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Evolutionary optimization for Variational Quantum Algorithms

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Variational quantum algorithms (VQAs) are one of the most promising NISQ-era algorithms due to their feasibility for their application in vastly diverse fields. Machine learning, quantum chemistry, mathematics, finance or combinatorial problems can be tackled through VQAs. However, the underlying optimization processes within these algorithms usually deal with local minima and barren plateau problems, preventing them to scale efficiently.
Here, we demonstrate how an optimization based on Differential Evolution can help to avoid or drastically reduce the effect of these issues in cost function minimization. Starting from a 1D Ising model, we show that while some common gradient-based and gradient-free optimizers tend to significantly fail when increasing the chain length, Differential Evolution always outperforms them when finding the ground state of the system. Our results demonstrate that non-exponential multiparticle strategies can help to increase the accuracy of these algorithms in large-scale applications.

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