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An analysis of particle methods. (English) Zbl 0598.76003

Numerical methods in fluid dynamics, Lect. 3rd 1983 Sess. C.I.M.E., Como/Italy 1983, Lect. Notes Math. 1127, 243-324 (1985).

[For the entire collection see Zbl 0549.00026.]

As a method of approximation for the solution of partial differential equations the particle method has been used in fluid mechanics (particle in cell methods for the numerical computation of compressible multifluid flow and vortex methods of simulation of incompressible fluid flow at high Reynolds numbers), for the numerical solution of kinetic equations in physics (Boltzmann, Vlasov, and Fokker-Planck equations), and, more recently, in plasma physics.

A precise mathematical analysis of this numerical method has not been available until recently. These lectures consist of two chapters which provide a rigorous mathematical introduction to the particle method. The first chapter is devoted to the numerical solution of linear hyperbolic equations of the first order and contains unpublished results obtained by the author and *G. H. Cottet*. The second chapter deals with the vortex method for the Euler equations of incompressible perfect fluid flow and is based on the analysis given by *O. Hald* [SIAM J. Numer. Anal. 16, 726-755 (1979; Zbl 0427.76024)] as extended and improved by *J. T. Beale* and *A. Majda* [Math. Comput. 39, 1-27 (1982; Zbl 0488.76024) and ibid. 29-52 (1982; Zbl 0488.76025)] and by *G. H. Cottet* [Méthodes particulaires pour l'equation d'Euler dans le plans, Thèse de 3e cycle, Univ. P. et M. Curie, Paris (1982)]. Relevant references are given.

Reviewer: U.Uhlhorn

MSC:

76A02	Foundations of fluid mechanics
76D05	Navier-Stokes equations for incompressible viscous fluids
76X05	Ionized gas flow in electromagnetic fields; plasmic flow
76N10	Existence, uniqueness, and regularity theory for compressible fluids and gas dynamics
76T99	Multiphase and multicomponent flows
82B05	Classical equilibrium statistical mechanics (general)

Keywords:

Boltzmann equation; Vlasov equation; method of approximation; particle method; particle in cell methods; compressible multifluid flow; vortex methods; simulation of incompressible fluid flow; Fokker-Planck equations; numerical solution of linear hyperbolic equations; Euler equations; incompressible perfect fluid flow