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Quantum Generative Modelling with Conservation Law based Pretraining — •AKASH MALEMATH^{1,2}, YANNICK WERNER³, PAUL LUKOWICZ^{1,3}, and MAXIMILIAN KIEFER-EMMANOUILIDIS^{1,2,3}
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Abstract:

Compared to the recent advancements in classical generative AI, quantum generative models still lack the capability to generate complex data effectively. One of the greatest challenges in classical AI is developing systems that extract fundamental relationships from large datasets and encode them into suitable embeddings. In quantum generative AI, these concepts are still in early stages and are mostly learned using classical methods.

In this work, we evaluate embeddings inspired by conservation laws as a pretraining step, applying them to simple quantum generative models like the Quantum Circuit Born Machine (QCBM). This implicit generative model is well-suited for reproducing target distributions and is simple enough to demonstrate the benefits of pretraining. Specifically, we explore pretraining using the particle number distribution and system Hamiltonian within the QCBM, aiming to model target distributions with reduced effort. Our analysis of pretraining in QCBM focuses on its impact on model convergence and accuracy, using metrics such as Kullback-Leibler (KL) divergence, and compares pretrained models with those trained normally.

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