Preface

The 17th edition of the Jacques-Louis Lions Spanish-French School, which addressed Numerical Simulation in Physics and Engineering, took place in Gijón, Spain, in June 2016. The School is a biennial event jointly organized by the Spanish Society of Applied Mathematics, SeMA, and the French Society of Applied and Industrial Mathematics, SMAI. This year, we also celebrated the 25th anniversary of SeMA. More than 80 mathematicians of different nationalities came together in Gijón for 5 days in order to attend the courses and participate in the other events organized for the occasion.

Four-hour courses were delivered by experts in the fields of Optimal Control, High Performance Computing, Numerical Linear Algebra, and Computational Physics. During the school, the attendants—graduate students and also some experienced researchers interested in the organized courses—had the opportunity to present their own work with a poster. Almost twenty participated in the poster session.

The lecture notes for the courses are presented in the first part of this book in the form of long review papers. These papers are authored by very experienced researchers and each one is intended to offer a self-contained presentation of the state of the art in the topic under consideration. We hope that they can be used both as a reference for the interested researcher and as a textbook for graduate students.

In the second part of this publication we present a selection of the extended abstracts submitted to the poster session. Together with these works, we have also included an extended abstract of the conference lecture by J. Calvo, winner of the 19th SeMA Antonio Valle Award, presented to the most outstanding young researcher in 2016.

The short papers in this part, all of which relate to different aspects of computational methods and numerical analysis, do not cover only topics concerning Simulation in Physics and Engineering. They also deal with topics ranging from numerical linear algebra or computational methods in group theory to applications of Mathematics to subjects such as biomedical sciences, chemistry, and quantum physics.

We think that both the courses and the short papers evidence that numerical simulation is no longer a field only applicable to physics or engineering and that, as more applications appear, the need for faster and more reliable methods in numerical linear algebra and computational techniques will become more pressing.

The first six papers in the second part correspond to the works presented at the school by J. Calvo, M. Garzon, S. Busto, J.R. Rodríguez-Galván, N. Esteban, and H. Al Rachid. We can say that these works fall into the classical definition of "applied mathematics", where some numerical method is developed and investigated to solve some aspect of a physical model.

The work by J.A. Huidobro et al. investigates different models in Chemistry and compares them with actual experimental data to develop a new simpler model to solve the problem.

The eighth extended abstract, introduced at the school by M.L. Serrano, investigates several aspects of numerical linear algebra, in close connection with the lecture notes of the course delivered by J.M. Peña and also related to the lecture notes of the course delivered by L. Grigori. Solving large scale systems of linear equations has become a necessity for the mathematical community. For instance, in the numerical experiments shown at the end of the course by E. Casas and M. Mateos, the nonlinear system (73)–(76) has more than one million unknowns and to solve it not just one but a sequence of linear systems with a huge number of variables must be solved.

The interesting paper by J. Martínez Carracedo and C. Martínez López shows how computer-based techniques can be applied to prove abstract algebra results.

The last two works, which correspond to posters presented by J.C. Beltrán and M. Loureiro-Ga, deal with applications of Mathematics to medical sciences. Here, we find again the usual language of applied mathematics: least squares, PDEs, discrete approximations. But the focus is on the applications of numerical simulation as another tool to help medical doctors in research and clinical work.

Finally, we want to thank all the contributors (more than forty) who have co-authored the articles contained in this volume, as well as the anonymous referees who have revised the work.

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