Comments on the report

- Structure of a report
  - Introduction of the problem
  - Numerical model and methods
  - Results
  - Conclusion

Some other things

- Results (50%)+Description (20%)+Explanation (30%)
  - Only results without any other things will get 0 point for that problem
- Give labels and description for figures and tables
- Do not miss necessary information of figures or tables
  - Missing 1 item, -1 points

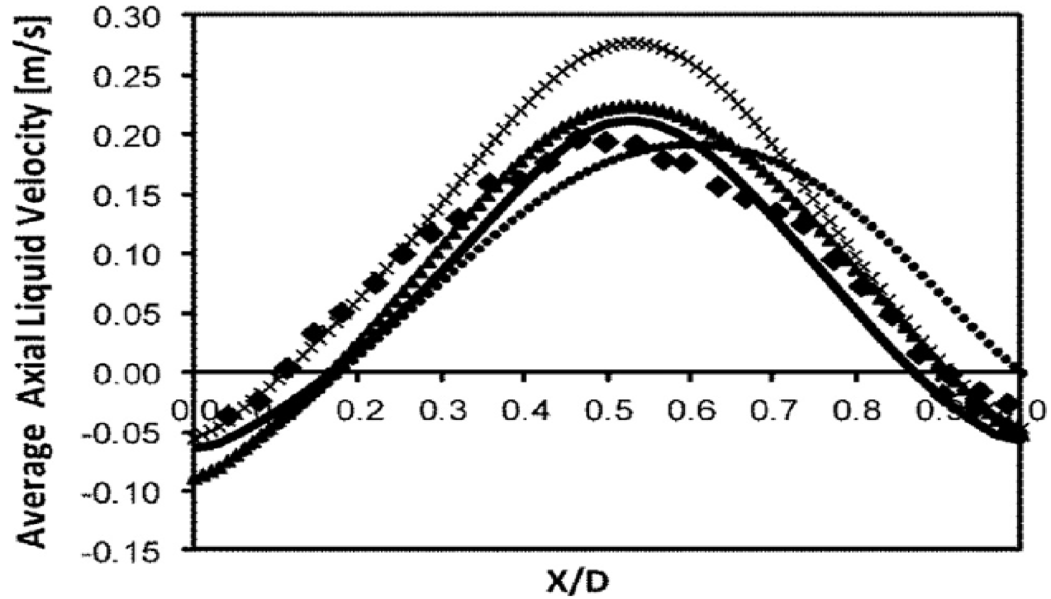


Fig. 4. Time averaged liquid phase axial velocity at $H=0.225$ m and superficial gas velocity=0.0073 m/s. (◆) Experimental data (Bai, 2010) (—) Ishii and Zuber (1979), (●) Schiller and Nauman (1935), (**x**) Grace et al. (1976), (▲) drag coefficient.

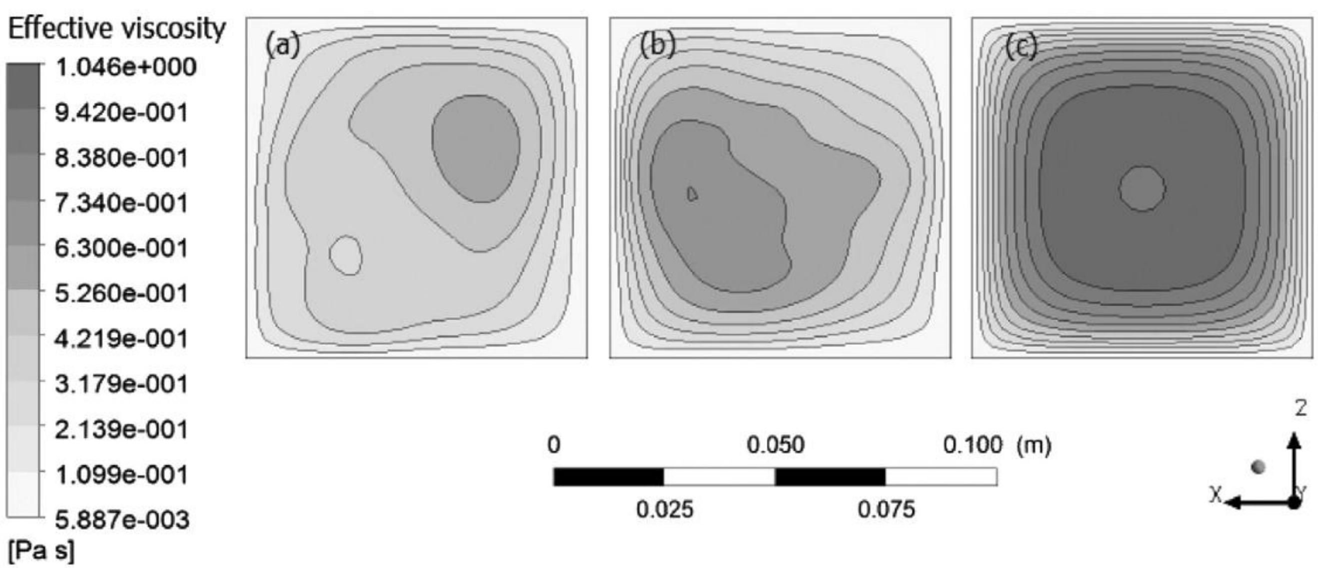


Fig. 22. Contours of instantaneous effective viscosity of liquid at $H=0.25$ m, (a) RNG (b) RNG BIT (c) EARSM.

Table 2a
The physical properties of fluid used in the series experiments [22] and the simulations in the present study

Series	Experiment				Simulation	
	Viscosity (μ_l) (Pa S)	Density (ρ_l) (kg/m^{-3})	Surface tension (σ) (N/m)	*Mo*	μ^* (μ_b/μ_l)	ρ^* (ρ_b/ρ_l)
S1	0.687	1250	0.063	7.0	2.68×10^{-05}	9.42×10^{-4}
S3	0.242	1230	0.063	0.11	7.61×10^{-05}	9.57×10^{-4}
S5	0.0733	1205	0.064	9.0×10^{-4}	2.51×10^{-4}	9.89×10^{-4}
S6	0.0422	1190	0.064	1.0×10^{-4}	4.37×10^{-4}	9.77×10^{-4}

- Do not forget units

- References:
  - Basic fluid mechanics: *Fluid Mechanics - An Introduction to the Theory of Fluid Flows*, F. Durst, Springer, 2008
  - CFD: *Computational Methods for Fluid Dynamics*, J. Ferziger, M. Peric, Springer, 2002
- Focus on one book, that’s enough

Before we start, there is sth. else

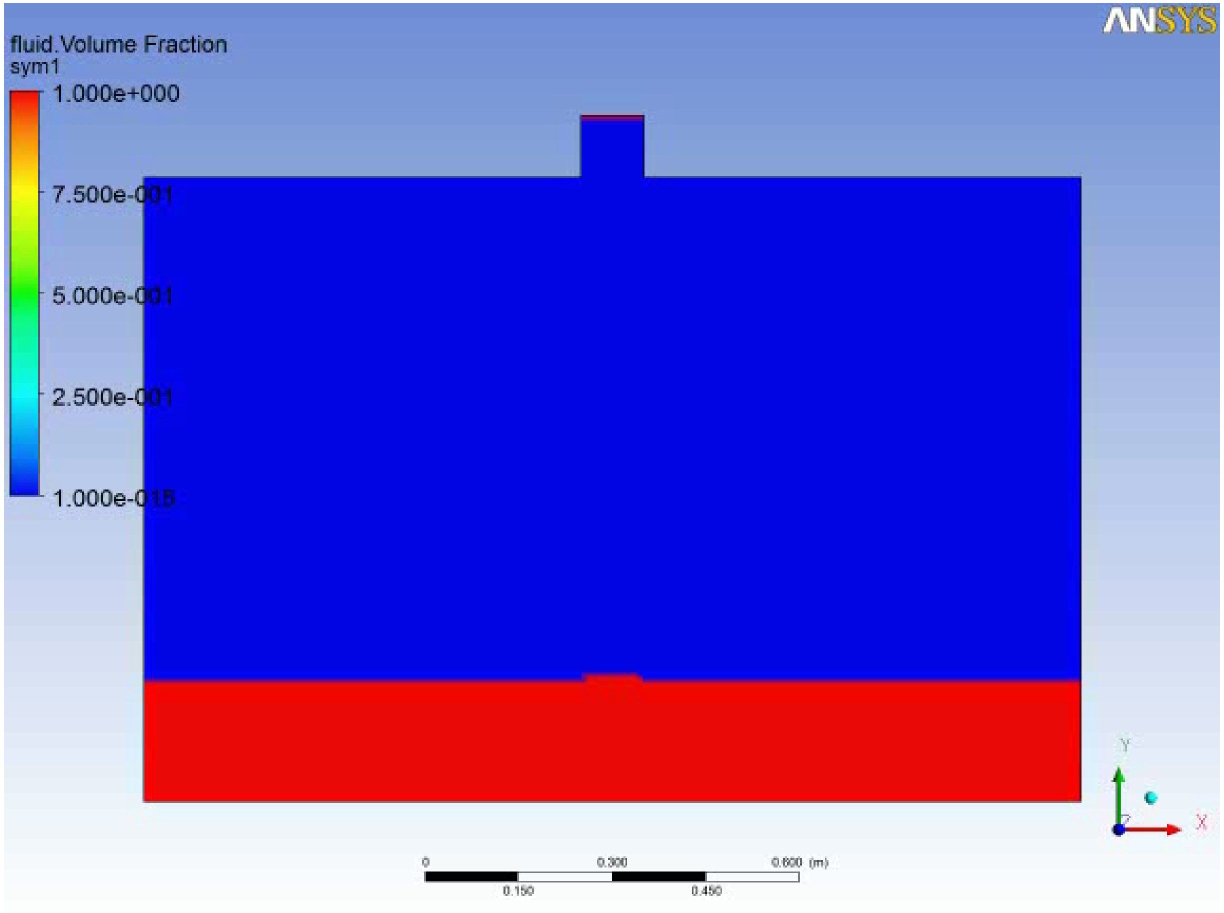
Warning about CFD

- CFD is not about:
  - Generating a grid for some structure (CAD)
  - Selecting some ~~unknown~~ model provided by the GUI
  - Running a simulation
  - Producing a colorful three-dimensional plot
  - Believing (and making others believe) the result
- CFD = "*Colors for Directors*"

→ understand models & equations
assess reliability of a simulation

Now I give you an example

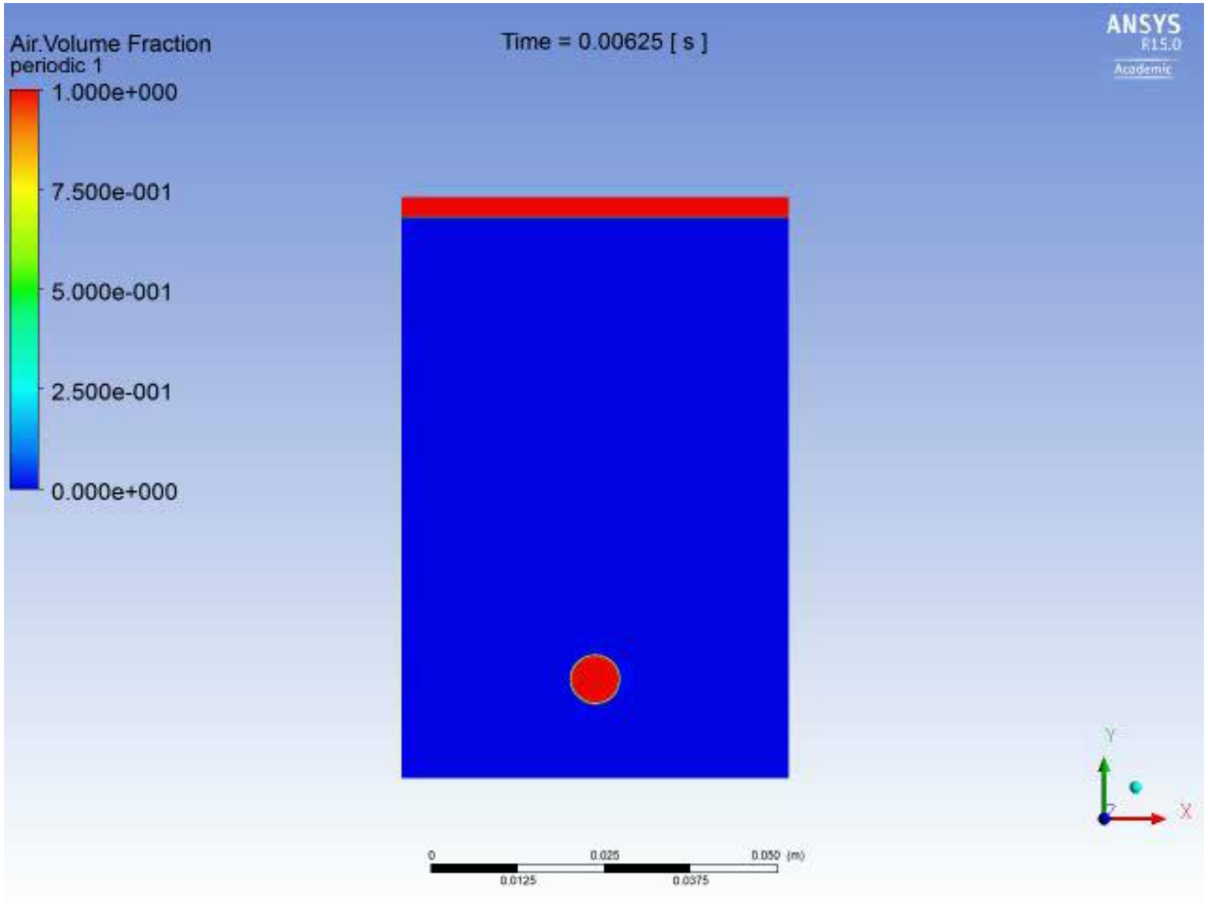
How air-water interact with each other?



- In principle, looks good
- But, just few questions
  - Bubble size?
  - When rupture?
  - How split/merge?
  - …

→ How to show this result is correct?

- Start the simulation on a simpler case



- After simulation, we can calculate
  - Rising velocity
  - Bubble shape

	Simulations
Rising velocity [cm/s]	21.2
Aspective ratio	0.86

- Looks boring?
  - But now we have some numbers

Is this result correct?

→Everybody believes the experimental results except the one who did it

→Nobody believes the numerical results except the one who did it

---- (I do not know…)

	Experiments	Simulations
Rising velocity [cm/s]	20.8	21.2
Aspective ratio	0.84	0.86

Remarks

- Before understanding the model, do not start the real simulations directly
- Start from sth. simple and similar
- Show <u>quantitative comparison</u> to the experiments/other valid results
  - Numerical validation (from real physics to correct model)
- Change the parameters for your simulation tasks
  - For computer, it is just a number
  - For experiments, it is another material / facility, etc.
  - Saving time and energy for prediction
- Explain your results from physical points of view
- Needs more experience