Preface to special issue (Fast reaction - slow diffusion scenarios: PDE approximations and free boundaries)

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PREFACE

This issue is focussed on the modeling, analysis and simulation of fast reaction-slow transport scenarios as well as corresponding fast-reaction limits. Within this framework, internal sharp and thin reaction layers form and travel through the spatial domain often producing unexpected effects. Such situations appear in a variety of significant applications; for example flame propagation in combustion, segregation and aggregation of biological individuals, chemical attack on reactive porous materials (such as concrete or natural stone), dissolution and precipitation reactions in minerals, tumor growth, grain boundary motion, and temperature-induced phase transitions in shape-memory alloys represent typical cases in which the fast process is localized within a *a priori* unknown internal active layer.

The challenge is to describe and predict such phenomena by methods of mathematical analysis. The typical difficulty, where experiments and numerical methods usually fail, is the occurrence of very different time scales and several distinct length scales. Advantages, shortcomings as well as possible interlinks of two current research directions, where analysis guides understanding of the physical phenomena and their simulation, need to be identified: (a) the moving- boundary methodology and (b) singular limits in reaction-diffusion systems.

This issue addresses subjects intimately connected to the singular-limit analysis such as reaction-induced blow up, large-time behavior of solutions, convergence towards solutions of free-boundary problems emphasizing the interplay between modeling, analysis and simulation. The focus lies on the analysis of the corresponding partial differential equations.

Guest Editors:
Toyohiko Aiki
Danielle Hilhorst
Masayasu Mimura
Adrian Muntean