# Engineered dissipation to mitigate barren plateaus

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Over the past decade, near-term quantum computing devices have emerged as promising technologies, motivating the design of algorithms tailored for these platforms. Among these, variational quantum algorithms (VQAs) [1] have gained popularity. Despite their potential advantages, VQAs face a specific bottleneck in quantum settings called barren plateaus [2] whose occurrence jeopardizes quantum speedups. Inspired by the positive effects of dissipation in other machine learning contexts, our objective is to demonstrate the potential of non-unitary dynamics as a powerful mitigation strategy for this problem. In our approach, we treat the qubit circuit as an open quantum system. Unlike uncontrolled noise, which leads to barren plateaus, we exploit the presence of engineered dissipation. The overall concept is visually depicted in the figure. Our approach consistently exhibits logarithmic time complexity relative to the number of qubits, enabling us to explore previously unattainable Hamiltonian classes. We explored diverse methods for implementing engineered dissipation based on specific requirements and our methodology also includes a novel initialization strategy, opening new avenues for exploration.

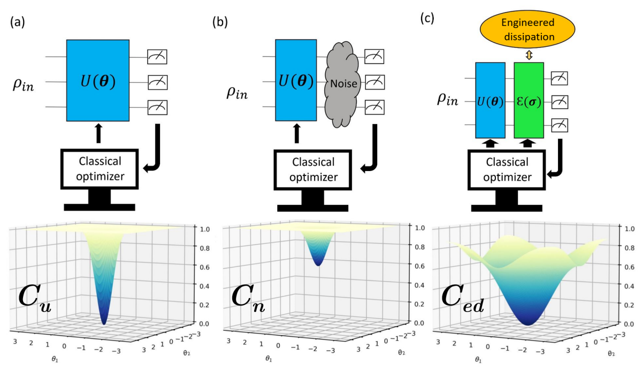


FIG. 1. Cross sections of analytical example cost function landscapes for a 20 qubits system. Fully unitary ansatz $C_u$ (a), landscape in the presence of a depolarizing channel (b), and engineered dissipation ansatz (c).

[1] Variational quantum algorithms, Cerezo, Marco et al., Nature Reviews Physics, , 625 (2021).

[2] Barren plateaus in quantum neural network training landscapes, McClean, Jarrod et al., Nature communications, 9, 1 (2018).