

Environmental Engineering

Leonardo Di G. Sigalotti
Jaime Klapp
Eloy Sira *Editors*

Computational and Experimental Fluid Mechanics with Applications to Physics, Engineering and the Environment

 Springer

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Preface

Fluid flows occur everywhere in nature and occupy a relevant place in our technological world as well as in the running of a vast number of industrial processes. They are not only essential to life, but also to understand fundamental physical processes at all measurable scales, from the nanometric world to the cosmological scales. The principles of fluid mechanics are used in almost every form of mechanical and chemical engineering, with far-reaching effects on the technological advances that lead to the multitude of products which determine the high standard of living that nowadays we take for granted. Fluid flows are also known to be at the heart of health, biological, and environmental sciences, including the flows in the human body and its energy supply, the multitude of flows in the entire fauna and flora, and the atmospheric flow processes, which influence the weather and the climate. Thus, fluid flows are vital and their understanding is an essential part of the general education of humans.

This book presents a collection of papers dealing with recent advances in computational and experimental fluid mechanics with applications to physics and engineering. Among these papers, a few ones are reviews outlining the impact of fluid mechanics on important active research areas such as weather prediction and climate change, cancer research, and cosmology. The present collection includes research work presented at the I Workshop of the Venezuelan Society of Fluid Mechanics, held in the *Margarita Island*, Venezuela, on November 5–9, 2012 under the auspices of the Instituto Venezolano de Investigaciones Científicas, IVIC, and the Fondo Nacional de Ciencia, Innovación y Tecnología, FONACIT, of Venezuela. The book begins with invited lectures held during the Workshop by renowned national and international scientists and engineers, covering a wide range of topics, followed by a number of invited seminars presented by young researchers and graduate students working actively in the field of fluid mechanics and related areas.

The I Workshop of the Venezuelan Society of Fluid Mechanics represented a unique opportunity to provide a forum for the presentation of state-of-the-art research in theoretical, experimental, and applied fluid mechanics oriented to engineering technology, where scientists, coming from different universities and research institutions of the country, together with mechanical, chemical, and petroleum engineers from public and private enterprises, with a huge experience in

applied industrial problems, have participated in fruitful discussions on fundamental and technical aspects, paving the way for future collaborations.

The Workshop will be organized every 2 years. The 5 days of oral sessions accommodated 45 talks and had close to 60 attendees with 10 international and 20 national researchers, and more than 30 graduate and undergraduate students. The wide variety of topics presented included free-surface and interface flows, such as drops and bubbles, turbulent flows, multiphase flows with applications to biological and oil extraction systems, shock structure and acoustic waves, opto-fluids, granular fluids, astrophysical and cosmological flows, and computational fluid dynamics. Among the renowned researchers, Joseph J. Niemela, from The Abdus Salam International Centre for Theoretical Physics, ICTP, Trieste, Italy, showed the results of controlled laboratory experiments of turbulent diffusion of heat at high Rayleigh numbers; Dominique Legendre, from the Institut de Mécanique des Fluides de Toulouse, IMFT, Toulouse, France, presented numerical simulations of sliding drops on an inclined solid surface; Catalina Stern-Forgach, from the Department of Physics of the Universidad Nacional Autónoma de México, UNAM, Mexico, described the results of experimental measurements of shock structure and acoustic waves inside a supersonic jet; and José R. Castrejón-Pita, coming from the Department of Engineering of the University of Cambridge, Cambridge, United Kingdom, spoke of the relevance of the breakup of liquid surfaces to industry and discussed current issues faced by researchers working in the field of droplet dynamics. Interesting lectures on bubble growth in viscous liquids were given by Abraham Medina and Abel López-Villa, both from the Instituto Politécnico Nacional (I.P.N.) of Mexico, while Julián Chela-Flores, from The Abdus Salam International Centre for Theoretical Physics, ICTP, Trieste, Italy, gave a magisterial conference on how fluid mechanics is playing a major role in space exploration for understanding the cosmic distribution of life. The theoretical physics of granular fluids and an introductory view of the jamming transition problem were given by Leonardo Trujillo, from the IVIC's Centre of Physics. Other interesting talks were presented by Humberto Cabrera, from the IVIC's Department of Applied Physics, on the Soret effect in binary fluid mixtures; by Luis R. Rojas-Solórzano, from the Department of Energy Conversion and Transport of the Universidad Simón Bolívar, USB, Caracas, Venezuela, who described a multiphase approach to model blood flow in micro-tubes; and Miguel R. Paiva-Rojas, from the Refining and Industrialization Department of the Instituto Tecnológico Venezolano del Petróleo, PDVSA-Intevep, Los Teques, Venezuela, who spoke on the estimation of the gas-liquid-solid phase distribution in a cold slurry bubble column system for hydro-conversion processes. Other local speakers gave short oral presentations on computational and experimental drop dynamics, compositional flows applied to the oil industry, granular and porous media flows, and astrophysical flows.

The short oral presentations were organized by themes: Drops, Particles, and Waves; Multiphase and Multicomponent Flow, Granular and Porous Media Flow; and Astrophysical and Relativistic Flow. The book is aimed to undergraduate and graduate students, as well as to physicists, chemists, and engineers dealing with

fluid mechanics from both the experimental and theoretical point of view. The material is also adequate for both teaching and research. The invited lectures and the other selected contributions are introductory and use a minimum of mathematics.

The editors are deeply indebted to the several institutions that made possible the realization of the I Workshop of the Venezuelan Society of Fluid Mechanics. In particular, we thank the Instituto Venezolano de Investigaciones Científicas, IVIC, and the Fondo Nacional de Ciencia, Innovación y Tecnología, FONACIT, of Venezuela for providing financial support. We are also grateful to the Instituto Tecnológico Venezolano del Petróleo (PDVSA-Intevep), the Centro de Investigaciones de Astronomía Francisco José Duarte, CIDA, the FUNDACITE-Miranda, and the Mexican institutions: Consejo Nacional de Ciencia y Tecnología, CONACYT, Consejo Mexiquense de Ciencia y Tecnología, COMECYT, Instituto Nacional de Investigaciones Nucleares, ININ, and Cinvestav-Abacus of the Instituto Politécnico Nacional, I.P.N.

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