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Quantum Signal Detection Simulations on IBM Quantum (IBMQ) Processors[1] MAKAYLA DIXON, Dartmouth College, GREGORY QUIROZ, PARAJ TITUM, Johns Hopkins University Applied Physics Laboratory — Quantum detection methods are important for sensing Gaussian signals in noisy environments. By tuning qubit sensitivity to the signal frequency, a qubit decoheres to its ground state faster in environments with signal than without. Our approach tunes qubit sensitivity through quantum circuits. We inject signal and control via gates. Then, the circuits are run on IBMQ devices, which provide noise. To maximize qubit decoherence in the presence of a signal, we optimize the number of gates, time between gates, and gate rotation angles though variational quantum algorithms. Our current research verifies optimal control parameters for the Carr-Purcell-Meiboom-Gill (CPMG) sequence (Titum et al 2020) using the IBMQ Qasm simulator. We optimized the time between gates and gate rotation angles with two algorithm types: Simultaneous Perturbation Stochastic Approximation (SPSA) and Genetic Algorithms (GA). Continuous and discrete SPSA performed well for small numbers of CPMG cycles. Discrete GA performance depended on the crossover method. One crossover method (DEAP cxOrdered) proved consistent for large numbers of CPMG cycles, significantly outperforming discrete SPSA. We hope our optimizer analysis helps future experimentation on IBMQ hardware.

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Makayla Dixon
Dartmouth College

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