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# Abstracts of Papers to Appear in Future Issues

STABILITY ANALYSIS OF A GALERKIN/RUNGE–KUTTA NAVIER–STOKES DISCRETISATION ON UNSTRUCTURED TETRAHEDRAL GRIDS. M. B. Giles. *Oxford University Computing Laboratory, Wolfson Building, Parks Road, Oxford OX1 3QD, United Kingdom.*

This paper presents a timestep stability analysis for a class of discretisations applied to the linearised form of the Navier–Stokes equations on a 3D domain with periodic boundary conditions. Using a suitable definition of the ''perturbation energy'' it is shown that the energy is monotonically decreasing for both the original p.d.e. and the semi-discrete system of o.d.e.'s arising from a Galerkin discretisation on a tetrahedral grid. Using recent theoretical results concerning algebraic and generalised stability, sufficient stability limits are obtained for both global and local timesteps for fully discrete algorithms using Runge–Kutta time integration.

APPLICATION OF THE GENERALIZED MULTIPOLE TECHNIQUE (GMT) TO HIGH-FREQUENCY ELECTROMAGNETIC SCATTERING FROM PERFECTLY CONDUCTING AND DIELECTRIC BODIES OF REVOLUTION. H. M. Al-Rizzo, J. M. Tranquilla, and S. M. Al-Amri. *Department of Electrical Engineering, Radiating Systems Research Laboratory, University of New Brunswick, Fredericton, New Brunswick, E3B 5A3, Canada.*

The generalized multipole technique (GMT) is utilized to calculate rigorously the full-vector electromagnetic (EM) fields scattered from electrically large, perfectly conducting (PC) and penetrable bodies of revolution, of smooth but otherwise arbitrary geometry. Analytically tractable, multiple spherical multipole (MSM) equivalent sources, involving spherical Hankel functions (SHFs) with their origins embedded within the surface and suitably located along the axis of rotational symmetry, are employed as eigenfunctions for the representation of the fields in the exterior domain of the scattering problem. The salient feature of the proposed formalism is that the induced fields in the interior of dielectric volumes are expressed as a superposition of appropriate set of equivalent multiple spherical vector wavefunctions involving spherical Bessel functions (SBFs) of the first kind and located in the interior of the object to be treated to take advantage of rotational symmetry. Numerical results for the differential scattering cross-section (DSCS) patterns as well as the extinction, scattering, absorption, and backscattering efficiencies are presented for a wide range of 3D electrically extended geometries which, to the best of our knowledge, have not been hitherto considered by either analytical solutions or any other integral, differential, and/or hybrid numerical methods.

FAST ALGORITHMS FOR TRIANGULAR JOSEPHSON JUNCTION ARRAYS. Sujay Datta and Deshdeep Sahdev. *Department of Physics, Indian Institute of Technology, Kanpur, 208 016, India.*

We develop fast algorithms for the numerical study of two-dimensional triangular Josephson junction arrays. The Dirac bra-ket formalism is introduced in the context of such arrays. We note that triangular arrays can have both hexagonal and rectangular periodicity and develop algorithms for each. Boundaries are next introduced and fast algorithms for finite arrays are developed.

HIGH ACCURACY NUMERICAL METHODS FOR THERMALLY PERFECT GAS FLOWS WITH CHEMISTRY. Ronald P. Fedkiw, Barry Merriman, and Stanley Osher. *Department of Mathematics, University of California, 405 Hilgard Avenue. Los Angeles, California 90095-1555.*

The compressible Navier–Stokes equations can be extended to model multispecies, chemically reacting gas flows. The result is a large system of convection–diffusion equations with stiff source terms. In this paper we develop the framework needed to apply modern high accuracy numerical methods from computational gas dynamics to this extended system. We also present representative computational results using one such method. The framework developed here is useful for many modern numerical schemes. We first present an enthalpy based form of the equations that is well-suited both for physical modeling and for numerical implementation. We show how to treat the stiff reactions via time splitting, and in particular, how to increase accuracy by avoiding the common practice of approximating the temperature. We derive simple, exact formulas for the characteristics of the convective part of the equations, which are essential for application of all characteristic-based schemes. We also show that the common practice of using approximate analytical expressions for the characteristics can potentially produce spurious oscillations in computations. We implement these developments with a particular high accuracy characteristic-based method, the finite difference ENO space discretization with the third-order TVD Runge–Kutta time discretization, combined with the second-order accurate Strang time splitting of the reaction terms. We illustrate the capabilities of this approach with calculations of a 1D reacting shock tube and a 2D combustor.

AN EXTENSION OF SPECTRAL METHODS TO QUASI-PERIODIC AND MULTISCALE PROBLEMS. A. Wirth. *CNRS, URA 1362, Observatoire de la Côte d'Azur, B.P. 229, 06304, Nice Cedex 4, France.*

For efficiently treating quasi-periodic and multiscale problems numerically, it is here proposed to change the number of space dimensions which is then multiplied by the number of different (incommensurable or widely separated) scales occurring in the problem. Then, all calculations are performed in this higher-dimensional space. In the higher-dimensional space the problem is a standard periodic problem where, in the presence of dissipation, only the lower-order harmonics are relevant and one can thus use all the standard spectral methods for periodic functions with a relatively small number of modes. The method is validated, using the Burgers equation, and the two-dimensional linearized Navier–Stokes equation, by comparison with standard spectral or pseudo-spectral methods (in which the dimensionality of the space is not changed but very high resolution is used). For physical problems of interest in which different widely separated scales occur, standard methods require very large computer resources; the gain in storage and CPU resources, when using the ''higher dimension'' method, is typically proportional to the ratio of scales.



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