Multiphase (VOF) simulation project

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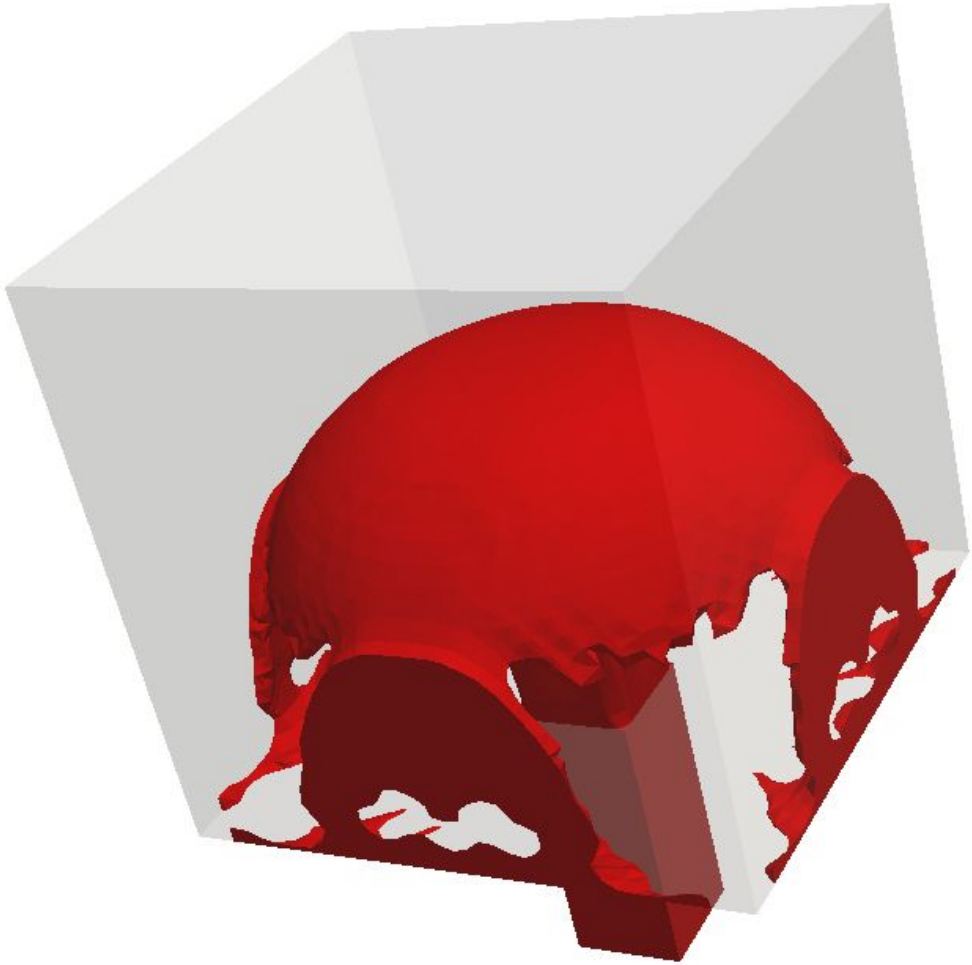
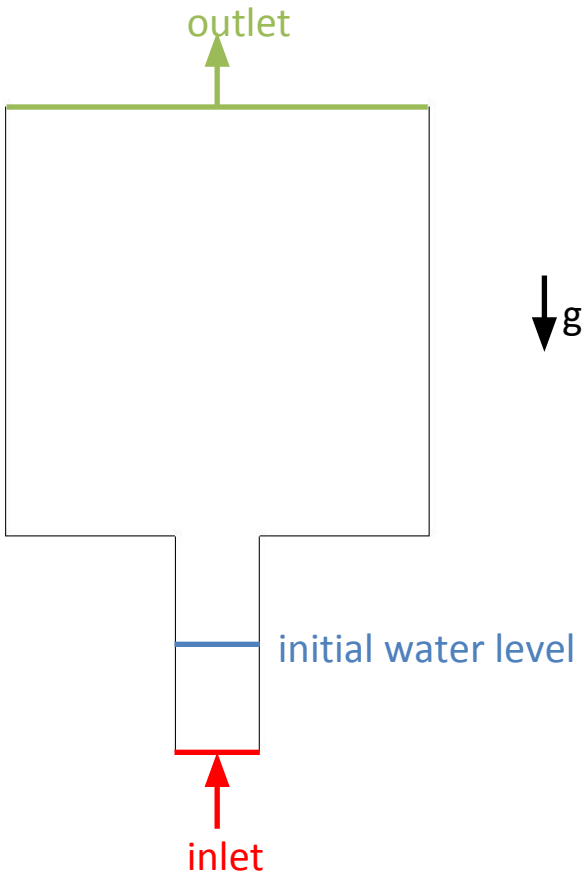


Goals

- Gain knowledge in multiphase modeling and meshing
  - snappyHexMesh
  - multiple phases (gas-liquid)
  - Volume of Fluid
- Case setup
- Initial values (BC)
- Simulate flow
  - coarse
  - refined
  - dynamic mesh
- Postprocessing

Geometry



Solver

interFoam:

> “Solver for two incompressible, isothermal immiscible fluids using a VOF (volume of fluid) phase-fraction based interface capturing approach, with optional mesh motion and mesh topology changes including adaptive re-meshing.”

- incompressible
- transient
- laminar and turbulent
- multi phase
- immiscible
- VOF
- isothermal
- dynamic mesh movement

Theory

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- multi phase
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Continuity equation:

$$\nabla \cdot \boldsymbol{u} = 0$$

Momentum equations:

$$\frac{\partial \rho \boldsymbol{u}}{\partial t} + \nabla \cdot (\rho \boldsymbol{u}\boldsymbol{u}) = -\nabla p + \nabla \cdot \rho \nu [2S] + F$$

Volume of Fluid:

$$\rho = \alpha \rho_l + (1 - \alpha)\rho_g$$

$$\frac{\partial \alpha}{\partial t} + \nabla \cdot (\alpha \boldsymbol{u}) + \nabla \cdot (\alpha(1 - \alpha)\boldsymbol{u}_r) = 0$$

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Courant (CFL) number

$$Co = \frac{U \cdot dt}{dx}$$

- Co number should be less than 1
- U - velocity (given by simulation)
- dx - characteristic cell length (given by mesh)
- dt - time step size (variable)
- To guarantee the condition Co < 1, time step has to be modified during runtime

```
scalarField sumPhi
(
    fvc::surfaceSum(mag(phi))().primitiveField()
);

CoNum = 0.5*gMax(sumPhi/mesh.V().field())*runTime.deltaTValue();
```

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