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Addressing the Current Challenges of Quantum Machine Learning through Multi-Chip Ensembles

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Practical Quantum Machine Learning (QML) is challenged by noise, limited scalability, and poor trainability in Variational Quantum Circuits (VQCs) on current hardware. We propose a multi-chip ensemble VQC framework that systematically overcomes these hurdles. By partitioning high-dimensional computations across ensembles of smaller, independently operating quantum chips and leveraging controlled inter-chip entanglement boundaries, our approach demonstrably mitigates barren plateaus, enhances generalization, and uniquely reduces both quantum error bias and variance simultaneously without additional mitigation overhead. This allows for robust processing of large-scale data, as validated on standard benchmarks (MNIST, FashionMNIST, CIFAR-10) and a real-world PhysioNet EEG dataset, aligning with emerging modular quantum hardware and paving the way for more scalable QML.

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