Classical surrogates of quantum control landscapes

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Since the introduction of the GRAPE algorithm for efficiently computing fidelity gradients, piecewise-constant controls have become a widely adopted ansatz for studying Quantum Optimal Control problems. The time evolution for this class of time-dependent Hamiltonians can be represented as a Parametrized Quantum Circuit, allowing us to analyze the properties of the fidelity as a function of the control pulses - the so-called Quantum Control Landscape - by employing concepts and techniques borrowed from Quantum Machine Learning (QML) and Variational Quantum Algorithms (VQA). Among these techniques are classical surrogate models, which represent the output of a quantum circuit as a linear combination of non-linear feature maps, providing valuable insights into the representational power of QML models and the structure of VQA landscapes. In this work, we employ classical surrogate models as a theoretical tool to investigate the properties of Quantum Control Landscapes, and to learn approximate representations of such landscapes using supervised learning.