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D-Wave Systems
Mitigating perturbative anticrossings with nonuniform driver Hamiltonians

The presence of small-gap perturbative anticrossings has long been identified as a computational bottleneck in quantum annealing. This bottleneck can be severe when the same transverse driver Hamiltonian is naively applied to each qubit, and all qubits are annealed in unison. Previous research has sought to alleviate such anticrossings in simulation by adjusting the transverse driver Hamiltonians on each qubit according to a perturbation approximation operating on the lowest nontrivial degree.

We apply this principle to a physical implementation of quantum annealing in a D-Wave 2000Q system, using per-qubit anneal offsets to effect nonuniform driver Hamiltonians. Our perturbation-based approach yields a systematic increase in minimum eigengap, ground state success probability, and escape rates from metastable valleys. We use the same approach to improve fair sampling of degenerate ground states.