Robust optimal control for a systematic error in the control amplitude

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In the NISQ era, physical qubits coherence time and high fidelity gates are essential to the functioning of quantum computers. In this work we demonstrate, theoretically and experimentally, that pulses (a trajectory can be found in Figure) designed by optimisation can be used to counteract the loss of fidelity due to a characterisation error of the coupling of the control to the qubit. We analyse the control landscape obtained by optimal control and find it to be dependent on the error and that the optimisation is less likely to converge at a slow gate-time. Robust controls are found for different error rates and are compared to incoherent loss of fidelity mechanism due to a finite relaxation rate. The controls are tested on the IBMQ's qubit and found to demonstrate resilience against significant ~ 10% errors.

Figures

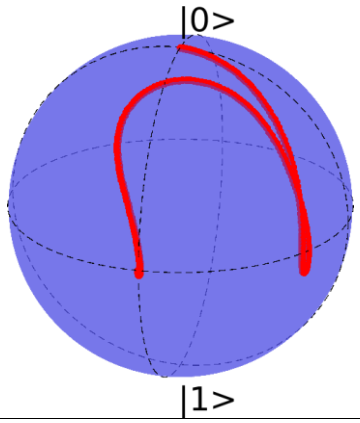

Figure: Robust trajectory of an optimised robust $X_{\pi/2}$ plotted on the Bloch sphere.