Diffusion Limited Aggregation

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DLA : Definition Diffusion-limited aggregation (DLA) is the process whereby particles undergoing a random walk due to Brownian motion cluster together to form aggregates of such particles. This theory, proposed by Witten and Sander in 1981 [1], is applicable to aggregation in any system where diffusion is the primary means of transport in the system.

DLA: Description The clusters formed in DLA processes are referred to as Brownian trees. Computer simulation of DLA on a lattice will change the fractal dimension slightly for a DLA in the same embedding dimension. Some variations are also observed depending on the geometry of the growth, whether it be from a single point radially outward or from a plane or line for example. Computer simulation of DLA is one of the primary means of studying this model. Several methods are available to accomplish this. Simulations can be done on a lattice of any desired geometry of embedding dimension. The idea of implementation here is to start from a point based model and consider random walk till it gets within a range of another particle and sticks to it.

Techniques 1. Random number generator with the a repetition of 1 in 10^8 2. Generation of paths to build a binary tree. A variation of binary tree data structure will be used to store values and store connections for future fractal dimension calculation 3. Timing analysis of the cluster generated. 4. Fractal dimension variation with variation in random number generator repetition.

DLA: Proposal Program to be implemented. A particle starts at a random point in a circle, a Gaussian random walk is generated, and if it finds

another particle, it sticks to it. The variations planned are 1. Changing the number of particles. 2. Changing the critical radii in which aggregation can take place. 3. (if possible) Taking into account seeding particles. 4. (if possible) Measure the transport coefficients

Methodology is to generate a 48 bit random number generator via Box-Mueller method and system clock seed. Then the grid is defined as a matrix of two dimensions that stores the values at which the particle sticks and forms the cluster. One particle is kept at the center where the particles are set. The simulation is run for different times and snapshots of the grid generated are taken. Then using a well defined algorithm, the fractal dimension of the grid is measured. Then a plot of fractal dimension with time is made. This process is essentially repeated for a 64 bit and higher bit random number generators and differences are explored. The objective is to see how differential limited aggregation can be used to explain cluster formation.

References 1. T. A. Witten Jr, L. M. Sander, Phys. Rev. Lett. 47, 1400 (1981) 2. "A survey in computational physics", Landau and Paez