

2nd Special Issue on Multi-Scale Science

Foreword

Several problems arising in the description and accurate numerical simulation of heterogeneous systems involve multiple length or time scales. When modeling this class of systems, the mathematical description of the thermodynamic processes taking place at distinct scales typically change as the scales change. Whence, an accurate description of such systems has to account for the influence of the complex phenomena at finer scales on the coarser ones. Heterogeneous systems appear in almost all areas of physics and applied mathematics. Important examples naturally arise in the computational modeling of coupled phenomena (electro, chemo, hydro, thermo and mechanical) in porous media. In this class of systems macroscopic models applicable to simulations at the field scale (a few kilometers) have to incorporate the chaotic behavior of the phenomenon at the pore scale (a few millimeters). Other examples particularly described by the articles in this special issue involve complex interactions in Solid Mechanics of heterogeneous media such as phase transformations, crack propagation, strain induced by magnetization in ferromagnetic materials, and interaction between elastic and viscous effects in heterogeneous viscoplastic polycrystals. In addition to the examples discussed in this issue, a broad range of applications related to the derivation of the effective medium approach from the up-scaling of the constitutive behavior of the system on finer scales has been discussed in the current literature illustrating the increasing relevance of this topic in modern Applied Mathematics. As guest editors of a previous special issue of Computational and Applied Mathematics (vol 21(2) 2002) containing selected articles presented at the ILNCC/IPRJ Meeting on Multi-Scale Computational Modeling of Heterogeneous Systems (27/07/00 - 29/07/00 IPRJ/UERJ, Nova Friburgo RJ) our aim was

to provide the first steps towards the development of a Brazilian scientific community working on this class of multidisciplinary research. This accomplishment motivated us to extend the still modest community into a much larger group, by scheduling the second symposium of the series including also well established international contributors. The 2nd *Symposium on Computational Modeling of Multiscale Phenomena* which took place at National Laboratory for Scientific Computing (LNCC/MCT, Petropolis 05/08/2002 - 09/08/2002) was the second meeting of the series on multi-scale science, and has also accomplished its mission of bringing together researchers working on different aspects of multi-scale science and applications. Likewise the first meeting the aim of the symposium was to develop an interdisciplinary forum aiming at identifying the common tools available in the use of different upscaling and downscaling techniques, such as Homogenization, Stochastic Methods, Averaging techniques, Renormalization Groups, general Perturbation Schemes and Lattice Boltzmann in the general treatment of the intriguing and challenging problems which commonly appear in the computational modeling of heterogeneous systems. Owing to the broad range of applications of multi-scale science the organizers concentrated the scope of the Symposium on themes related to Porous Media, Biomechanics, Material Science and Solid Mechanics with microstructure. Several internationally respected scientists delivered talks on the aforementioned topics and have accepted the invitation for contributing to this special issue. The organizers wish to thank Prof. Marco Antonio Raupp, Director of LNCC, for his collaboration to this project, and J. M. Martinez, Chief Editor of Computational and Applied Mathematics for also providing the necessary support of the journal for publishing this special issue. The financial supports from the Brazilian agencies CNPq, FAPERJ and CAPES and also from IM-AGIMB are gratefully acknowledged.

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