An Efficient Nearest Neighbor Design for 2D Quantum Circuits

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Abstract

In the last couple of years, synthesis of quantum circuits has received huge impetus among the research communities after the evolution of an efficient and powerful computational technology called “quantum computing”. But physical implementation of these circuits considers the nearest neighbor qubit interaction as the desirable one otherwise a computational error can result. Realization of such an architecture in which qubit interacts only with its adjacent neighbors is termed as the *Nearest Neighbor* (NN) property. To attain such design architecture, SWAP gates plays a significant role of bringing the qubits to adjacent locations. But this in turn introduces design overhead so NN-based realization using limited number of SWAP gates has become significant. In order to explore this area, in this article, we introduced an efficient design technique for NN realization of quantum circuits in 2D architecture. The design algorithm has been partitioned into three phases of qubit selection, qubit placement and SWAP gate implementation. To verify the exactness of the stated design approach, its functionality has been evaluated over a wide set of benchmark function and subsequently witnessed an improvement on its cost metrics. By running our algorithm an overall improvement of about 17%, 3% against existing 2D works and 35%, 22% against 1D works over SWAP gate count and quantum cost metrics have been recorded, respectively.

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