

MATHEMATISCHES FORSCHUNGSINSTITUT OBERWOLFACH

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Reactive Flows in Deformable, Complex Media

Organised by

Margot Gerritsen, Stanford
Iuliu Sorin Pop, Diepenbeek
Florin Adrian Radu, Bergen
Barbara Wohlmuth, Garching

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ABSTRACT. Many processes of highest actuality in the real life are described through systems of equations posed in complex domains. Of particular interest is the situation when the domain is changing in time, undergoing deformations that depend on the unknown quantities of the model. Such kind of problems are encountered as mathematical models in the subsurface, material science, or biological systems. The emerging mathematical models account for various processes at different scales, and the key issue is to integrate the domain deformation in the multi-scale context. The focus in this workshop was on novel techniques and ideas in the mathematical modelling, analysis, the numerical discretization and the upscaling of problems as described above.

Mathematics Subject Classification (2010): 35 (Partial differential equations), 65 (Numerical analysis), 74 (Mechanics of deformable solids), 76 (Fluid mechanics).

Introduction by the Organisers

Problems involving flow, reactive transport and mechanical or bio-chemical deformations in complex media are encountered in fields of utmost societal relevance. Such aspects have been addressed during this meeting from a mathematical prospect: the mathematical modelling and analysis, the numerical discretization and simulation. The goal was to find major mathematical challenges connected with such issues and the underlying applications. This was facilitated by the active involvement of the participants, who were scientists with various expertise, sharing the interest and will to collaborate and exchange ideas.

The workshop was attended by 52 scientists from 9 countries, including 5 young scientists supported by the "Oberwolfach Leibniz Graduate Students" Programme

and two by US National Science Foundation. One of the participants, Prof. Ivan Yotov, was awarded the Simons Visiting Professorship. This supported his visits to the universities in Bergen (Norway) and Hasselt (Belgium). There were 30 presentations addressing the workshop theme from various prospects:

- Mathematical methods, including homogenization, multi-scale analysis, and model order reduction;
- Discretisation schemes, including (mixed and conformal) finite elements, finite volumes, enriched Galerkin or gradient discretisation methods, including multi-scale methods and mixed dimensional discretisations;
- Complex mathematical models, including coupled porous medium and free flow, or flow and mechanical deformation, diffuse interface and free boundary models, problems in fractured media, or sub-continuum scale models.

The organizers would like to acknowledge the involvement of Jan Nordbotten (Bergen), who was co-organiser of the first edition of this workshop and was also involved in the organisation of this workshop. The meeting took place in a friendly and inspiring atmosphere. The presentations of highest level were accompanied by fruitful discussions, which generated promising initiatives. As sustained unanimously by all participants, this would not have been possible without the support from the MFO. The hospitality and the wonderful conditions offered in Oberwolfach, thanks to the dedicated work of the MFO staff was gratefully acknowledged by all participants.

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