Journal of Computational Physics **158,** 136–137 (2000)
doi:10.1006/jcph.2000.6441, available online at http://www.idealibrary.com on IDEAL®

Abstracts of Papers to Appear

SIMULTANEOUSLY RESOLVED BIFURCATION DIAGRAMS: A NOVEL GLOBAL APPROACH APPLIED TO LIQUID FIGURES OF EQUILIBRIUM. Gábor Domokos,* Imre Szeberényi,† and Paul H. Steen.‡ **Department of Strength of Materials, and †Department of Control Engineering and Information Technology, Technical University of Budapest, H-1521 Budapest, Hungary; and ‡Department of Chemical Engineering and Center for Applied Mathematics, Cornell University, Ithaca, New York 14853.* E-mail: domokos@iit.bme.hu, szebi@iit.bme.hu, phs7@cornell.edu.

A new approach to the computation of bifurcation diagrams is illustrated on axisymmetric equilibria of liquid droplets and bridges. The new technique has an architecture that solves boundary-value problems in parallel and delivers a global bifurcation diagram, capturing isolated branches. In contrast, conventional techniques deliver solutions in sequence using local path-continuation. A suitable mathematical formulation for the classical problem of predicting shapes of droplet and bridge equilibria is introduced, and it is shown how the new technique yields global diagrams. Properties of these diagrams allow families of equilibria to be organized in a way that reveals common structures.

STRICT STABILITY OF HIGH-ORDER COMPACT IMPLICIT FINITE-DIFFERENCE SCHEMES— THE ROLE OF BOUNDARY CONDITIONS FOR HYPERBOLIC PDES. PART I. Saul S. Abarbanel and Alina E. Chertock. *Department of Applied Mathematics, School of Mathematical Sciences, Tel-Aviv University, Tel-Aviv, Israel.* E-mail: saul@math.tau.ac.il, cheral@math.tau.ac.il.

Temporal, or "strict," stability of approximation to PDEs is much more difficult to achieve than the "classical" Lax stability. In this paper, we present a class of finite-difference schemes for hyperbolic initial boundary value problems (IBVPs) in one and two space dimensions that possess the property of strict stability. The approximations are constructed so that all eigenvalues of corresponding differentiation matrix have nonpositive real part. Boundary conditions are imposed by using penalty-like terms. Forth- and sixth-order compact implicit finite-difference schemes are constructed and analyzed. Computational efficacy of the approach is corroborated by a series of numerical tests in 1-D and 2-D scalar problems. Part II of this paper deals with the problem of *systems of hyperbolic PDEs* in one and two space dimensions.

NUMERICAL MODELING OF OPTICAL GRADIENT TRAPS USING THE VECTOR FINITE ELEMENT METHOD. Daniel A. White. *Center for Applied Scientific Computing, Lawrence Livermore National Laboratory, P.O. Box 808 M/S L-560, Livermore, California 94551.* E-mail: dwhite@llnl.gov.

It has been established that under certain conditions microscopic dielectric objects can be trapped by a tightly focused laser beam. This phenomenum is commonly referred to as an optical gradient trap. The recently developed vector finite element method is used to visualize the interaction of the laser beam with the dielectric object and to quantitatively predict the optical trapping efficiency. The vector finite element method is an accurate and efficient approach when the incident beam wavelength is comparable to the object size, and it has the advantage that it can be used to model the trapping of arbitrarily shaped 3D objects.

0021-9991/00 $35.00

INSTABILITY OF THE FILTERING METHOD FOR VLASOV'S EQUATION. H. Figua,* F. Bouchut,* M. R. Feix,† and E. Fijalkow.* *Laboratoire de Mathématiques Appliquées et Physique Mathématique d'Orléans, Départment de Mathématiques, UFR Sciences, BP 6759, 45067 Orléans Cedex 2, France; and †Ecole des Mines de Nantes, 4, rue Alfred Kastler, 44070 Nantes Cedex 3, France.* E-mail: hfigua@labomath.univ-orleans.fr.

Numerical simulations of the Vlasov–Poisson system exhibit filamentation in phase space. Recently, a numerical method was introduced in order to remove this filamentation. This method consists of convolving the distribution function by a Gaussian kernel in the velocity variable. This new function solves a transport equation with a second-order term on the right-hand side. In the present paper we show how the numerical resolution of this new equation instead of the original Vlasov equation affects the stability in the Fourier–Fourier transformed space, and prove that the use of Fourier–Fourier transform is a fundamental requirement to solve this new equation.

CONSERVATION PROPERTIES OF UNSTRUCTURED STAGGERED MESH SCHEMES. Blair Perot. *219 Engineering Laboratory, Department of Mechanical Engineering, University of Massachusetts, Amherst, Massachusetts 01003.* E-mail: perot@ecs.umass.edu.

Classic Cartesian staggered mesh schemes have a number of attractive properties. They do not display spurious pressure modes, and they have been shown to locally conserve mass, momentum, kinetic energy, and circulation to machine precision. Recently, a number of generalizations of the staggered mesh approach for unstructured (triangular or tetrahedral) meshes have been proposed. These unstructured staggered mesh methods have been created to retain the attractive pressure aspects and mass conservation properties of the classic Cartesian mesh method. This work addresses the momentum, kinetic energy, and circulation conservation properties of unstructured staggered mesh methods. It is shown that with certain choices of the velocity interpolation, unstructured staggered mesh discretizations of the divergence form of the Navier–Stokes equations can conserve kinetic energy and momentum both locally and globally. In addition, it is shown that unstructured staggered mesh discretizations of the rotational form of the Navier–Stokes equations can conserve kinetic energy and circulation both locally and globally. The analysis includes viscous terms and a generalization of the concept of conservation in the presence of viscosity to include a negative definite dissipation term in the kinetic energy equation. These novel conserving unstructured staggered mesh schemes have not been previously analyzed. It is shown that they are first-order accurate on nonuniform two-dimensional unstructured meshes, and second-order accurate on uniform unstructured meshes. Numerical confirmation of the conservation properties and the order of accuracy of these unstructured staggered mesh methods is presented.