simulated annealing and genetic algorithms provide satisfactory performance when the earth structure has only 15 free parameters. As this number is increased to 22, and then, 30 parameters both techniques become more costly. Genetic algorithms, however, still yielded accurate solutions for problems with 30 free parameters, a point at which simulated annealing was only marginally useful. The superior performance of genetic algorithms may reflect the non-proximate search methods used by them or, possibly, the more complex and capacious memory available to a genetic algorithm for storing its accumulated experience.

ADAPTIVE REMESHING FOR THREE-DIMENSIONAL COMPRESSIBLE FLOW COMPUTATIONS. J. Peraire and J. Peiró. *Department of Aeronautics, Imperial College of Science, Technology and Medicine, Prince Consort Road, London SW7 2BY, United Kingdom*; K. Morgan. *Department of Civil Engineering, University College, Swansea SA2 8PP, United Kingdom.*

An adaptive mesh procedure for computing steady state solutions of the compressible Euler equations in three dimensions is presented. The method is an extension of previous work in two dimensions. The approach requires the coupling of a surface triangulator, an automatic tetrahedral mesh generator, a finite element flow solver, and an error estimation procedure. An example involving flow at high Mach number is included to demonstrate the numerical performance of the proposed approach. The example shows that the use of this form of adaptivity in three dimensions offers the potential of even greater computational savings than those attained in the corresponding two-dimensional implementation.

A CELL-CENTERED LAGRANGIAN-MESH DIFFUSION DIFFERENCING SCHEME. J. E. Morel, J. E. Dendy, Jr., Michael L. Hall, and Stephen W. White. *University of California, Los Alamos National Laboratory, Los Alamos, New Mexico.*

A new cell-centered diffusion differencing scheme for the quadrilateral meshes associated with Lagrangian hydrodynamics codes is described. Computational comparisons of this scheme and existing schemes are given. It is shown that the new scheme is much more accurate than existing schemes when the mesh is significantly skewed. The new scheme is also more costly because there are special cell-edge unknowns in addition to the standard cell-center unknowns, and the associated diffusion matrix is asymmetric. The disadvantages of an asymmetric diffusion matrix are mitigated by a multigrid solution technique that is quite effective.

COMPUTATIONAL IMPLEMENTATION OF A COUPLED PLASMA-NEUTRAL FLUID MODEL. E. L. Vold, F. Najmabadi, and R. W. Conn. *Institute of Plasma and Fusion Research, Department of Mechanical, Aerospace, and Nuclear Engineering, University of California, Los Angeles, Los Angeles, California 90024-1597.*

This paper describes the computational transport of coupled plasma-neutral fluids in the edge region of a toroidally symmetric magnetic confinement device, with applications to the tokamak. The model couples neutral density in a diffusion approximation with a set of transport equations for the plasma density including classical plasma parallel velocity, anomalous cross-field velocity, and ion and electron temperature equations. The plasma potential, gradient electric fields, drift velocity, and net poloidal velocity are computed as dependent quantities under the assumption of ambipolarity. The implementation is flexible to permit extension in the future to a fully coupled set of non-ambipolar momentum equations. The computational method incorporates sonic flow and particle recycling of ions and neutrals at the vessel boundary. A numerically generated orthogonal grid conforms to the poloidal magnetic flux surfaces. Power law differencing based on the SIMPLE relaxation method is modified to accomodate the compressible reactive plasma flow with a "semi-implicit" diffusion method. Residual corrections are applied to obtain a valid convergence to the steady state solution. Results are presented for a representative divertor tokamak in a high recycling regime, showing strongly peaked neutral and plasma densities near the divertor target. Solutions show large poloidal and radial gradients in the plasma density, potential, and temperatures. These findings may help one to understand the strong turbulence experimentally observed in the plasma edge region of the tokamak.

A CHEBYSHEV COLLOCATION ALGORITHM FOR 2-D NON-BOUSSINESQ CONVECTION. P. Le Quéré, R. Masson, and P. Perrot. *LIMSI-CNRS, BP 133, 91403 Orsay Cedex, France.*

A Chebyshev collocation algorithm is developed to integrate the time-dependent Navier–Stokes equations for natural convection flow with large temperature differences. The working fluid is assumed to be a perfect gas and its thermophysical properties vary with temperature according to Sutherland laws. The governing equations do not allow for acoustic waves. The Generalized Helmholtz and Uzawa operators which arise from time discretization are solved iteratively and the performances of several types of preconditioners and iterative schemes are examined. The algorithm is validated by computing almost Boussinesq flows and by comparing with previous results obtained with a finite difference algorithm. We investigate the effects of the temperature difference and of total mass contained within the cavity on the transition to unsteadiness in a cavity of aspect ratio 8. It is shown that these parameters have indeed a significant effect on the value of Rayleigh number at which unsteadiness is triggered. We also discuss the nature of the time-periodic solution which is obtained for Ra values slightly supercritical.

A PRIMITIVE VARIABLE METHOD FOR THE SOLUTION OF THREE-DIMENSIONAL INCOMPRESSIBLE VISCOUS FLOWS. F. Sotiropoulos and S. Abdallah. *Department of Aerospace Engineering and Engineering Mechanics, University of Cincinnati, Cincinnati, Ohio 45221.*

In this paper we present a new primitive variable method for the solution of the three-dimensional, incompressible, Reynolds averaged Navier–Stokes equations in generalized curvilinear coordinates. The governing equations are discretized on a non-staggered grid and the discrete continuity equation is replaced by a discrete pressure–Poisson equation. The discrete pressure equation is designed in such a way that: (i) the compatibility condition for the Poisson–Neumann problem is automatically satisfied, and (ii) the discrete incompressibility constraint is satisfied to, at least, truncation error accuracy while the computed pressure is smooth. The momentum equations are integrated in time using the four stage Runge–Kutta algorithm while the pressure equation is solved using the point successive relaxation technique. The method is applied to calculate the turbulent flow field over a ship model. The computed results are in very good agreement with the experimental data.

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