Demonstrations in Fluid Mechanics. (L8)

Non-Examinable (Part III Level)

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While the equations governing most fluid flows are well known, they are often very difficult or impossible to solve. Simplifying these equations while maintaining the relevant physics requires a combination of mathematical analysis and physical insight. Laboratory experiments are an excellent tool to develop physical insight by learning to observe, describe, and interpret fluid flows. They offer the flexibility to reproduce phenomena at varying levels of complexity, while still capturing essential dynamics that may be difficult to express analytically. As such, they provide both qualitative and quantitative data against which theoretical and numerical models may be tested.

The purpose of this demonstration course is to help develop an intuitive 'feeling' for fluid flows, how to conceptualise phenomena and then model them in the laboratory, and how fluid flows relate to simplified mathematical models. Limitations of experimental data will also be encountered and discussed. Although the course is entitled 'demonstrations', the course has a history of including some novel experiments that have not, to our knowledge, been performed anywhere previously. Some of these have subsequently led to PhD projects. The course thus offers an introduction into how experiments can provide insight into previously unexplored (or undiscovered) phenomena.

The demonstrations will include a range of flows currently being studied in a range of research projects in addition to classical experiments illustrating some of the flows studied in lectures. The demonstrations are likely to include

- instability of jets, shear layers and boundary layers;
- gravity waves, capillary waves, internal waves and inertial waves;
- thermal convection, double-diffusive convection, thermals and plumes;
- gravity currents, intrusions and hydraulic flows;
- vortices, vortex rings and turbulence;
- bubbles, droplets and multiphase flows;
- avalanches, granular flows, sedimentation and resuspension;
- flows in porous, absorbent and elastic media;
- ventilation and industrial flows;
- rotationally dominated flows;
- non-Newtonian and low-Reynolds-number flows;
- image processing techniques and methods of flow visualisation.

It should be noted that students attending this course are not required to undertake laboratory work on their own account, although participation is encouraged.

Pre-requisites

Undergraduate Fluid Dynamics.

Literature

1. M. Van Dyke. An Album of Fluid Motion. Parabolic Press.
2. G. M. Homsy, H. Aref, K. S. Breuer, S. Hochgreb, J. R. Koseff, B. R. Munson, K. G. Powell, C. R. Robertson, S. T. Thoroddsen. Multimedia Fluid Mechanics (Multilingual Version CD-ROM). CUP.
3. M. Samimy, K. Breuer, P. Steen, & L. G. Leal. A Gallery of Fluid Motion. CUP.