Peskin, Charles S.

The immersed boundary method. (English) Zbl 1123.74309

Acta Numerica 11, 479-517 (2002).

Summary: This paper is concerned with the mathematical structure of the immersed boundary (IB) method, which is intended for the computer simulation of fluid-structure interaction, especially in biological fluid dynamics. The IB formulation of such problems, derived here from the principle of least action, involves both Eulerian and Lagrangian variables, linked by the Dirac delta function. Spatial discretization of the IB equations is based on a fixed Cartesian mesh for the Eulerian variables, and a moving curvilinear mesh for the Lagrangian variables. The two types of variables are linked by interaction equations that involve a smoothed approximation to the Dirac delta function. Eulerian/Lagrangian identities govern the transfer of data from one mesh to the other. Temporal discretization is by a second-order Runge-Kutta method. Current and future research directions are pointed out, and applications of the IB method are briefly discussed.

MSC:

74F10	Fluid-solid interactions (including aero- and hydro-elasticity, porosity, etc.)
65M06	Finite difference methods for initial value and initial-boundary value problems involving PDEs
76D05	Navier-Stokes equations for incompressible viscous fluids
76M20	Finite difference methods applied to problems in fluid mechanics
76M25	Other numerical methods (fluid mechanics) (MSC2010)
76Z05	Physiological flows

Full Text: DOI