JOURNAL OF COMPUTATIONAL PHYSICS **137,** 245–246 (1997)
ARTICLE NO. CP975832

Abstracts of Papers to Appear in Future Issues

SOLUTION OF THE DIV-CURL PROBLEM IN GENERALIZED CURVILINEAR COORDINATES. F. Bertagnolio and O. Daube. *LIMSI-CNRS, BP 133, 91403 Orsay Cedex, France*. E-mail: franck@limsi.fr; daube@limsi.fr.

We propose a method for solving the div-curl problem on a structured nonorthogonal curvilinear grid. The differential operators are discretized using a MAC-scheme for the unknowns in such a way that the discrete counterparts of the usual vector analysis relations are satisfied. The derived discrete problem is then solved by performing a Helmholtz-type decomposition of the unknown vector field. This allows us to obtain a vector field for which both divergence and curl are satisfied to within machine accuracy. The method is validated for several configurations in two and three dimensions, and its accuracy is numerically checked.

A PARALLEL FINITE-VOLUME RUNGE–KUTTA ALGORITHM FOR ELECTROMAGNETIC SCATTERING. Vineet Ahuja and Lyle N. Long. *Department of Aerospace Engineering, Pennsylvania State University, University Park, Pennsylvania 16802*. E-mail: lnl@psu.edu.

A 3D explicit finite volume algorithm has been developed to simulate scattering from complex geometries on parallel computers using structured body conformal curvilinear grids. Most simulations for practical 3D geometries require a large number of grid points for adequate spatial resolution making them suitable for parallel computation. The simulations have been carried out using a multiblock/zonal approach in the message passing paradigm on the SP-2. Each zone is placed on a separate processor and interprocessor communication is carried out using the Message Passing Library/Interface (MPL/MPI). Integration of Maxwell's equations is performed using the four-stage Runge–Kutta time integration method on a dual grid. This method of integrating on a staggered grid gives enhanced dissipative and dispersive characteristics. A scattered field formulation has been used and the Liao boundary condition is used at the outer nonreflecting boundary. The far zone transformation has also been implemented efficiently, using specialized MPL functions to evaluate the far zone scattering results. Results show extremely good comparisons for scattering from the sphere and the ogive with the exact solution and standard FDTD type algorithms. Comparisons for nonaxisymmetric targets like the NASA almond with experimental data has also been found to be extremely good.

A SPECTRAL METHOD FOR UNBOUNDED DOMAINS. T. Matsushima and P. S. Marcus. *Department of Mechanical Engineering, University of California at Berkeley, Berkeley, California 94720*. E-mail: phil@cfd.me.berkeley.edu.

A spectral method for an unbounded domain is presented. Rational basis functions, which are algebraically mapped Legendre functions, are used for expansion in the radial direction of polar coordinates

0021-9991/97 $25.00

(r, ϕ) or (r, ϕ, z). They satisfy the pole condition exactly at the coordinate singularity and their behavior as $r \rightarrow \infty$ is suitable for expanding smooth functions which decay algebraically or exponentially as $r \rightarrow \infty$. The method is not stiff when it is applied to initial value problems despite the presence of the coordinate singularity. Solenoidal vector fields are treated efficiently by the toroidal and poloidal decomposition which reduces the number of dependent variables from 3 to 2. Examples include the computation of vortex dynamics in two and three dimensions.

MULTIPHASE DYNAMICS IN ARBITRARY GEOMETRIES ON FIXED CARTESIAN GRIDS. H. S. Udaykumar, Heng-Chuan Kan, Wei Shyy, and Roger Tran-Son-Tay. *Department of Aerospace Engineering, Mechanics and Engineering Science, University of Florida, Gainesville, Florida 32611.* E-mail: ush@confucius.aero.ufl.edu.

In this work, a mixed Eulerian–Lagrangian algorithm, called *ELAFINT* (Eulerian Lagrangian algorithm for interface tracking) is developed further and applied to compute flows with solid–fluid and fluid–fluid interfaces. The method is capable of handling fluid flows in the presence of both irregularly shaped solid boundaries and moving boundaries on a fixed Cartesian grid. The field equations are solved on the underlying fixed grid using a collocated variable, pressure-based formulation. The moving boundary is tracked explicitly by the Lagrangian translation of marker particles. The moving boundary passes through the grid and the immersed boundary technique is used to handle its interaction with the underlying grid. The internal solid boundaries are dealt with by using a cut-cell technique. Particular attention is directed toward conservation and consistency in the vicinity of both phase boundaries. The complex geometry feature has been tested for a variety of flow problems. The performance of the immersed boundary representation is demonstrated in the simulation of Newtonian liquid drops. The combination of the two features is then employed in the simulation of the motion of drops through constricted tubes. The capabilities developed here can be useful for solving flow problems involving moving and stationary complex boundaries.

Statement of ownership, management, and circulation required by the Act of October 23, 1962, Section 4369, Title 39, United States Code: of

JOURNAL OF COMPUTATIONAL PHYSICS

Published monthly (semimonthly in January, March, May, July, September, and November) by Academic Press, 6277 Sea Harbor Drive, Orlando, FL 32887-4900. Number of issues published annually: 18. Editor: Dr. J. U. Brackbill, Los Alamos National Laboratory, T-3, MS B216, Los Alamos, NM 87545.
Owned by Academic Press, 525 B Street, Suite 1900, San Diego, CA 92101-4495. Known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, and other securities: None.
Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner. Names and addresses of individuals who are stockholders of a corporation which itself is a stockholder or holder of bonds, mortgages, or other securities of the publishing corporation have been included in paragraphs 2 and 3 when the interests of such individuals are equivalent to 1 percent or more of the total amount of the stock or securities of the publishing corporation.
Total no. copies printed: average no. copies each issue during preceding 12 months: 1579; single issue nearest to filing date: 1599. Paid circulation (a) to term subscribers by mail, carrier delivery, or by other means: average no. copies each issue during preceding 12 months: 444; single issue nearest to filing date: 449. (b) Sales through agents, news dealers, or otherwise: average no. copies each issue during preceding 12 months: 583; single issue nearest to filing date: 586. Free distribution (a) by mail: average no. copies each issue during preceding 12 months: 45; single issue nearest to filing date: 45. (b) Outside the mail: average no. copies each issue during preceding 12 months: 15; single issue nearest to filing date: 15. Total no. of copies distributed: average no. copies each issue during preceding 12 months: 1087; single issue nearest to filing date: 1095. Percent paid and/or requested circulation: average percent each issue during preceding 12 months: 94%; single issue nearest to filing date: 95%.

(Signed) Patricia Butler, Director of Circulation