LABORATORY FOR COMPUTER SCIENCE

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PHYSICS OF COMPUTATION SEMINAR

Date: Monday, March 28, 1994
Time: Refreshments at 4:00pm
Talk at **4:15pm**
Place: 6-120

An Exact Theory For Lattice Gas Hydrodynamics

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Lattice gases are a class of dynamical systems in which particles move about on a lattice in discrete time steps. In much the same way that the Ising model and other similar lattice spin models provide simple examples of equilibrium statistical mechanical systems, lattice gases capture many features of nonequilibrium statistical mechanical systems such as fluids. In recent years, they have been used for the study and simulation of Navier-Stokes fluids, two-phase flow, convective flow, Burgers' equation, reaction-diffusion equations, magnetohydrodynamics, and a variety of other physical systems.

Most theoretical work on lattice gases has been done in a framework where the Boltzmann molecular chaos assumption is made, neglecting all correlations between the particles moving and colliding on the lattice. In this talk we describe an exact theory of lattice gases in which the effects of correlations are included. For a wide variety of lattice gases, the effect of these correlations is simply to correct or renormalize the hydrodynamic transport coefficients. We show how this correction can be calculated, and we compare some of these calculations to numerical experiments.

In addition to the quantitative refinement of lattice gas calculations, the exact theory provides a tool with which to investigate the dynamics of inter-particle correlations in lattice gases. Since the dynamics of such correlations are responsible for pattern-formation in certain systems, it is likely that this exact theory will provide important insights into the dynamical basis of self-organization.

Host: Norm Margolus

This talk is part of a seminar series on adapting computers and computations to the constraints of, and opportunities afforded by, microphysics; and on the development and application of the physical theory of computation and information. This series is being sponsored by the MIT Information Mechanics Group (Lab for Computer Science), in conjunction with the MIT Physics and Media Group (Media Lab), the MIT Porous Flow Project (Earth, Atmospheric and Planetary Sciences), and the Mathematical Sciences Research Group at Thinking Machines Corporation. If you would like to receive electronic notice of these seminars, send email to "poc@im.lcs.mit.edu."

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