as $(1-x^2)^{-1/2}$ as x approaches ± 1. Comparisons are made with the errors associated with derivatives of functions approximated by Fourier series, in which case it is reported that the errors only grow linearly with N and are evenly distributed throughout the domain. A method for reducing the error is discussed.

A NUMERICAL METHOD FOR SOLVING SYSTEMS OF LINEAR ORDINARY DIFFERENTIAL EQUATIONS WITH RAPIDLY OSCILLATING SOLUTIONS. Ira B. Bernstein and Leigh Brookshaw, *Department of Applied Physics, Yale University, Yale Station, New Haven, Connecticut 06520-2159, U.S.A.*; Peter A. Fox, *Center for Solar and Space Research, Yale University, P.O. Box 6666, New Haven, Connecticut 06522-6666, U.S.A.*

A numerical method is presented which allows the accurate and efficient solution of systems of linear equations of the form $dz_i(x)/dx = \sum_{j=1}^{N} A_{ij}(x)\, z_j(x)$ $i = 1, 2, ..., N$, when the solutions vary rapidly compared with the $A_{ij}(x)$. The method consists of numerically developing a set of basis solutions characterized by new dependent variables which are slowly varying. These solutions can be accurately computed with an overhead that is substantially independent of the smallness of the scale length characterizing the solutions. Examples are given.

DENSITY-SCALING: A NEW MONTE CARLO TECHNIQUE IN STATISTICAL MECHANICS. J. P. Valleau, *Chemical Physics Theory Group, Lash Miller Laboratories, University of Toronto, Toronto, Ontario, CANADA M5S 1A1.*

We demonstrate the feasibility of using "umbrella sampling" to do Monte Carlo Markov-sampling runs each covering a substantial range of density: "density-scaling Monte Carlo," or DSMC. One can obtain in this way not only the usual canonical averages but also the relative free energy as a function of density. To test this it has been applied to systems for which there are some previous reliable results: the hard-sphere system and the restricted primitive model of 1:1 and 2:2 electrolytes. The method proves to be startlingly powerful in that very extensive results can be obtained with very few DSMC runs. An important further motivation is the prospect of using the technique to study phase transition regions.

A COMPUTATIONAL MODEL OF THE COCHLEA USING THE IMMERSED BOUNDARY METHOD. Richard P. Beyer, Jr., *Department of Applied Mathematics, University of Washington, Seattle, Washington 98125, U.S.A.*

In this work we describe a two-dimensional computational model of the cochlea (inner ear). The cochlea model is solved by modifying and extending Peskin's immersed boundary method, originally applied to solving a model of the heart (*J. Comput. Phys.* **25** (1977), 220). This method solves the time-dependent incompressible Navier–Stokes equations in the presence of immersed boundaries. The fluid equations are specified on a fixed Eulerian grid while the immersed boundaries are specified on a moving Lagrangian grid. The immersed boundaries exert forces locally on the fluid. These local forces are seen by the fluid as external forces that are added to the other forces, pressure and viscous, acting on the fluid. The modifications and extension of Peskin's method involve both the fluid solver and the calculation and transfer of immersed-boundary forces to the fluid. For the fluid, the Navier–Stokes equations are solved on a doubly periodic rectangular grid in a second-order accurate manner using a projection method developed by Bell, Colella, and Glaz (*Lawrence Livermore National Laboratory Report* UCRL-98225, 1988). The extension of the immersed-boundary forces from the moving grid to the fixed fluid grid and the restriction of the fluid velocities from the fixed fluid grid to the moving grid have been modified to be second-order accurate. The calculation of the immersed-boundary forces can be done either explicitly or implicitly or a combination of both. The cochlea is modelled as two fluid chambers