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Abstracts of Papers to Appear

AN ITERATIVE GRID REDISTRIBUTION METHOD FOR SINGULAR PROBLEMS IN MULTIPLE DIMENSIONS. Weiqing Ren and Xiao-Ping Wang. *Department of Mathematics, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong.*

We introduce an iterative grid redistribution method based on the variational approach. The iterative procedure enables us to gain more precise control of the grid distribution near the regions of large solution variations. The method is particularly effective for solving PDEs with singular solutions (e.g., blow-up solutions). Our method requires little prior information of the singular solutions and can handle multiple singularities. The method is successfully applied to the nonlinear Schrödinger equation and the Keller-Segal equations where solutions with multiple blow-up points can be solved very close to the blow-up time.

A CRANK-NICOLSON-TYPE SPACE–TIME FINITE ELEMENT METHOD FOR COMPUTING ON MOVING MESHES. Peter Hansbo. *Department of Solid Mechanics, Chalmers University of Technology, Göteborg, Sweden.* E-mail: hansbo@solid.chalmers.se.

In this paper, a space–time finite element method for evolution problems that is second-order accurate in both space and time is proposed. For convection-dominated problems, the elements may be aligned along the characteristics in space–time, which results in a Crank-Nicolson method along the characteristics. The method is also suitable as an alternative to other moving mesh methods for problems in deforming domains. Numerical examples dealing with diffusion and convection are given.

EFFICIENT ALGORITHM FOR FINDING GROUND-STATES IN THE RANDOM FIELD ISING MODEL WITH AN EXTERNAL FIELD. Carlos Frontera,* Jürgen Goicoechea,† Jordi Ortín,† and Eduard Vives.† **Institut de Ciència de Materials de Barcelona, Consell Superior d'Investigacions Científiques, Campus UAB, 08193 Bellaterra, Catalonia, Spain; and †Department d'Estructura i Constituents de la Matèria, Universitat de Barcelona Diagonal 647, Facultat de Física, E-08028 Barcelona, Catalonia, Spain.*

We present an efficient algorithm that, combined with a max-flow min-cut minimization algorithm, makes it possible to find the ground states of the Gaussian Random Field Ising model (RFIM) when are external applied field B is continuously varied from $-\infty$ to $+\infty$. The algorithm exactly finds all the possible ground-states and their limiting range ($B_{\min}$, $B_{\max}$). Examples of the dependence of the magnetization and energy with B are shown for the 2d-RFIM.

A LOCAL MESH REFINEMENT MULTIGRID METHOD FOR 3-D CONVECTION PROBLEMS WITH STRONGLY VARIABLE VISCOSITY. Michael Albers. *Institut Für Geophysik, Herzberger Landstrasse 180, 37075 Göttingen, Germany.* E-mail: mab@geo.physik.uni-goettingen.de.

A numerical method for solving 3-D convection problems with variable viscosity in Cartesian geometry is presented. Equations for conservation of mass, momentum, and energy are solved using a second-order finite-volume discretization in combination with a multigrid method. Viscosity variations of 10 orders of magnitude are considered. Convergence deteriorates with increasing viscosity variations, but modifications of the multigrid algorithm are found to improve the robustness of the numerical method for very large viscosity contrasts. An

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efficient and flexible local mesh refinement technique is presented which is applied to various convection problems with variable viscosity. Comparisons with other numerical methods reveal that accurate results are obtained even when viscosity varies strongly.

COMPUTER MODELING IN CARDIAC ELECTROPHYSIOLOGY. Niels F. Otani. *Department of Biomedical Engineering, Case Western Reserve University, Cleveland, Ohio 44106.*

The skills of a computational physicist are shown to be useful in the seemingly distant field of cardiac electrophysiology. The propagation of cardiac action potentials and their ability to form spiral waves are easily understood at a basic level when standard concepts from the theory of partial differential equations are applied. The design of computer simulations of action potential propagation is facilitated by adapting numerical concepts routinely applied by computational physicists. These concepts must be modified and combined with computer structures standard in computer science to handle the timescale and spatial scale problems unique to the action potential propagation problem. The resulting simulation shows how details of ion channel dynamics determine properties of the spiral wave, including its propagation speed, period, stability, and the size of the spiral core.