

Exercises – Serie 9 – Vortex shedding

Exercise 1 - Vortex Induced Vibrations

Consider a cylinder of diameter $D = 6\text{cm}$ with a smooth surface. The cylinder is placed in a wind tunnel (in air) and is subjected to a uniform flow $U = 5.2\text{ m/s}$ at a temperature of $T = 20^\circ\text{C}$.

- Determine whether or not vortices are periodically shed from the cylinder.
- What might occur if the cylinder was placed in water at the same velocity?
- How would the surface roughness influence the vortex shedding frequency. Alternatively, if the same cylinder is placed in a water tunnel at a speed of $U = 20\text{ m/s}$, what would be the effect of the surface roughness on the shedding frequency.
- The video and the file given with the exercise are the results of a numerical simulation with the flow parameters of question a). From these results, extract the Lift and Drag coefficients as a function of time.
- The cylinder is now mounted on a set of springs and dampers allowing it to move in both the x and y direction. Considering the Lift and a Drag force found above, write the equation of motion of the system. (Note that, for simplicity, we neglect any y -component of the velocity in U_{rel} , and we assume that the cylinder movement has no influence on vortex shedding i.e., $C_L(t), C_D(t)$ are the same than ones found in the static numerical simulation).

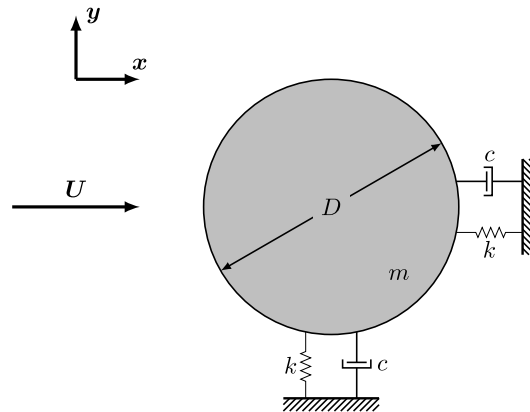


Figure 1: Spring-mass-damper Cylinder

- Numerically compute the $x - y$ motion of the cylinder. The stiffness is equal to $k = 10^4\text{ N/m}$ and consider the following dampings: $c = [10, 75, 180, 500]\text{ Ns/m}$.