

Preface

The rapid development of computers has enabled us to design several industrial products relying on detailed numerical simulation which is based on the Navier–Stokes equation. This proves the reliability of the equation and one has become to be able to manufacture those products without knowing the mathematical details of the equation. The mathematical studies are, however, still crucial to invent completely novel way to investigate unsolved problems, because the numerical simulation does not suggest any new concepts. Moreover, even the governing equations have not been known for complicated phenomena which include several different scales. Multiphase flow is a typical and important example of such complicated multi-scale phenomena. Mathematics can play an important role to construct formulation and theory for the multiphase flows and other complex phenomena.

The research project titled *A challenge to unsolved problems in fluid engineering with modern mathematical analysis* was pursued from 2009 to 2014 (five and half years) as part of the CREST (Core Research for Evolutional Science and Technology)–SBM (Search for Breakthrough by Mathematics). The aim of the research was to tackle the above-mentioned problems enhancing the cooperation between mathematics and engineering. On the occasion of the final year of the project, the international conference was held during 11–14 November 2014 at Waseda University in Tokyo in order to announce the results obtained through the project as well as stimulate other related researches. This book is an outcome of the conference which consists of original papers offered by invited speakers. The contents range from the experimental study on cavitation jets to up-to-date mathematical analysis of the Navier–Stokes equations reflecting the feature of the conference.

This book is divided into two parts: Multiphase Flows and Other Related Topics. Both the parts contain articles on a wide range of studies from mathematics to engineering. We hope that this contribution is attractive and useful for a wide range of researchers and engineers as well.

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