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RESEARCH

Performance Analysis of the Hardware-Efficient Quantum Search Algorithm

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Abstract
This article explores the Hardware-Efficient Quantum Search Algorithm and compares it with other well-known counterparts. Escalating the count of qubits may elevate susceptibility to errors, particularly in iterative algorithms such as Grover's. Conversely, Noisy-Intermediate-Scale-Quantum (NISQ) computers encounter limitation in the number of gates necessary for excecution of any quantum queries. Thus, we utilize hardware-efficient quantum search algorithm for further investigation due to its optimized circuit depth. Moreover, the Qiskit library and Matlab are used for validation of the analysis. Furthermore, the noise effects, encompassing phase-damping (PD) and amplitude-damping (AD) noises, are explored to present a comparative analsysis of various search algorithms.

Keywords Depth optimization · Hardware efficient quantum search algorithm · Noise analysis · Qiskit · Quantum amplitude estimation algorithm

1 Introduction

Quantum computing has become popular among researchers due to its unique capabilities, including the potential for exponential acceleration in solving specific problems when compared to their classical counterparts. Quantum computer technologies stand at the forefront of quantum supremacy such as the Grover search algorithm as a case [1]. However, near-term quantum computers are limited by the number of sequence of gates, i.e., circuit depth, which denotes the count of consecutive operators needed to carry out a quantum operation.

Noisy intermediate-scale quantum computers (NISQ) are well-behaved with the shallower circuits due to their low susceptibility to gate and decoherence errors [2, 3]. Quantum algorithms can potentially present quantum supremacy more than any other

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