

ME-627

## 2nd Workshop on Advances in Theoretical and Computational Modelling of Interface Dynamics in Capillary Two-Phase Flows

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Cursus	Sem.	Type
Energy		Obl.

Language of teaching	English
Credits	2
Session	
Exam	Autre (reprise)
Workload	60h
<b>Hours</b>	<b>36</b>
Courses	20
TP	16
<b>Number of positions</b>	<b>20</b>

### Frequency

Every year

### Remark

Next time: October 9th to October 13th, 2017

### Summary

This workshop instructs researchers on the latest advances in the computational modelling of the interfacial dynamics of capillary two-phase flow phenomena using the CFD-based frameworks of VOF, LS, ALE-FEM, and Molecular Dynamics methods. Lectures are complemented with practical hands-on sessions.

### Content

The workshop is composed of the following main parts:

- Mathematical basis of two-phase flow, Computational Fluid Dynamics and Molecular Dynamics approximations, surface tension, and phase change;
- Eulerian techniques with diffused interface methods to advect the interface, Volume Of Fluid (VOF) and Level Set (LS) methods, implicit advection of a color function, geometrical reconstruction and interface compression of the interface, interface topology calculation, surface tension and phase change modelling on a VOF and LS framework;
- Eulerian techniques for two-phase flows advecting marker points to preserve interface sharpness, numerical methods to advect marker points, mass conservation, front remeshing;
- Arbitrary Lagrangian-Eulerian (ALE) finite-element methods (FEM) for two-phase flows, finite element formulation, use of python language to build simplified models, update of the mesh morphology, moving boundaries;
- Molecular Dynamics (MD) simulations of liquid-vapor interfaces and phase change, structure and stability of liquid-vapor interfacial regions, interface thermophysics for polar and non-polar fluids, thin-film stability and rupture at the molecular level;
- Use of an opensource CFD package (OpenFOAM) with VOF and LS to simulate two-phase flows.
- Use of an in-house ALE-FEM code (Prof. Anjos) to simulate two-phase flows with an interface-fitting computational mesh.

- Use of an in-house MD code (Prof. Carey) to simulate the interface dynamics and phase change at the molecular level.

**Note**

External lecturers include: Prof. M. Trujillo (Univ. of Wisconsin-Madison, USA), Profs. A. Tomiyama and K. Hayashi (Kobe Univ., Japan), Prof. G. Anjos (State Univ. Rio de Janeiro, Brazil)

**Keywords**

Computational Fluid Dynamics, Hydrodynamic Instability, Surface tension, Two-phase flow

**Learning Prerequisites****Required courses**

Numerical Flow Simulation  
Numerical Methods in Heat Transfer  
Discretization Methods in Fluids

**Resources****Bibliography**

Encyclopedia of Two-Phase Heat Transfer and Flow (J.R. Thome)  
Direct Numerical Simulations of Gas-Liquid Multiphase Flows (R. Scardovelli, S. Zaleski, G. Tryggvason)

**Ressources en bibliothèque**

- [Encyclopedia of Two-Phase Heat Transfer and Flow / Thome](#)
- [Direct Numerical Simulations of Gas-Liquid Multiphase Flows / Scardovelli](#)

**Websites**

- <http://tcm.epfl.ch/>
- <http://tcm.epfl.ch/cms/page-127462.html>