Quantum approximate optimization of non-planar graph problems on a planar superconducting processor

Optimization

By Terra Quantum AG
terraquantum.swiss

2021

Quantum approximate optimization of non-planar graph problems on a planar superconducting processor

Matthew P Harrigan, et al.

ABSTRACT

Faster algorithms for combinatorial optimization could prove transformative for diverse areas such as logistics, finance and machine learning. Accordingly, the possibility of quantum enhanced optimization has driven much interest in quantum technologies. Here we demonstrate the application of the Google Sycamore superconducting qubit quantum processor to combinatorial optimization problems with the quantum approximate optimization algorithm (QAOA). Like past QAOA experiments, we study performance for problems defined on the planar connectivity graph native to our hardware; however, we also apply the QAOA to the Sherrington–Kirkpatrick model and MaxCut, non-native problems that require extensive compilation to implement. For hardware-native problems, which are classically efficient to solve on average, we obtain an approximation ratio that is independent of problem size and observe that performance increases with circuit depth. For problems requiring compilation, performance decreases with problem size. Circuits involving several thousand gates still present an advantage over random guessing but not over some efficient classical algorithms. Our results suggest that it will be challenging to scale near-term implementations of the QAOA for problems on non-native graphs. As these graphs are closer to real-world instances, we suggest more emphasis should be placed on such problems when using the QAOA to benchmark quantum processors.

The full article can be found here:
https://www.nature.com/articles/s41567-020-01105-y