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Hybrid Quantum-Classical Networks for Reconstruction and Classification of Earth Observation Images

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Earth Observation (EO) has experienced promising progress in the modern era via an impressive amount of research on establishing a state-of-the-art Machine Learning (ML) technique to learn a large dataset. Meanwhile, the scientific community has also extended the boundary of ML to the quantum system and exploited a new research area, so-called Quantum Machine Learning (QML), to integrate advantages from both ML and Quantum Computing (QC). Recent papers investigated the application of QML in the EO domain mainly based on Parameterized Quantum Circuits (PQCs), which are regarded as suitable architecture for quantum neural networks (QNNs) due to their potential to be efficiently simulated on near-term quantum hardware. But more contributions are still required in-depth, and various challenges should be tackled, such as large EO image size for the current quantum simulators, trainability of the quantum circuit, etc.
This work introduces a hybrid Quantum-Classical model performing reconstruction and classification simultaneously and explores its application for EO image multi-class classification. Moreover, we investigate for the first time the correlation between different PQC descriptors and the training results in the realistic EO use case. The results demonstrate that the hybrid model successfully achieves up to 10 class classification suggesting a potential usage of QNNs for a realistic context, and also hint at generic approaches for choosing the suitable PQC architecture for a given problem.

Significance

References

Experiment context, if any

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