JOURNAL OF COMPUTATIONAL PHYSICS **127,** 226 (1996)
ARTICLE NO. 0171

Abstracts of Papers to Appear in Future Issues

A PIECEWISE-QUINTIC INTERPOLATION SCHEME. Piotr Holnicki. *Systems Research Institute, Polish Academy of Sciences, 01-447 Warsaw, ul. Newelska 6, Poland.*

In this paper a piecewise quintic polynomial interpolation scheme, based on a four-point stencil and a uniform grid, is investigated. The interpolant utilizes four consecutive grid data points and the first derivative estimates at the internal points. Sufficient conditions for the scheme to be positive definite are formulated in terms of the discrete maximum principle. Monotonicity conditions are characterized as admissible variability regions of the respective scheme's parameters. Standard limiter functions for derivative estimates are applied with accuracy gain obtained by relaxing monotonicity constraints near local extrema. Results of numerical tests are presented for regular function interpolation as well as for 1D and 2D advection of standard test profiles.

MULTILEVEL METHODS FOR THE SIMULATION OF TURBULENCE. A SIMPLE MODEL. Roger Teman. *Laboratoire d'Analyse Numérique, Université Paris-Sud, Bâtiment 425, 91405 Orsay, France and The Institute for Scientific Computing & Applied Mathematics, Rawles Hall, Indiana University, Bloomington, Indiana 47405.*

Our aim in this article is to present for a very simple model—namely a pair of ordinary coupled differential equations—some of the features of the multilevel numerical methods which have been introduced recently for the numerical simulation of turbulent flows. The two components of this simple differential system are intended to represent the large and small scale components of a flow. We show that many new numerical schemes can be introduced by treating differently the small and large scale components; also different time steps can be used for these two components. The stability analysis which we conduct for this simple model shows that these new multilevel schemes can produce a substantial saving in computing time, although the stability analysis leads sometime to counterintuitive conclusions. The error analysis for this model will be conducted elsewhere. Also the reader is referred to other articles for the utilization of similar multilevel schemes for the Navier–Stokes equations themselves.

ARTIFICIAL VISCOSITY MODELS FOR VORTEX AND PARTICLE METHODS. G.-H. Cottet. *LMC-IMAG, Université Joseph Fourier, BP 53, 38041 Grenoble Cédex 9, France.*

The analysis of the truncation error produced by particle methods leads to artificial viscosity schemes. For vortex methods, they can be seen as eddy viscosity models, with anisotropic non-linear diffusion tensors. Numerical experiments on decaying incompressible 2D turbulence illustrate the efficiency of the method, and in particular the fact that the diffusion stops acting in large coherent eddies. For compressible flows, this approach allows us to understand the oscillations produced by particle methods and to derive new artificial viscosity schemes.

CALCULATION OF THE ADDITION COEFFICIENTS IN ELECTROMAGNETIC MULTISPHERE-SCATTERING THEORY. Yu-lin Xu. *Department of Astronomy, P.O. Box 112055, University of Florida, Gainesville, Florida 32611-2055.*

One of the most intractable problems in electromagnetic multisphere-scattering theory is the formulation and evaluation of vector addition coefficients introduced by the addition theorems for vector spherical harmonics. This paper presents an efficient approach for the calculation of both scalar and vector translational addition coefficients, which is based on fast evaluation of the Gaunt coefficients. The paper also rederives the analytical expressions for the vector translational addition coefficients and discusses the strengths and limitations of other formulations and numerical techniques found in the literature. Numerical results from the formulation derived in this paper agree with those of a previously published recursion scheme that completely avoids the use of the Gaunt coefficients, but the method of direct calculation proposed here reduces the computing time by a factor of 4–6.

BLOB METHOD FOR KINETIC PLASMA SIMULATION WITH VARIABLE-SIZE PARTICLES. G. G. M. Coppa, G. Lapenta, G. Dellapiana, F. Donato, and V. Riccardo. *Dipartimento di Energetica, Politecnico di Torino, Corso Duca Degli Abruzzi, 24, 10129 Torino, Italy.*

A new approach to particle in cell simulation is presented for collisionless plasmas. The new method is based on computational particles of variable size (*blobs*). Each blob represents an element of phase space and its shape and size are evolved in time to represent better the correct evolution. The blob particles can be split to increase the accuracy in selected regions of stronger gradients. Blobs can also be coalesced to keep the total number of blobs constant. The performance of the blob method is analyzed in the case of the Landau damping and in the formation of a sheath in a bounded plasma. The results show the correctness and effectiveness of the new method. When compared to standard PIC methods, the blob technique reduces the noise for a given number of computational particles.

0021-9991/96 $18.00
Copyright © 1996 by Academic Press, Inc.
All rights of reproduction in any form reserved.