

Image-to-Image Wildfire Detection via Quantum-Compatible Variational Segmentation from Remotely-sensed Data

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Over the last decade, the incidence of wildfires has surged, causing widespread destruction globally. To better comprehend and manage these incidents, remote sensing and aerial missions have been implemented in recent efforts. However, this has resulted in an exponential rise in the amount of remote sensing data utilization, leading to a need for intelligent automation of data extraction in wildfire studies. Machine learning provides an accurate automated approach for detecting these natural anomalies and facilitates decision-makers to take prompt actions. To make insightful decisions in wildfire management, it is imperative to move beyond simple detection and explore the potential of probabilistic generative machine learning for creating "what-if" scenarios for various wildfire conditions. Such models offer improved representation of the stochastic nature of wildfire events. However, the optimization of these models can be computationally expensive, especially when using classical computers. Quantum computers have recently emerged as a promising solution to reduce the computational cost of training such models and improve their performance. In this study, we aim to utilize quantum-compatible machine learning techniques to implement our probabilistic generative approach. To that end, we propose a supervised probabilistic variational model consisting of a U-NET-based image-to-image component along with encoder and decoder networks which work as a variational autoencoder (VAE) component. Additionally, we explore the type of latent distribution type in the VAE component and implement different means for modeling the prior distribution. We further investigate the quantum-compatible versions of the model compared to the classical counterpart and benchmark potential benefits of quantum compatibility over the classical model.