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PARALLEL ENSEMBLE MONTE CARLO FORMULATION ON A CLUSTER FOR TRANSIENT CHARACTERISTICS OF GaAs

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ABSTRACT

The nature of the Ensemble Monte Carlo method where it is base on the successive and simultanious calculation of the motions of many particles during a small time interval makes it a very suitable candidate for cluster or parallel implementation. Simulating charge transport phenomena in solid state devices is usually very costly in term of computational requirements when implemented on a single processor personal computer (PCs). This is due to the fact that to ensure numerically sound simulation results, large ensembles of particle need to be simulated, something in the order of 100 000 particles. The major problem encountered in this type of simulation using the conventional ensemble or sigle particle monte carlo method is the long computational time even on the fast 2.5 MHz PCs. An altenative and cost effective solution to this problem is the application, or a computer cluster network in a master-slave model. In managing a cluster network, we have been using the Parallel Virtual Machine (PVM) standards. In this paper we report an implementation of a parallel algorithm using parallel ensemble MC simulation for device simulation with particular emphasis on transient transport phenomena in GaAs. In this simulation we present the transient charge velocities as a function of applied field at various particle numbers and the different computational times taken when in cluster enviroment.

http://journal.masshp.net/wp-content/uploads/Journal/2004/R%20Umar71-77.pdf

REFERENCES

[1] A. P. Othman, R. Umar and A. J. M Adnan. Implementing Parallel Ensemble Monte Carlo on a LINUX Cluster. Proceedings of the ATC2003 in Theoretical Sceinces 2003 (CATS 2003)

[2] Norma Alias, Dr.Mohd Salleh Sahimi Mohamed, Prof.Abdul Rahman Abdullah. Communacation Issues For Parallel Alternating Group Explicit Methods On A Distributed Memory Architechture. Proceedings of the ATC2003 in Theoretical Sceinces 2003 (CATS 2003)

[3] C. Jacoboni, and L. Reggiani. (1983) The Monte carlo method for solution of charge transport in semiconductors with application to covalent materials Rev. Mod.Phys. 55 (3), 645

[4] T. Kurosawa (1966) . Monte carlo Simulation of hot electron problems, J. Phys. Soc. Suppl, 21, 527

[5] C. Jacoboni and P. Lugli (1989), The Monte carlo method for Semiconductor Device Simulation, Springer-Verlag, New York

[6] M.V. Fischetti, and S.E. Laux (1988) Monte carlo Analysis of Electron transport in small semiconductor devices including band structure and space-charge effects Phys. Rev. B, 38 (19), 9721

[7] Zhou Xing (1995) Workshop on High Performance Computing Activities in Singapore (Unpublished)

[8] K.Tomizawa, Numerical Simulation of Submicron Devices, Artech House, Boston, 1993.

[9] http://www.epm.ornl.gov/pvm/pvm_home.html.