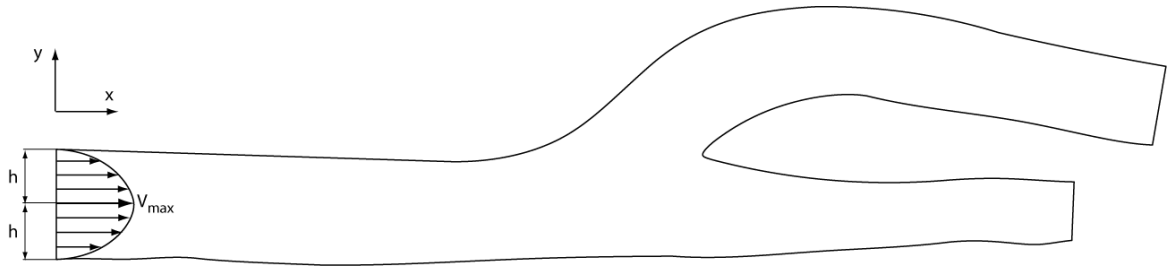
Bifurcation Simulations

Description

In this lab exercise the COMSOL package will be used to study incompressible flow fields inside the two dimensional bifurcation presented in the following figure.



A geometry file for this carotid bifurcation is provided (`bifurcation.dxf`). The filling fluid is considered to be blood with density $\rho = 1050$ kg/m^3 and dynamic viscosity $\eta = 0.004$ Pa $\cdot$ s. The exit pressure is equal to 80 mmHg. The normal inlet velocity profile has the following form:

$$u = V_{max}\left[1 - \left(\frac{y - y_0}{h}\right)^2\right],$$

with:

$$V_{max} = \frac{3q_l}{4h},$$

where q_l is the flow rate per unit length, $(0, y_0)$ is the geometric center of the inlet and h represents the half of the length of the inflow boundary segment. In our case $y_0 = 3.271537 \cdot 10^{-4}$ m and $h = 0.0038005$ m.

Solve the incompressible flow field inside the 2D bifurcation for the flow rate per unit length values of 13.5 cm^2/s, 27.26 cm^2/s, and:

- Make surface plots of the velocity components (u, v), of the velocity magnitude (speed) and pressure.
- Plot the streamlines.
- Plot the wall shear stress on the upper and lower walls.
- Evaluate the length of the recirculation zones.

The geometry file data are in SI units, so all units provided in COMSOL must be consistent.