

# Preface

Modern Computational Science and Engineering (CSE) is confronted with several challenges of “multi-type”: Multi-physics problems involve more than one physical effect; multi-scale models involve different scales with respect to space or time; multi-level methods are needed to efficiently tackle large linear systems; multi-core architectures require a new access to parallelism; and much of the research in CSE requires the collaboration of experts from several disciplines – it is multi-disciplinary. Concerning the first issue, multi-physics problems such as fluid-structure interactions (FSI), i. e. the interplay of some moveable or deformable structure with an internal or surrounding flow field, are one of the most relevant and most intensely studied coupled problems. Despite this high attention, FSI are still not completely understood, and there is an obvious lack of reliable, robust, and efficient computational methods.

Furthermore, there is a somewhat astonishing discrepancy between, on the one hand, how complex specific scenarios have already been successfully simulated (think of airbags or parachutes, e. g.) and, on the other hand, how big the problems are that occur when those codes shall be used for different problems. Hence, there hasn’t been any widely accepted numerical benchmark for FSI before this volume’s predecessor LNCSE **53** in 2006. Also experimental validation has turned out to be far from trivial: either the experimental setting is too complicated for the numerical tools, or the numerical setting is not feasible for experiments; if, finally, both experiments and numerical simulations can deal with a certain scenario, the effects intended to study often do not show up. All this shows that there are still challenging questions in FSI research, ranging from modelling via numerical treatment up to implementation and software tools – and only their ensemble provides a key to deeper insight in FSI.

The present volume contains selected contributions from the “First International Workshop on Computational Engineering – special topic Fluid-Structure Interactions” held in Herrsching, Germany, in October 2009. This three-day workshop was jointly organized by three initiatives funded by the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG) – the “International Graduate School of Computational Engineering” in Darmstadt, the “International Graduate School of Science and Engineering” in Munich, and the Research Unit 493 “Fluid-Structure Interaction: Modelling, Simulation, Optimization” (FOR 493). FOR 493

was established by the DFG in 2003. In this framework, researchers from seven German universities working in the fields of mathematics, informatics, mechanical engineering, chemical engineering, or civil engineering joined their forces to push forward the state-of-the-art of fundamental computational research in FSI. Designed as a forum for latest results in computational engineering in general and FSI in particular, the workshop in Herrsching brought together leading experts from all over the world, allowing for three highly interesting days of tutorials, invited lectures, and minisymposia, and, now, resulting in the fifteen papers collected in this volume – which is the second book on FSI published by our Research Unit FOR 493.

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