## Computational Multiphase Flows (3 credits)

**Instructors**
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**Synopsis**
Multiphase flows are ubiquitous in industry (petroleum, nuclear engineering and energy transformations) as well as in environment. Depending on the flow regime, two flow configurations can be observed: dispersed two-phase flows with particles, drops and bubbles or flows with complex and deformable interfaces experiencing topologic evolutions: rupture, coalescence, etc. The numerical simulation has proven to be an efficient tool for engineers and researchers to understand and model the complex interplay between the phases. The purpose of the lectures is to introduce numerical simulations for (i) dispersed two-phase flows and advanced topics in computational fluids mechanics, including particle suspensions, bubbly liquids and droplet sprays, and (ii) numerical methods able to deal with complex interfaces. Lectures on classic numerical approaches for solving Navier-Stokes equations will be introduced, together with their coupling with Lagrangian tracking of particles (dispersion, two-way coupling, modelling of hydrodynamic interactions) or with one-fluid approaches as Volume of Fluid (VoF) or Level Set. Students will be trained to program some practical examples of important phenomena. Students will work on projects using Matlab to simulate particle suspension flows, bubble and droplet dispersions.

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<th>Offering</th>
<th>2015 Julmester</th>
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<tbody>
<tr>
<td>Audience</td>
<td>Year 3 &amp; 4 Undergraduate and Graduate Students</td>
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<tr>
<td>Classroom</td>
<td>Room xxx, Teaching Bldg. No. XX, Peking University</td>
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<td>Schedule</td>
<td><strong>Class:</strong> 2-5 PM, M-F, July 6–24, 2015; <strong>Final Exam:</strong> 2-5 PM, July 25, 2015</td>
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<td>Objective</td>
<td>To develop an understanding of the numerical method for solving multiphase flows. The students will be trained to the specificity of particles, drops and bubbles dynamics in order to have a better ability to develop numerical modeling. Numerical simulations of complex industrial configurations will be discussed.</td>
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| Topics        | 1. Introduction to computational fluids mechanics  
2. Examples of two-phase flows in engineering applications  
3. Particle and bubble dynamics (Forces)  
4. Solving ODEs for particle trajectories  
5. Numerical techniques for two-way coupling simulations  
6. Numerical project on particles/bubbles in fluid flows  
7. General equation for two-phase flow problems  
8. Introduction to VoF and level set methods |
5) Journal Papers. |

**Grading**
- Midterm Exam 25%
- Final Exam 25%
- Numerical Modeling Project 30%
- Homework 20%
- **Total** 100%