

Preface

Mathematical modeling and numerical solution is today firmly established in science and engineering. Research conducted in almost all branches of scientific investigations and the design of systems in practically all disciplines of engineering can not be pursued effectively without, frequently, intensive analysis based on numerical computations.

The world we live in has been classified by the human mind, for descriptive and analysis purposes, to consist of fluids and solids, continua and molecules; and the analyses of fluids and solids at the continuum and molecular scales have traditionally been pursued separately. Fundamentally, however, there are only molecules and particles for any material that interact on the microscopic and macroscopic scales. Therefore, to unify the analysis of physical systems and to reach a deeper understanding of the behavior of nature in scientific investigations, and of the behavior of designs in engineering endeavors, a new level of analysis is necessary.

This *new level of mathematical modeling and numerical solution* does not merely involve the analysis of a single medium but must encompass the solution of multi-physics problems involving fluids, solids, and their interactions, involving multi-scale phenomena from the molecular to the macroscopic scales, and must include uncertainties in the given data and the solution results. Nature does not distinguish between fluids and solids and does not ever exactly repeat itself.

This new level of analysis must also include, in engineering, the effective optimization of systems, and the modeling and analysis of complete life spans of engineering products, from design to fabrication, to possibly multiple repairs, to end of service.

The objective of the *M.I.T. Conferences¹ on Computational Fluid and Solid Mechanics* is to bring together researchers and practitioners of mathematical modeling and numerical solution in order to focus on the current state of analysis of fluids, solids, and multi-physics phenomena and

to lead towards the new level of mathematical modeling and numerical solution that we envisage.

However, there is also a most valuable related objective – indeed a “mission” – for the M.I.T. Conferences.

When contemplating the future and carving a vision thereof, two needs stand clearly out. The first is the need to foster young researchers in computational mechanics, because they will revitalize the field with new ideas and increased energy. The second need is to bring Industry and Academia together for a greater synthesis of efforts in research and developments.

This mission expressed in “*To bring together Industry and Academia and To nurture the next generation in computational mechanics*” is of great importance in order to reach, already in the near future, the new level of mathematical modeling and numerical solution, and in order to provide an exciting research environment for the next generation in computational mechanics.

We are very grateful for the support of the sponsors of the Conference, for providing the financial and intellectual support to attract speakers and bring together Industry and Academia. In the spirit of helping young researchers, fellowships have been awarded to about one hundred young researchers for travel, lodging and Conference expenses, and in addition, Conference fees have been waived for all students.

The papers presented at the Conference and published in this book represent, in various areas, the state-of-the-art in the field. The papers have been largely attracted by the session organizers. We are very grateful for their efforts.

Finally, we would like to thank Jean-François Hiller, a student at M.I.T., for his help with the Conference, and also Elsevier Science, in particular James Milne, for the efforts and help provided to publish this book in excellent format and in due time for the Conference.

K.J. BATHE, M.I.T.

¹ A series of Conferences is planned.