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Reconsideration of adiabatic theorem toward efficient quantum annealing

In the standard understanding of quantum annealing, the ground state can be obtained with high probability when the quantum fluctuation slowly decreases enough with the warrant of the adiabatic theorem. Most of the preceding studies focused only on the energy gap, which is contained in the denominator of the probability generating the excited states from the ground state in the formulation of the adiabatic theorem.

We considered the adiabatic theorem again toward efficient quantum annealing, and focused on the eigenvector of all excited states in the numerator of the characteristic quantity in the adiabatic theorem as a counterpart of the energy gap therein. We confirmed that the excitation from the ground state can occur even if the energy gap is large, because of the large value of the numerator. The result implies that both of the energy gap and eigenvector are significant for efficient quantum annealing.

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