ARTIFICIAL INTELLIGENCE LABORATORY

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PHYSICS OF COMPUTATION AMORPHOUS COMPUTING JOINT SEMINAR

Date: Thursday, November 5, 1998
Time: Talk at **2pm**
Refreshments after the talk
Place: NE43, 8th-floor AI Playroom

Pattern formation in a reversible physical model

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I will discuss a lattice gas model of cluster growth via the diffusive aggregation of particles in a closed system obeying a local, deterministic, microscopically reversible dynamics. This model roughly corresponds to placing the irreversible Diffusion Limited Aggregation model (DLA) in contact with a heat bath. Particles release latent heat when aggregating, while singly connected cluster members can absorb heat and evaporate. The heat bath is initially empty, hence we observe the flow of entropy from the aggregating gas of particles into the heat bath, which is being populated by diffusing heat tokens.

Before the population of the heat bath stabilizes, the cluster morphology (quantified by the fractal dimension) is similar to a standard DLA cluster. The cluster then gradually anneals, becoming more tenuous, until reaching configurational equilibrium when the cluster morphology resembles a quenched branched random polymer. As the microscopic dynamics is invertible, we can reverse the evolution, observe the inverse flow of heat and entropy, and recover the initial condition. This simple system provides an explicit example of how macroscopic dissipation and self-organization can result from an underlying microscopically reversible dynamics.

The details of the model will be presented along with an analytic formulation for the macroscopic limit of the model. The subsequent discussion will focus on the transitions in the resulting growth morphology of the clusters and the approach to thermodynamic equilibrium.

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. If you would like to receive electronic notice of these seminars, send email to "poc@mit.edu."