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Abstracts of Papers to Appear in Future Issues

A METHOD OF SELF-PURSUED BOUNDARY VALUE ON A BODY AND THE MAGNUS EFFECT CALCULATED WITH THIS METHOD. Fumio Yoshino, Tatsuo Hayashi, and Ryoji Waka, *Tottori University, Tottori, JAPAN.*

When the Navier–Stokes equations formulated in terms of stream function Ψ and vorticity ζ are numerically solved, we encounter the problem of determining the value of Ψ on a body in an external flow. Although this problem is especially important in cases with a shear flow, an unsteady flow, or a flow around a rotating circular cylinder, there are no efficient methods available which do not use empirical factors. The authors here propose a method of automatically determining the value of Ψ on a body with an arbitrary profile, without using any empirical factors (named the SPB method), and apply this method to the case of a rotating circular cylinder in a uniform shear flow. A comparison of the results by the SPB method with those by the method of fixing the value of Ψ on a body and by the conventional empirical method showed that the SPB method is very efficient and is applicable to both steady and unsteady flows. Of course, the method always satisfies the condition of single valuedness of the pressure term of the equation of motion. Through applying the SPB method to the case of a rotating circular cylinder in a uniform shear flow, the aerodynamic forces acting on the cylinder were obtained and the lift force was found to decrease as the velocity gradient of the shear flow increases when the rotational speed of the cylinder was kept constant.

COMPUTATION OF MHD EQUILIBRIUM OF TOKAMAK PLASMA (Review Article). Tatsuoki Takeda and Shinji Tokuda, *Japan Atomic Energy Research Institute, Ibaraki-Ken, JAPAN.*

Computation of the MHD equilibrium of a tokamak plasma is reviewed as comprehensively as possible. The basic equation of this problem is the Grad–Shafranov equation. General remarks on this equation and relating issues are, first, summarized with historical survey of the MHD equilibrium solution, where some mathematical discussions on the numerical analysis of the problem are also presented. Distinguishing features of this problem are seen in treatment of the boundary condition and constraining conditions and we describe them in a rather detailed manner. In the main part of this review paper we present a concrete description on the numerical procedures of the MHD equilibrium solvers which are classified into two groups, that is, the real space solvers and the inverse equilibrium solvers. We also describe topics on more general equilibrium models, that is, the equilibrium with steady flow, anisotropic equilibria, equilibria with specified current sources, and equilibrium evolution. Brief comments on three-dimensional equilibrium solvers are also presented. As for application of the MHD equilibrium solvers we present only a small part, that is, beta limit optimization, design of external coils, analysis of positional instability, and analysis of experimentally obtained data from electromagnetic measurement. It is concluded that among various kinds of numerical solution methods we can usually find most adequate ones for the present problem.

HIGH ACCURACY SOLUTIONS OF INCOMPRESSIBLE NAVIER–STOKES EQUATIONS. Murli M. Gupta, *George Washington University, Washington, District of Columbia, USA.*

In recent years we have developed high accuracy finite difference approximations for partial differential equations of elliptic type, with particular emphasis on the convection–diffusion equation. These approximations are of compact type, have a local truncation error of fourth order, and allow the use

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of standard iterative schemes to solve the resulting systems of algebraic equations. In this paper, we extend these high accuracy approximations to the solution of Navier–Stokes equations. Solutions are obtained for the model problem of driven cavity and are compared with solutions obtained using other approximations and those obtained by other authors. It is discovered that the high-order approximations do indeed produce high-accuracy solutions and have a potential for use in solving important problems of viscous fluid flows.

CONSERVATIVE SCHEME FOR A MODEL OF NONLINEAR DISPERSIVE WAVES AND ITS SOLITARY WAVES INDUCED BY BOUNDARY MOTION. Qianshun Chang, Goubin Wang, and Boling Guo, *Academia Sinica, Bejing, PEOPLE'S REPUBLIC OF CHINA.*

A conservative difference scheme is given for a model of nonlinear dispersive waves. Convergence and stability of the scheme are proved. By means of this scheme, we explore numerically the relationship between the boundary data and the amplitudes and the number of solitary waves it produces.

NONLINEAR FOURIER ANALYSIS FOR THE INFINITE-INTERVAL KORTEWEG–DE VRIES EQUATION I: AN ALGORITHM FOR THE DIRECT SCATTERING TRANSFORM. A. R. Osborne, *Universita and Istituto di Cosmo-Geofisica, Torino, ITALY.*

The nonlinear Fourier analysis of wave motion governed approximately by the Korteweg–de Vries (KdV) equation on the infinite line is the central point of discussion. We assume that the wave amplitude is recorded in the form of a discrete space or time series which is determined either by experimental measurement or by computer simulation of the physical system of interest. We develop numerical data analysis procedures based upon the scattering transform solution to the KdV equation as given by Gardner *et al.* We are motivated by the observation that historically the Fourier transform has been ubiquitously used to spectrally analyze linear wave data; here we develop methods for employing the scattering transform as a tool to similarly analyze nonlinear wave data. Specifically we develop numerical methods to evaluate the direct scattering transform (DST) of a space or time series: the approach thus provides a basis for analyzing and interpreting nonlinear wave behavior in the wavenumber or frequency domain. The DST spectrum separates naturally into soliton and radiation components and may be simply interpreted in terms of the large-time asymptotic state of the infinite-line KdV equation.

NONLINEAR FOURIER ANALYSIS FOR THE INFINITE-INTERVAL KORTEWEG–DE VRIES EQUATION II: NUMERICAL TESTS OF THE DIRECT SCATTERING TRANSFORM. A. Provenzale and A. R. Osborne, *Universita and Istituto di Cosmo-Geofisica, Torino, ITALY.*

A recursive algorithm for computing the direct scattering transform (DST) of a discrete space or time series whose dynamics is described approximately by the infinite-line Korteweg–de Vries (KdV) equation is tested for numerical accuracy by considering several example problems for which the exact DST spectrum is known. The effects of truncation, roundoff, discretization, and noise errors are specifically addressed. Procedures for estimating errors in a general experimental context are developed and the nonlinear filtering of noise is discussed.

SPECTRAL METHOD SOLUTION OF THE STOKES EQUATIONS ON NONSTAGGERED GRIDS. Mark R. Schumack, William W. Schultz, and John P. Boyd, *University of Michigan, Ann Arbor, Michigan, USA.*

The Stokes equations are solved using spectral methods with staggered and nonstaggered grids. Numerous ways to avoid the problem of spurious pressure modes are presented, including new techniques using the pseudospectral method and a method solving the weak form of the governing equations