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Nonlinear Interfacial Wave Phenomena from the Micro- to the Macro-Scale

Editorial

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This Procedia IUTAM volume contains the research papers from the IUTAM Symposium on "Nonlinear Interfacial Wave Phenomena from the Micro- to the Macro-Scale," held in Limassol, Cyprus from 14 to 17 of April 2013.

This symposium brought together researchers working on viscous and inviscid interfacial phenomena with an aim to exchange ideas and knowledge of their respective fields. There are several instances where the mathematical approaches share common tools, including the use of asymptotic analysis to develop reduced models, the use of dynamical systems theory to analyze emerging equations, the use of analytic function theory to solve inviscid or highly viscous flows, and the use of boundary integral or boundary element methods to simulate the flows directly. The symposium was expected succeeded to advance the field by nurturing and supporting interdisciplinary research in nonlinear interfacial waves.

The emergence of new technologies and miniaturization has produced many applications, which can benefit significantly from a fundamental understanding of interfacial waves in complex physical systems. Examples include micro-manufacturing, coating technologies and heat or mass transfer enhancement. Such flows are characterized by small Reynolds numbers and are driven by interfacial forces such as capillarity, Marangoni forces and electrostatic stresses, for instance. Even though viscosity is dominant, nonlinear dynamics can emerge which support coherent structures such as solitary waves, with very intricate mathematical properties and behavior. In addition to waves of permanent form and their interactions, the evolution can terminate in finite time singularities that are a precursor of topological transitions or substrate touchdown. Such structures are of fundamental mathematical and physical interest because they are special solutions of the Navier-Stokes equations in multi-fluid flows.

On the macro-scale interfacial wave phenomena are primarily inviscid and are driven by inertial effects induced by gravitational forces. Applications include oceanography and metereology. Even though linear phenomena are well understood, their nonlinear counterparts have only recently proven amenable to both rigorous analysis and

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computation. Many challenging problems exist including the existence and stability of three-dimensional traveling waves in the presence or absence of vorticity.

The Symposium's Scientific Committee, appointed by the Bureau of IUTAM, consisted of Onno Bokhove from the Netherlands and the UK, Thomas Bridges from the UK, Paul Christodoulides from Cyprus, James Duncan from the USA, Mark Groves from Germany, Omar Matar from the UK, Touvia Miloh from Israel, and Frederic Dias from Ireland and France as the IUTAM Bureau Representative. The Organizing Committee consisted of Demetrios Papageorgiou from the UK (Hair), Paul Christodoulides from Cyprus, Yiorgos-Sokratis Smyrlis from Cyprus and Jean-Marc Vanden-Broeck from the UK.

There were 32 oral presentations with the number of registered participants reaching 45 from 10 countries – Brazil, Cyprus, France, Ireland, Israel, the Netherlands, Republic of Korea, Russian Federation, United Kingdom and United States of America –, 14 of which were graduate students or postdoctoral researchers. In Fig. 1 a photograph of a group of the participants is shown.

Fig. 1. A photograph of a group of participants of the IUTAM Symposium on "Nonlinear Interfacial Wave Phenomena from the Micro- to the Macro-Scale," taken at the Mediterranean hotel, Limassol, Cyprus on 17 April, 2013, right after the end of the scientific part of the Symposium..

We believe that the symposium largely fulfilled its objectives, a fact indicated by the quality of the papers of the current volume, which we hope the reader will enjoy.