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BOOK REVIEW
Particle modeling

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Series: Modeling and Simulation in Science, Engineering and Technology

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The book deals with a particle approach to modelling various physical phenomena in fluids and solids.

The medium in which a considered phenomenon takes place is modelled by a system of particles-mass points (atoms, molecules) interacting by newtonian forces. The numerical values of the forces depend on the considered species and phenomena.

Mathematically, the models are systems of second order ordinary differential equations for the positions of the particles. The equations correspond to the Newton's second law of mechanics, with the initial and boundary conditions pertinent to the considered problems.

In Part I, after explaining the general philosophy of the modelling and the partocle method in particular, two numerical methods of solving the system of ordinary differential equations are described: the leap frog method, and completely conservative method. Both methods are introduced and explained in detail by means of numerical examples.

In Part II the intuitive, simple models of various physical systems and phenomena are introduced and analysed using the particle approach: motion of elastic strings — motion of a finite system of mass points (discrete elements which form the string) with nearest neighbour interactions, elastic 2-D snap through, development of minimal surfaces, selforganization by bi-

ological cell sorting, cavity flow of particles, creation of a vortex as a result of the motion of a set of particles modelling a rigid body, formation and dynamics of liquid drops, molecular model of motion of tops and gyroscops.

The approximated solutions of the considered systems of equations are investigated. Several problems which arise during the process of obtaining the numerical solutions of the systems of equations are discussed, e.g. the velocity dumping.

In Part III several problems, important e.g. for engineering applications, are discussed, e.g. the particle models of bars, simulations of crack and fracture developments in rigid bodies, collisions of microdrops of water and a model of melting. The realistic values of the intermolecular potentials are used in the calculations.

Many of the considered two-dimensional examples can be easily generalized to three dimensions.

The book contains a large number of illustrations pertinent to the considered problems, which facilitates the reading and development of intuition, and understanding of the results of application of the particle method approach.

The book is suplemented by listings of FORTRAN programs written for some of the considered examples. It is well suited to those readers, who want to learn how to model some features of various interesting physical phenomena by elementary tools.

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