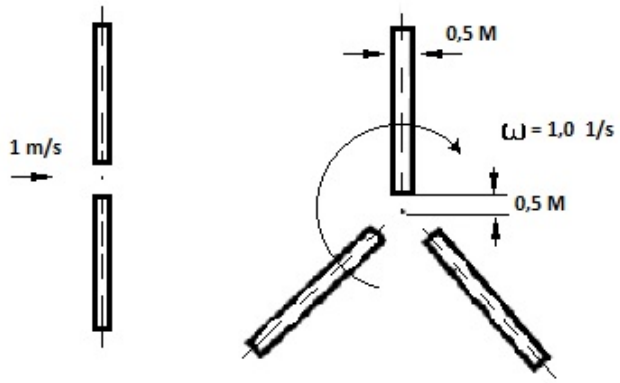


Figure 1: Each wing has the aspect ratio of ten and pitch angle of 5 degrees.

In the last two computations, the profile NACA63006 is constant along the span. Use moving reference frame (MRF) option of the OpenFoam and calculate just one wing. The effect of two others wings should be taken into account by boundary conditions and additional forces (Coriolis and centrifugal ones) added to original equations within MRF.
In all three computations use two turbulence models: Spalart Almares and $k-\omega$ SST ones.

Obtain and analyse the following results (minimal program):

1. Pressure distribution on the two-dimensional airfoil at different angles of attack.
2. Dependence of the liff coefficient, drag coefficient, pressure center for the two-dimensional airfoil at different angles of attack.
3. Pressure coefficient distribution at different cross-sections along the span of three-dimensional wing.
4. Lift coefficient, drag coefficient, pressure center for 3D wing.
5. Validate the previous results using the code Autowing (https://www.lemos.uni-rostock.de/Lehre)
6. Pressure coefficient distribution at different cross-sections along the span of rotating wing.
7. Distribution of the lift along the span of the rotating wing.
8. Torque moment and axial force on the rotating wing.

For the two dimensional problems generate grid with around 200000 cells.
For the three-dimensional problems generate grid with around $0,5$M cells.
The sample of the grid forthe three dimensional wing can be get from the Chair of modeling and simulation (Mr. Mahesh Dhone).

The possible content of the thesis is

- Introduction. Motivation of the work aims.
- Theoretical background. Governing equations. Turbulence Models.
- Numerical Methods.
- Results. Analysis of graphs.
- Conclusion
- References.

The thesis in hard copy form should be submitted at least one week before the defending.