Numerical simulation of subcritical flows over an obstacle

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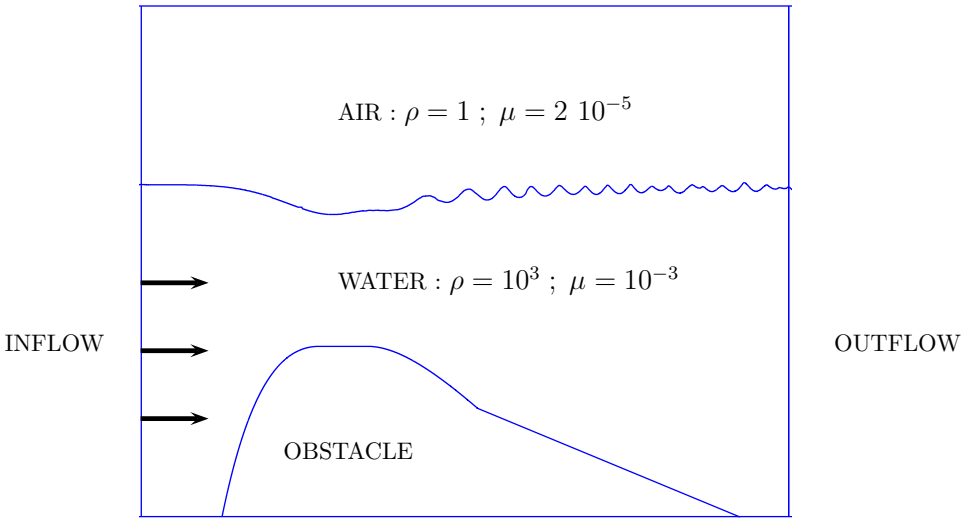
This study addresses a problem of wave and current interactions. Experiments performed in a wave channel in which a flow is imposed over an obstacle have shown very interesting features such as wave blocking and the generation of blue shifted waves [**?**]. Like in [**?**], we use a Chorin-type projection method to solve the incompressible variable density Navier-Stokes equations. This leads to solve successively

$$\frac{\mathbf{u}^{n+\frac{1}{2}}-\mathbf{u}^{n}}{\triangle t}+(\mathbf{u}.\nabla)\,\mathbf{u}=\frac{(\nabla.\tau)^{T}}{\rho}+\mathbf{g}\quad\text{with}\quad\tau=\mu\left(\nabla\mathbf{u}+\nabla\mathbf{u}^{T}\right)\ ,$$

$$\nabla.\left(\frac{\nabla p}{\rho}\right)=\frac{\nabla.\mathbf{u}^{n+\frac{1}{2}}}{\triangle t}\ ,$$

$$\text{and}\quad\mathbf{u}^{n+1}-\mathbf{u}^{n+\frac{1}{2}}+\triangle t\frac{\nabla p}{\rho}=0\ .$$

Several techniques, avoiding the generation of conformal meshes, will be used to take into account the presence of both moving interface and obstacle in a two dimensional incompressible fluid flow. The cut-cell method [**?**] is used in order to enforce the no-slip boundary condition on the rigid obstacle. The moving interface (between air and water) is tackled with the well-known Level-Set technique. The jump conditions (for instance pressure jump due to surface tension) across the interface are solved by using the boundary condition capturing method [**?**].



Références

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