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Abstracts of Papers to Appear in Future Issues

MICROSTRUCTURAL EVOLUTION IN INHOMOGENEOUS ELASTIC MEDIA. H.-J. Jou,* P. H. Leo,† and J. S. Lowengrub‡. *Division of Engineering, Colorado School of Mines, Golden, Colorado 80401; †Department of Aerospace Engineering and Mechanics, University of Minnesota, Minneapolis, Minnesota 55455; ‡School of Mathematics, University of Minnesota, Minneapolis, Minnesota 55455*

We simulate the diffusional evolution of microstructures produced by solid state diffusional transformations in elastically stressed binary alloys in two dimensions. The microstructure consists of arbitrarily shaped precipitates embedded coherently in an infinite matrix. The precipitate and matrix are taken to be elastically isotropic, although they may have *different* elastic constants (elastically inhomogeneous). Both far-field applied strains and mismatch strains between the phases are considered. The diffusion and elastic fields are calculated using the boundary integral method, together with a small scale preconditioner to remove ill-conditioning. The precipitate–matrix interfaces are tracked using a nonstiff time updating method. The numerical method is spectrally accurate and efficient. Simulations of a single precipitate indicate that precipitate shapes depend strongly on the mass flux into the system as well as on the elastic fields. Growing shapes (positive mass flux) are dendritic while equilibrium shapes (zero mass flux) are squarish. Simulations of multiparticle systems show complicated interactions between precipitate morphology and the overall development of microstructure (i.e., precipitate alignment, translation, merging, and coarsening). In both single and multiple particle simulations, the details of the microstructural evolution depend strongly on the elastic inhomogeneity, misfit strain, and applied fields.

QUASI-ENO SCHEMES FOR UNSTRUCTURED MESHES BASED ON UNLIMITED DATA-DEPENDENT LEAST-SQUARES RECONSTRUCTION. Carl F. Ollivier-Gooch. *Mathematics and Computer Science Division, Argonne National Laboratory, Argonne, Illinois 60439.*

A crucial step in obtaining high-order accurate steady-state solutions to the Euler and Navier–Stokes equations is the high-order accurate reconstruction of the solution from cell-averaged values. Only after this reconstruction has been completed can the flux integral around a control volume be accurately assessed. In this work, a new reconstruction scheme is presented that is conservative, is uniformly accurate, allows only asymptotically small overshoots, is easy to implement on arbitrary meshes, has good convergence properties, and is computationally efficient. The new scheme, called DD-L_2-ENO, uses a data-dependent weighted least-squares reconstruction with a fixed stencil. The weights are chosen to strongly emphasize smooth data in the reconstruction, satisfying the weighted ENO conditions of Liu, Osher, and Chan. Because DD-L_2-ENO is designed in the framework of k-exact reconstruction, existing techniques for implementing such reconstructions on arbitrary meshes can be used. The scheme allows graceful degradation of accuracy in regions where insufficient smooth data exists for reconstruction of the requested high order. Similarities with and differences from WENO schemes are highlighted. The asymptotic behavior of the scheme in reconstructing smooth and piecewise smooth functions is demonstrated. DD-L_2-ENO produces uniformly high-order accurate reconstructions, even in the presence of discontinuities. Results are shown for one-dimensional scalar propagation and shock tube problems. Encouraging preliminary two-dimensional flow solutions obtained using DD-L_2-ENO reconstruction are also shown and compared with solutions using limited least-squares reconstruction.

HIGH RESOLUTION COMPUTATIONS OF OCEAN WAVE SPECTRAL MODULATIONS DUE TO TWO-DIMENSIONAL WAVE–CURRENT INTERACTIONS. R. A. Fusina, A. L. Cooper, and S. R. Chubb. *Remote Sensing Division, Naval Research Laboratory, Code 7253, Washington, DC 20375-5351.*

A new nesting technique has been developed for computing solutions of the steady-state form of the wave action equation. The technique is especially useful for investigating the effects of resolution on the accuracy and stability of the computation. This has importance in the problem of determining ocean wave spectra under the influence of ambient wind fields and current distributions. The technique enables extremely high resolution computations to be performed with minimal computer storage requirements. It is especially useful for applications in modelling radar imagery of the ocean surface. Investigations of the convergence, stability, and accuracy of the procedure are made possible by introducing a fixed grid point location which is common to all the nested grids. In order to display the method, we apply it to a particular model of an oceanographic current rip feature that was recently observed during the first High Resolution Remote Sensing Experiment. Limitations of the method are also discussed.

CALCULATION OF INCOMPRESSIBLE VISCOUS FLOWS BY AN UNCONDITIONALLY STABLE PROJECTION FEM. J.-L. Guermond* and L. Quartapelle†. **Laboratoire d'Informatique pour la Mécanique et les Sciences de l'Ingénieur, CNRS, BP 133, 91403, Orsay, France; †Dipartimento di Fisica, Politecnico di Milano, Piazza Leonardo da Vinci, 32, 20133 Milano, Italy.*

This paper investigates the numerical performance of a finite element implementation of a new incremental fractional-step method to compute steady and unsteady incompressible viscous flows under general boundary conditions and using unstructured meshes. A variational framework is adopted which accommodates two different spaces for representing and approximating the velocity fields calculated respectively in the viscous and inviscid phases of the method, but which leads to a very simple numerical scheme in terms of only one discrete velocity field. An unconditionally stable semi-implicit approximation of the nonlinear term is used to eliminate any time-step restriction, as far as the numerical stability is concerned. Numerical results for five test problems in two dimensions are reported to illustrate the flexibility of the proposed method.

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