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Jaime Klapp
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Experimental and Computational Fluid Mechanics

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Editors

Experimental and Computational Fluid Mechanics

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Preface

The understanding of fluid flow has become a very important field of research because of its relevance in many human activities. The study of fluid flow is essential in many fields such as physics, biology, medicine, engineering, environmental sciences, energy, atmospheric flow processes that influence the weather and the climate, and so on. Many industrial processes are governed by the equations of fluid dynamics and so its study is valuable. Numerical simulations of fluid flow is reducing the high cost of very expensive experimental tests. Dynamical fluid dynamics are also very important for understanding fundamental physical processes at all scales.

This book presents recent experimental and theoretical advances in fluid dynamics in physics and engineering. It begins with invited lectures given during the International Enzo Levi Spring School 2012 held at the Universidad Autónoma Metropolitana-Azcapotzalco, May 17–18, 2012, and invited seminars presented in the 18th National Congress of the Fluid Dynamics Division of the Mexican Physical Society, held at the Centro de Investigación Científica y Educación Superior de Ensenada (CICESE), Ensenada, Baja California, Mexico, November 21–23, 2012.

The Spring School is organized every year in honor of Prof. Enzo Levi, a well-known Mexican scientist that dedicated his research to the study of fluids. He was one of the founders of the Instituto de Ingeniería (Engineering Institute) of the Universidad Nacional Autónoma de México (UNAM), and of the Instituto Mexicano de Tecnología del Agua (Mexican Institute for Water Technology) of the National Water Commission. He was the mentor of several generations of Mexican Engineers.

During the 2 days school, lectures were given by well-known national and international scientists. In 2012, many people attended the meeting with 50 researchers and more than a hundred graduate and undergraduate students. A wide variety of topics were presented by young national researchers that included asymptotic methods in fluids, convection, computational methods for biological systems, interfacial fluid dynamics, and problems related to colloidal dispersion and fractured porous media. Among the lectures we want to mention a very interesting description of the Alya Cardiac Computational Model given by Mariano Vazquez of the Barcelona Supercomputing Center in Spain, two lectures by Rouslan Kretchetnikov of the University of California in Santa Barbara entitled Walking with coffee: why it splits and A few puzzles in interfacial fluid dynamics,

two lectures by Cesar Treviño (UNAM) on asymptotic method in fluids and linear stability of mixed convection flows. Other interesting lectures were given on the Turbulence of marine currents by Angel Ruíz (UNAM), on the hydrodynamic interactions of heterogeneous colloidal dispersions by Catalina Haro (UAM-A), on the Boundary element method in Fluid Mechanics by Abel López Villa (IPN), and on An Experimental Analogy of Pedestrians under Panic Situations by Abraham Medina (IPN). Several of these lectures were included in Part I of the Book.

The Annual Fluid Dynamics Congress has a different format. In 2012, it lasted 3 days and was composed of five plenary lectures and many short oral presentations of students and researchers.

In part I, we also included the plenary lectures given during the congress by international well-known invited speakers and some of the most interesting short oral contributions. Among the plenary lectures, we can mention those given on the basic concepts of ignition and fuel through diffusion flames by Amable Liñan of the Universidad Politécnica de Madrid, on the Transition to turbulence in stratified wakes by Patrice Meunier of the Aix-Marseille University, France, on flow driven by harmonic forcing in planetary atmospheres and cores by Michael Le Bars, also of the Aix-Marseille University, France, on the role of symmetry in biomimetic wakes for propulsion by Verónica Raspa of the University of Paris Diderot, France, on toroidal vortex with chaotic stream lines by Oscar Velasco of CICESE, Baja California, México, on the symmetry instability in a mixed convection problem by Cesar Treviño of UNAM, and on The boundary element method for bubble formation by Abel López of the IPN, México.

The other short presentations are organized in topics: Multiphase Flow and Granular Media (Part II), Convection and Diffusion (Part III), Vortex, Oceanography and Meteorology (Part IV), and General Fluid Dynamics and Applications (Part V).

In Part II, Multiphase Flow and Granular Media, we have focused on petroleum-related applications, you can find interesting contributions on the nitrogen dispersion in the neighborhood of a well, on a phenomenological description of heavy oil, on an experimental study of the growth of bubbles in corrugated tubes, which has applications for foam injection in fractured porous media, on surface tension and interfacial tension measurements in water-surfactant-oil systems, and other related problems. Other contributions in this section are in granular media and mass flow in a silo.

Convection and Diffusion can be found in Part III, with interesting contributions on conjugate convection in an open cavity, and on transport of particles in a periodically forced flow. We also found two applications to porous media flow: experimental studies of a vaporization front, and the mass and mass transfer during steam injection. There is also an interesting numerical study with SPH of the Kelvin–Helmholtz instability.

In Part IV, Vortex, Oceanography, and Meteorology, one can find three contributions on atmospheric fluid dynamics, the first on forced dynamics by normal wind to the boundary, the second on numerical experiments of wind circulation off the Baja California coast, and the third one is a review on environmental fluid

dynamics. Two further contributions are on the effect of the inlet flow angle on the vortex induced vibration of a collinear array of flexible cylinders and the wake patterns behind a tapping foil.

Finally, in Part V, General Fluid Dynamics and Applications, we find several contributions of fluid dynamics to various fields such as magnetohydrodynamics, evaporation of a liquid layer, a study of the drag coefficient in the Navier–Stokes fractional equation, interactions of fluids, numerical simulation of biological systems with the DPD method, and soil transport of contaminants.

The book is aimed to fourth-year undergraduate and graduate students, and to scientists in the field of physics, engineering, and chemistry that have interest in fluid dynamics from the experimental and theoretical point of view. The material includes recent advances in experimental and theoretical fluid dynamics and is adequate for both teaching and research. The invited lectures are introductory and avoid the use of complicated mathematics. The other selected contributions are also adequate to fourth year undergraduate and graduate students.

The editors are very grateful to the institutions who made possible the realization of the International Enzo Levi Spring School 2012 and the 18th National Congress of the Fluid Dynamics Division of the Mexican Physical Society, especially the Consejo Nacional de Ciencia y Tecnología (CONACYT), the Sociedad Mexicana de Física, the Universidad Autónoma Metropolitana-Azcapotzalco, the Centro de Investigación Científica y Educación Superior de Ensenada (CICESE), the Universidad Autónoma de México (UNAM), the Instituto Politécnico Nacional (IPN), Cinvestav-Abacus, and the Instituto Nacional de Investigaciones Nucleares (ININ).

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Jaime Klapp
Abraham Medina

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