Analysis of underlying mechanisms and alleviation of static ZZ coupling

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Gate fidelities and gate times are continuously being improved in the ongoing attempts to create a superconducting quantum computer. However, the ZZ coupling remains as a fundamental obstacle to further improve the performance of current superconducting qubit systems. Here, we present a theoretical analysis of the underlying mechanisms which cause the static ZZ coupling, with the aim of both alleviating and utilizing the effect in single- and two-qubit gates. This analysis uses perturbation theory to study a simplified model and validates the results via more detailed numerical investigations. We expect that these insights into the static ZZ coupling will contribute to improving gate fidelities in two-qubit entangling gates.