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QDENSITY—A Mathematica quantum computer simulation ☆

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ABSTRACT

This Mathematica 6.0 package is a simulation of a Quantum Computer. The program provides a modular, instructive approach for generating the basic elements that make up a quantum circuit. The main emphasis is on using the density matrix, although an approach using state vectors is also implemented in the package. The package commands are defined in Qdensity.m which contains the tools needed in quantum circuits, e.g., multiqubit kets, projectors, gates, etc.

New version program summary

Program title: QDENSITY 2.0
Catalogue identifier: ADXH_v2_0
Program summary URL: http://cpc.cs.qub.ac.uk/summaries/ADXH_v2_0.html
Program obtainable from: CPC Program Library, Queen's University, Belfast, N. Ireland
Licensing provisions: Standard CPC licence, http://cpc.cs.qub.ac.uk/licence/licence.html
No. of lines in distributed program, including test data, etc.: 26 055
No. of bytes in distributed program, including test data, etc.: 227 540
Distribution format: tar.gz
Programming language: Mathematica 6.0
Operating system: Any which supports Mathematica; tested under Microsoft Windows XP, Macintosh OS X, and Linux FC4
Catalogue identifier of previous version: ADXH_v1_0
Journal reference of previous version: Comput. Phys. Comm. 174 (2006) 914
Classification: 4.15
Does the new version supersede the previous version?: Offers an alternative, more up to date, implementation
Nature of problem: Analysis and design of quantum circuits, quantum algorithms and quantum clusters.
Solution method: A Mathematica package is provided which contains commands to create and analyze quantum circuits. Several Mathematica notebooks containing relevant examples: Teleportation, Shor's Algorithm and Grover's search are explained in detail. A tutorial, Tutorial.nb is also enclosed.
Reasons for new version: The package has been updated to make it fully compatible with Mathematica 6.0
Summary of revisions: The package has been updated to make it fully compatible with Mathematica 6.0
Running time: Most examples included in the package, e.g., the tutorial, Shor's examples, Teleportation examples and Grover's search, run in less than a minute on a Pentium 4 processor (2.6 GHz). The running time for a quantum computation depends crucially on the number of qubits employed.

☆ This paper and its associated computer program are available via the Computer Physics Communications homepage on ScienceDirect (http://www.sciencedirect.com/science/journal/00104655).

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