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FAKULTÄT FÜR ANGEWANDTE WISSENSCHAFTEN

Fakultäts - Kolloquium

Zeit: Mittwoch, 19. 05. 2004, 17.00 Uhr (s.t.)
Ort: Raum 02-016, Geb. 101, Georges-Köhler-Allee

Simulation of Quantum Computing

Prof. Dr. John P. Hayes

z.Zt. als Humboldtpreisträger zu Gast an der Universität Freiburg
(Heimatuniversität: University of Michigan, USA)

Abstract

Quantum-mechanical phenomena are playing a growing role in information processing as transistor size approaches the nanometer level, and quantum methods appear in the most secure forms of communication. Quantum algorithms can, in principle, solve some important and hitherto intractable problems such as prime factorization of large numbers. Simulating quantum computations efficiently is extremely difficult, however, because of the vast size of the state space involved. The superposition property of quantum states allows n quantum bits (qubits) to store 2^n n-bit words simultaneously. Hence the vectors modeling qubit states and the matrices representing operations on them grow exponentially with n. A further complication is caused by errors (noise) due to unwanted interactions between qubits and their environment. Consequently, although simulating quantum circuits and their associated errors is potentially useful in many applications, it is well beyond the computational abilities of most classical simulation techniques in both time and memory. In this talk, we will first review the basics of quantum computation and quantum circuits. Data structures and simulation methods that are applicable to such circuits will then be discussed. A new technique based on graph algorithms will be described which can simulate quantum circuits very efficiently. A key component of this approach is the Quantum Information Decision Diagram (QuIDD) data structure. Finally, we will present some comparative simulation results on benchmark circuits using a QuIDD-based simulator that we have developed called QuiDDPro.

Gastgeber: Prof. Dr. Bernd Becker

Alle Interessenten sind recht herzlich eingeladen.

Organisation : Prof. Dr. B. Becker / F. Schmiedle

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