TFES Lab (ME EN 4650)
Computational Fluid Dynamics

Required Figures

Captions

A meaningful and comprehensive caption must accompany all figures. The caption is placed *below* the figure and includes the label Figure 1x., where x denotes the letter a–e according to the plot order listed below. Use the following guidelines when writing figure captions:

- → Ideally, the figure caption should provide a "standalone" description of the plot, and contain enough information that the reader can understand what is being shown without having to refer back to the main text of the document (report, memo, etc.).
- → The caption should start with a statement of the quantities plotted on both axes. Typically the axis labels will utilize mathematical symbols (with appropriate units) for the quantities being plotted; however, in the caption, these quantities are described in words.
- → Include relevant contextual information about the plot. For example, for the wake profile, you should state the x/D location and Re_D value at which the measurements were taken. Additionally, you should state that the measurements are for the case of flow around a two-dimensional circular cylinder. Finally, adding some text about the measurement technique used to obtain the data would be appropriate.
- → When your plot includes errorbars, it is helpful to provide information in the caption about the errorbars. For example, you should include the fact that the errorbars represent a 95% confidence interval.
- → When comparing with published data, provide a reference for the publication.
- → If in doubt about what information to include in the caption, one should err on the side of providing more information, rather than less.

Plots

1a. In a single figure, include two images of your computational mesh. The top image should be of the entire domain and the bottom image should be zoomed in near the airfoil. These should be for the case of n=400 nodes on the airfoil with an angle of attack of 0 deg.

1b. In a single figure, include three convergence plots for the case with an angle of attack of 12 deg. The left plot should be the residuals (continuity, x-velocity, y-velocity, k, omega) as a function of number of iterations; the middle plot should be the drag coefficient as a function of number of iterations; and, the right plot should be the lift coefficient as a function of number of iterations.

1c. In a single figure, include two contour plots of the velocity magnitude for the case with an angle of attack of 12 deg. The top plot should be of the entire domain; and, the bottom plot should be of the region zoomed-in near the hexagon.

1d. Provide a plot of the pathlines near the airfoil for the case with an angle of attack of 12 deg.

1e. Provide a contour plot of the pressure coefficient near the airfoil for the case with an angle of attack of 12 deg.

1f. In a single figure, include two plots side-by-side of the drag and lift coefficients as function of angle of attack showing the experimental data. Overlay your simulation results for angles of attack of 5 deg and 12 deg. Use the Matlab figure files posted on CANVAS under the "Resources" row.

1g. Provide a table comparing the lift and drag coefficients from the simulation at angles of attack of 5 deg and 12 deg with those obtained from experimental data at a similar Reynolds number. Also include the percent difference between the simulation values and experimental values.

Short-Answer Questions

2a. Discuss how the CFD simulation results vary with mesh spacing. Use the results from the tutorial to answer this question. Be sure to be specific in your response. [4–6 sentences]

2b. Discuss what is "validation" in the context of CFD simulations and why it is necessary. [2–4 sentences]