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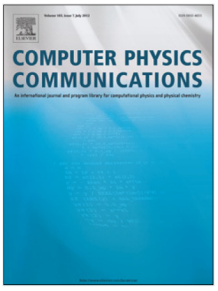

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Benchmarking gate-based quantum computers

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Abstract

With the advent of public access to small gate-based quantum processors, it becomes necessary to develop a benchmarking methodology such that independent researchers can validate the operation of these processors. We explore the usefulness of a number of simple quantum circuits as benchmarks for gate-based quantum computing devices and show that circuits performing identity operations are very simple, scalable and sensitive to gate errors and are therefore very well suited for this task. We illustrate the procedure by presenting benchmark results for the IBM Quantum Experience, a cloud-based platform for gate-based quantum computing.

Keywords: Quantum computing, benchmarking, superconducting qubits, quantum circuits

1. Introduction

As small gate-based quantum computer hardware is being made available to the public [1, 2], it is now possible for independent parties to validate and benchmark the operation of these devices. Therefore, it seems natural to introduce a suite of quantum algorithms (i.e. sequences of gate operations [3]) which should be used to validate quantum processors. The aim of this paper is to explore the potential of several different, simple sequences of gate operations that can be used

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