

Quantum Annealing based Power Grid Partitioning for Parallel Simulation

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Graph partitioning has many applications in power systems from decentralized state estimation to parallel simulation. Focusing on parallel simulation, optimal grid partitioning minimizes the idle time caused by different simulation times for the sub-networks and their components and reduces the overhead required to simulate the cuts. Partitioning a graph into two parts such that, for example, the cut is minimal and the sub-graphs have equal size is an NP-hard problem. In this paper we show how optimal partitioning of a graph can be obtained using quantum annealing (QA). We show how to map the requirements for optimal splitting to a quadratic unconstrained binary optimization (QUBO) formulation and test the proposed formulation using a current D-Wave QPU. We show that the necessity to find an embedding of the QUBO on current D-Wave QPUs limits the problem size to under 200 buses and notably affects the time-to-solution. We finally discuss the implications of quantum hardware non-ideality on near term implementation in the simulation loop.