COMPUTATIONAL METHODS IN MULTIPHASE FLOW II

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Preface

The flow of blood in arteries, the flow of refrigerant in an air conditioner, the injection of fuel in an internal combustion engine and the sequestration of supercritical carbon dioxide in saline aquifers, are a small set of examples that illustrate the pervasiveness of multiphase flows in natural and man-made processes. The ability to predict multiphase flows is of great benefit in process design, or in the diagnosis and correction of problems in an established process.

Although enormous strides have been made in the understanding, modeling and numerical simulation of multiphase flows, it is clear that much remains to be done. The principal difficulty that one has in modeling multiphase flow is that in general several length scales, with coupling in one or both directions, play a part in the overall behavior of the flow. Because of the wide range of length scales, it is very difficult to treat such systems solely by employing massive computer resources. On the other hand, continuum constitutive models are more efficient, but they seldom describe all the physics that are taking place in a rigorous way. The link between the different scales remains elusive.

As an example, consider the processing of a familiar emulsion, mayonnaise. In decreasing order of magnitude, the relevant length scales are the size of the container, the size of the droplets in the emulsion, the separation between droplets, the molecular size of the constituents. In addition, drops may break or coalesce as a function of the surface tension and the stress state. The difficulty of modeling such a system in its entirety is enormous. Other systems may be further complicated by chemical reactions, diffusion and turbulence.

It is not likely that an all-encompassing theory will be found which can account for the multitude of complex interacting phenomena found even in the simplest systems, or that computers powerful enough to perform a full ab initio simulation will solve the problem. What is more probable is that one or more particular techniques are matched to a system or a phenomenon of interest, which is able to capture the essential physics under a range of conditions. This book which comprises most of the papers presented at the 2nd International Conference on Multiphase Flow held in Sante Fe, New Mexico, aims to facilitate this process, that is, to expose researchers and practitioners in the field to new techniques, new problems, new paradigms, resulting in the generation of new ideas.

The breadth of topics covered in this book is evident from the table of contents. The editors are grateful to the scientific advisory committee for their invaluable help especially in attracting many excellent contributions. We hope and trust that their efforts will result in new ideas, collaborations and to the advancement of this important branch of scientific knowledge in general.

The Editors
Sante Fe, 2003

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