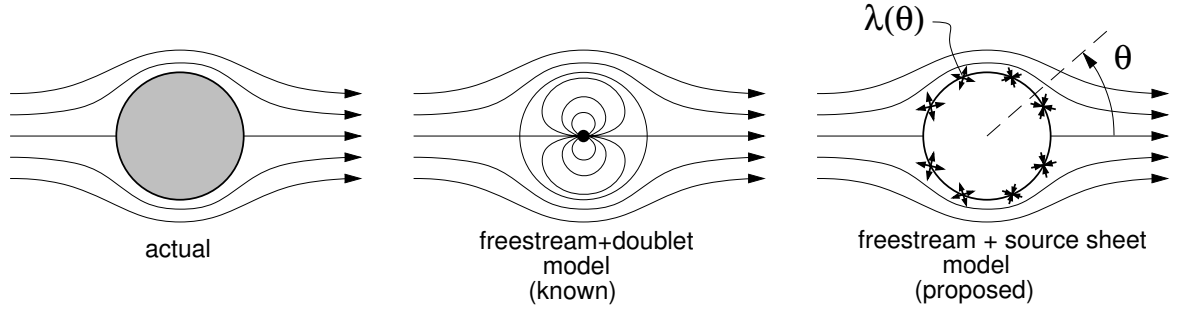
F21. As shown in class, the nonlifting irrotational flow past a circular cylinder can be represented by superimposing the uniform freestream flow and a doublet. An alternative representation is proposed using a source sheet placed on the cylinder surface as shown. The proposed sheet strength distribution about the cylinder is $\lambda(\theta) = -2V_\infty \cos\theta$. There is no vortex sheet, so on the surface, $\gamma = 0$.



You are to determine whether the new model is correct.

a) Determine the velocity at point A from the known exterior surface velocities for the cylinder.

$$V_\theta(\theta) \;=\; -2V_\infty \,\sin\theta \qquad , \qquad V_r = 0$$

Using the sheet jump relations,

$$\Delta V_n = \lambda \qquad , \qquad \Delta V_s = \gamma$$

determine the interior velocity at point B.

b) Again using the known exterior $V_\theta(\theta), V_r$ result at point C, use the sheet jump condition to determine the velocity at point D.

c) Compare velocities at B and D. What appears to be the fictitious velocity inside the cylinder?

d) Is the source sheet jump $\Delta V_n = \lambda$ consistent with the exterior and interior normal flows everywhere on the cylinder surface? Is the proposed source-sheet model correct?