# Greedy Randomized Search for Scalable Compilation of Quantum Circuits

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**Extended Abstract.** In the work [1] we investigate the performances of greedy randomized search (GRS) techniques [2] to the problem of compiling quantum circuits to emerging quantum hardware. Quantum Computing represents the next big step towards power consumption minimization and CPU speed boost in the future of computing machines. Quantum computing uses *quantum gates* that manipulate multi-valued bits (*qubits*). A quantum circuit is composed of a number of qubits and by a series of quantum gates that operate on those qubits, and whose execution realizes a specific quantum algorithm. Current quantum computing technologies limit the qubit interaction distance allowing the execution of gates between adjacent qubits only. This has opened the way to the exploration of possible techniques aimed at guaranteeing nearest-neighbor (NN) compliance in any quantum circuit through the addition of a number of so-called *swap* gates between adjacent qubits. In addition, technological limitations (*decoherence* effect) impose that the overall duration (makespan) of the quantum circuit realization be minimized.

One core contribution of the paper [1] is a lexicographic two-key ranking function for quantum gate selection: the first key acts as a *global* closure metric to minimize the solution makespan; the second one is a *local* metric acting as "tie-breaker" for avoiding cycling. We present a GRS procedure that synthesizes NN-compliant quantum circuits realizations, starting from a set of benchmark instances of different size belonging to the *Quantum Approximate Optimization Algorithm* (QAOA) class [3] tailored for the MaxCut problem. We demonstrate that the presented meta-heuristic outperforms the approach used in previous research [3] against the same benchmark, both from the CPU efficiency and from the solution quality standpoint.

## References

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