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FVP-QAOA: A robust and scalable alternative to standard QAOA

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We present the Fixed Variational Parameters Quantum Approximate Optimization Algorithm (FVP-QAOA), a scalable variant of QAOA that keeps a constant number of variational parameters, independent of qubit count, Hamiltonian complexity, or circuit depth. By fixing the parameter count, FVP-QAOA mitigates barren plateaus in multidimensional optimization, one of the main problems to scaling variational quantum algorithms. The method implements a digitized adiabatic evolution with three smoothly parameterized schedule functions for the initial, problem, and auxiliary Hamiltonians, yielding a compact yet expressive ansatz. Benchmarks on random MaxCut instances and the Tail Assignment Problem (TAP) show that FVP-QAOA attains equal or superior performance to standard QAOA while requiring nearly constant optimization iterations. Fewer iterations translate into fewer quantum circuit evaluations, reducing quantum processor usage and overall operational cost. An experimental implementation on IBM quantum hardware with up to 50 qubits confirms the robustness and efficiency of the algorithm under realistic noise. These results position FVP-QAOA as a practical, hardware-efficient framework for scalable quantum optimization on near-term processors.

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