



**Opening for PhD Position**  
Multiphase Flow Laboratory  
Department of Engineering and  
Architecture - University of Udine  
Head: Prof. Cristian Marchioli



Multiphase Flow Laboratory - University of Udine

## Turbulent multiphase flows: Simulations and Experiments

**Description:** The Multiphase Flow Lab is looking for PhD candidates in the field of Computational and Experimental Multiphase Flow.

The following research projects are available, ordered by strategic importance for the Lab:

**ID 1. Development and assessment of physics-based Wall-Modeled Large-Eddy Simulation (WMLES) in particle-laden turbulent flows**  
Aim of this project is to develop wall models specifically targeted for LES of wall-bounded particle-laden turbulent flows. In particular, we aim at incorporating small-scale information associated to the near-wall flow structures that are unresolved by WMLES but are crucial to correctly reproduce inertial particle transport. This kind of information, not present in standard WMLES, is necessary to predict with accuracy macroscopic observables such as wall-normal concentration at low and moderate friction Stokes numbers. The main questions to be addressed can be summarized as follows: (1) Understand how to enrich WMLES with small-scale information that mimics the unresolved flow structures; (2) Assess the accuracy of WMLES in particle-laden compressible flows; (3) Investigate the effect of the interaction between the inner and the outer part of the wall layer on particle transport in compressible flow.

**ID 2. Simulation of fully-resolved particles in turbulence**  
Turbulent dispersion of large finite-size particles in boundary layers is a phenomenon with many transversal applications in sciences and technology, yet still poorly understood. Numerical simulations of such systems are challenging since they involve transient fluid flow with many immersed (either spherical or non-spherical) solid objects subject to large displacements. Understanding the phenomena occurring on the particle length scale requires accurate numerical methodologies, typically based on Direct Numerical Simulation (DNS) of the flow. Aim of the project is to develop a DNS-based numerical tool for massively-parallel, fully-resolved, particle-level simulations.

**ID 3. Experimental characterization of polymer/fiber-induced drag reduction**  
Aim of this project is to investigate experimentally polymer and/or fiber drag reduction in an industrial-scale loop equipped with standard centrifugal pumps. The effect of different polymer/fiber drag reducing agents (DRA) and the efficiency of polymers/fibers as drag reducers will be analysed for a range of concentrations and Reynolds numbers). Drag reduction data will be used to estimate the effect of polymer injection in industrial-size pipes, considering the effect of polymer degradation due to the injection system and/or to turbulence inside the flow.



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All projects are sponsored by a University grant and will be carried out at the Multiphase Flow Laboratory (<http://158.110.32.35/>).

**Eligibility criteria:** Applicants must possess an outstanding master degree in any of the following disciplines: Aerospace, Mechanical Engineering, Chemical Engineering, Physics, Applied Mathematics or any related field.

The ideal candidate should possess previous experience in Computational and/or Experimental Fluid Mechanics. It will be advantageous to have good knowledge of any of following areas: Multiphase Flows, Numerical approaches to Turbulence (Direct and/or Large-Eddy Simulation), Experimental techniques.

The successful candidate will work in a research group with cutting-edge expertise in Multiphase Flow, which will support the proposed research by providing a conducive environment. The candidate is expected to present research at conferences and participate to school and workshops. Good analytical, mathematical, project management and communication skills, as well as good command of the English language are required.

**Stipend:** The successful candidate will be enrolled by the University of Udine with a 3-year fixed-term contract, full health and safety insurance coverage and a monthly net salary of 1,230 €, sufficient to cover fully living expenses in Udine. The scholarship is increased by 50% for research and study periods spent abroad, up to a maximum of 18 months. In addition to the direct coverage of the expenses for research/conferences/schools granted by the lab, (during the 2nd and 3rd year of the PhD) a lump sum of 1,500 € per year is made available under direct responsibility of the doctoral student to cover further research-related expenses.

**Selection:**

Candidates must apply for the PhD position through the University's online application form ([click to open](#)).

Make sure to select "PhD in Environmental and Energy Engineering Science" as the programme of study.

Applicants are also welcome to contact the reference person, Prof. Cristian Marchioli ([marchioli@uniud.it](mailto:marchioli@uniud.it)), in case they wish to receive more information about the project they are interested in. When sending your e-mail, please use the subject line: "Application for PhD Studentship in Multiphase Flow - Project N" (where N is the ID number of the preferred research project: N=1, 2 or 3).

Any interaction with the reference person prior to the selection process has no formal value, and does not grant access to the PhD programme at all. To access the PhD program, candidates must submit a formal application as described above. All interested candidates are in fact welcome to apply.

**Deadline for Written Application:** See: PhD website ([click to open](#)).

**Contact:** Enquiries for further details can be sent to Dr. Cristian Marchioli ([marchioli@uniud.it](mailto:marchioli@uniud.it)).