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Abstracts of Papers to Appear

A COMPUTATIONAL MODEL FOR SUSPENDED LARGE RIGID BODIES IN 3D UNSTEADY VISCOUS FLOWS. Feng Xiao. *Computational Science Laboratory, Institute of Physical and Chemical Research (RIKEN), Hirosawa 2-1, Wako, Saitama, 351-0198, Japan.* E-mail: xiao@atlas.riken.go.jp.

A 3D numerical model for computing large rigid objects suspended in fluid flow has been developed. Rather than calculating the surface pressure upon the solid body, we evaluate the net force and torque based on a volume force formulation. The total effective force is obtained by summing up the forces at the Eulerian grids occupied by the rigid body. The effects of the moving bodies are coupled to the fluid flow by imposing the velocity field of the bodies to the fluid. A Poisson equation is used to compute the pressure over the whole domain. The objects are identified by color functions and calculated by the PPM scheme and a tangent function transformation which scales the transition region of the computed interface to a compact thickness. The model is then implemented on a parallel computer of distributed memory and validated with Stokes and low Reynolds number flows.

A NUMERICAL STUDY OF UNDULATORY SWIMMING. H. Liu* and K. Kawachi.† **Japan Science and Technology Corporation (JST); and †Research Center for Advanced Science and Technology, University of Tokyo, Tokyo, Japan.*

A numerical study of undulatory locomotion is presented. Unsteady hydrodynamics around an undulatory swimming body is solved by using a time accurate solution of the three-dimensional, incompressible, laminar Navier–Stokes equations. A realistic tadpole-shaped body is modeled, which is swam by sending a laterally compressing, sinusoidal wave down the tail tip. Validation of the method is established by an extensive numerical study of the thrust generation of an oscillating airfoil, involving comparisons with the reliable experimental results. For a three-dimensional tadpole model that undergoes undulatory swimming, hydrodynamics and a mechanism of the undulatory swimming were then analyzed and compared with the conventional hydrodynamic theories, which provides a general understanding of the relationship between the dynamic vortex flow and the jet-stream propulsion associated with undulatory locomotion of vertebrates.

A NEW TECHNIQUE FOR SAMPLING MULTIMODAL DISTRIBUTIONS. K. J. Abraham* and L. M. Haines.† **Department of Physics and Astronomy, Iowa State University, Ames, Iowa 50011; and †Department of Statistics and Biometry, University of Natal, Private Bag X01, 3209 Scottsville, Pietermaritzburg, South Africa.* E-mail: abraham@iastate.edu, haines@stat.unp.ac.za.

In this paper we demonstrate that multimodal probability distribution functions (PDFs) may be efficiently sampled using an algorithm originally developed for numerical integration by Monte Carlo methods. This algorithm can be used to generate an input PDF which can be used as an independence sampler in a Metropolis–Hastings chain to sample otherwise troublesome distributions. Some examples in one, two, and five dimensions are worked out. We also comment on the possible application of our results to event generation in high energy physics simulations.

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ON A WIND-DRIVEN, DOUBLE-GYRE, QUASI-GEOSTROPHIC OCEAN MODEL: NUMERICAL SIMULATIONS AND STRUCTURAL ANALYSIS.

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The main objectives of this paper are to adapt an efficient and accurate spectral-projection method for a wind-driven, double-gyre, mid-latitude, quasi-geostrophic ocean model, and to study the double-gyre phenomena from the numerical and structural analysis points of view. A number of numerical simulations are carried out, and their structural stability and structural transition/bifurcation are investigated using a new dynamical systems theory of two-dimensional incompressible flows.

A PDE-BASED FAST LOCAL LEVEL SET METHOD.

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We develop a fast method to localize the level set method of Osher and Sethian [20], and address two important issues that are intrinsic to the level set method: (a) How to extend a quantity that is given only on the interface to a neighborhood of the interface; and (b) how to reset the level set function to be a signed distance function to the interface efficiently without appreciably moving the interface. This fast local level set method reduces the computation effort by one order of magnitude, works in as much generality as the original one, and is conceptually simple and easy to implement. Our approach differs from previous related works in that we extract all the information needed from the level set function (or functions in multiphase flow), and do not need to find explicitly the location of the interface in the space domain. The complexity of our method to do tasks such as extension and distance reinitialization is $O(N)$, where N is the number of points in space, not $O(N \log N)$ as in [12] and [23]. This complexity estimation is also valid for quite general geometrically based front motion for our localized method.