

Preface

The success of quantitative modeling in the rapidly expanding areas of the natural sciences, such as materials science and biology, produces a variety of new mathematical models. The predictive power of these models has to be tested, and methods for their effective treatment have to be developed. This major opportunity for mathematics led to the foundation of the Collaborative Research Center SFB 611 entitled ‘Singular Phenomena and Scaling in Mathematical Models’ at the University of Bonn in 2002. One of its major goals was the efficient handling of new types of models through the close combination of theoretical and numerical methods.

Funded by the Deutsche Forschungsgesellschaft, we progressively integrated theoretical analysis, numerical simulation and modeling approaches for the treatment of singular phenomena in three consecutive phases until the end of 2012. Our particular projects were focused on actual applied problems, and we developed qualitatively new and mathematically challenging methods for various problems from the natural sciences.

Our Collaborative Research Center was organized in the following three divisions ranging from stochastic and geometric analysis over nonlinear analysis and modeling to numerical analysis and scientific computation:

- Part I: Scaling Limits of Diffusion Processes and Singular Spaces
- Part II: Multiple Scales in Mathematical Models of Materials Science and Biology
- Part III: Numerics for Multiscale Models and Singular Phenomena

All the three divisions addressed, in their specific way, the key aspects of the SFB 611, namely, multiple scales and model hierarchies, singularities and degeneracies and scaling laws and self-similarity. These subjects proved to be timely, challenging and at the forefront of international research. While taking on these topics, the SFB 611 acted as a bridge between analysis, modeling and numerical simulation.

A total number of 19 principal investigators and more than 45 other scientists participated in the research of the last funding period of the SFB from 2009 to 2012. This volume now comprises our final and latest contributions to the exciting field of ‘Singular Phenomena and Scaling in Mathematical Models’.

At this place, we want to thank the Deutsche Forschungsgesellschaft and the University of Bonn for their ongoing support.

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