

Turbulence - Theory and Modelling

Computer exercise 2

Comparing turbulence models

In this computer exercise you will compare the performance of several RANS based turbulence models. The set-up is the same as was used in the previous exercise, i.e. flow around a cylinder at $Re=10000$. The models you should look at are the standard $k-\epsilon$ model, realizable $k-\epsilon$, Spalart-Almaras 1-equation model, SST $k-\omega$ and RSM. These may be compared in terms of, for example drag force, velocity distribution, distribution of k and the production thereof and the separation point. Please hand in a short report (max 4 pages) latest 6 December to johan.revstedt@energy.lth.se

Instructions

- You will work with the same files as for computer exercise 1. Hence, follow the same procedure for downloading and starting up as in CE1.
- The case is initially set to the standard $k-\epsilon$ model. To change goto **Models**→**Viscous**.
- Simulate using the 5 models above and save your cases and data. Hint: It is recommended that you re-initialize when you change model except for the RSM where it is better to start from a previous solution (e.g. $k-\epsilon$)
- Compare your results from the five models. A first step would be to look at contour plots of some variables such as speed, turbulent kinetic energy etc. For a more detailed analysis you should look at parameters such as length of the recirculation, separation angle, drag and distribution of k along lines.
 - To create a line goto the tab **Postprocessing**, on the upper left chose **Create**→**Line/Rake** and type in the coordinates of the end points and name the line. NB, the cylinder is centred at (0,0) and the radius is 0.5. I recommend that you at least create the following lines:
 - 1 line from $x=-5$ to $x=10$ at $y=0$
 - 3 lines at $x=1, 3, 5$ from $y=-3$ to $y=3$
 - To plot data along a line goto **Plots**→**XY Plots**. If you want to plot along one of you lines make sure that you mark '**Position on X Axis**' under **Options**, mark the line you want to use and make sure that '**Plot Direction**' is set along your line. If you want to save your line data mark the option **Write to File**. This is good when you want to compare cases, then just press **Load File** and choose the cases you want to look at.
 - To find the separation point a good way is to plot the wall shear stress or the skin friction coefficient. To plot as a function of angle you will have to use a **Custom Field Function**. To plot you should unmark '**Position on X Axis**' and use your function 'angle' on the x-axis. You will find it under the group Custom Field Functions, i.e. under **X Axis Function** replace '**Pressure**' with '**Custom Field Function**'. Don't forget to mark 'cylinderwall' under **Surfaces**.
 - To calculate the drag goto the tab **Postprocessing** and choose **Forces**, check the direction vector and press **Print**.