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Neural network accelerator for quantum control

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Efficient quantum control is necessary for practical quantum computing implementations with current technologies. However, conventional algorithms for determining optimal control parameters are computationally expensive, mainly excluding them from use outside of the simulation. Furthermore, existing hardware solutions structured as lookup tables are imprecise and costly. A more efficient method can be produced by designing a machine learning model to approximate the results of traditional tools. Such a model can then be synthesized into a hardware accelerator for quantum systems. Our study demonstrates a machine learning algorithm for predicting optimal pulse parameters. This algorithm is lightweight enough to fit on a low-resource FPGA and perform inference with a latency of 175ns and pipeline interval of 5ns with gate fidelity greater than 0.99. In the long term, such an accelerator could be used near quantum computing hardware where traditional computers cannot operate, enabling quantum control at a reasonable cost at low latencies without incurring large data bandwidths outside the cryogenic environment.

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