Ryo Tamura
National Institute for Materials Science
Quantum annealing for clustering of artificial data set by quantum Monte Carlo methods

Quantum annealing (QA) is an efficient method to obtain the best solution for combinatorial optimization problems [1]. Combinatorial optimization problems are often mapped to the Ising model to perform QA, some of which succeeded to realize QA experimentally by using QA processors. However, to consider the performance of QA for systems with multi-valued variables is important to clarify the potential of QA [2,3,4,5], since it is convenient to use models with multi-valued variables (e.g., the Potts model and the clock model) for the representation of some problems in the information engineering field (i.e., clustering problem, coloring problem, and grey-scale or color image recovery problems). In addition, if a machine which can treat multi-valued variable as in Ref. [6] is developed, the motive would become more significant.
In this work, as an application of QA for the systems with multi-valued variables, we compare the performances for clustering of artificial data set by QA performed by quantum Monte Carlo methods and by the general algorithm. To investigate the efficiency systematically, we used the Gaussian mixture model. We clarify the potential of QA for solving the clustering problems.
This research is collaboration work with Shu Tanaka (WIAS, Waseda University, JST, PRESTO, and MANA, NIMS).

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