HYBRID QUANTUM-CLASSICAL SEARCH SPACE REDUCTION HEURISTIC FOR OPTIMIZATION

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In this work we propose a hybrid quantum-classical heuristic for solving constrained approximate optimization problems. As an approximate solution, we propose a hybrid quantum-classical heuristic for solving problems whose constraints can be classified into two classes: global and partial constraints. The new approach consists of two main subroutines. In the first step, we employ a quantum subroutine to sample feasible partial solutions by imposing the partial constraints of the problem. Then, we generate solutions by concatenating partial solutions, imposing the global constraints, and addressing the cost function. This approach employs a quantum subroutine in a difficult task, reducing the search space for the classical subroutine, but with a limited resource demand, making it more appropriate for the NISQ era. We validate our results by solving the one-dimensional Bin Packing Problem [1, 2] and a the Electric Vehicle Routing and Routing Problem [3]. We also give an intuition for employing this approach for handling a broader class of optimization problems.

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[2] M. Garcia de Andoin, E. Osaba, I. Oregi, E. Villar-Rodriguez, and M. Sanz, "Comparative Benchmark of a Quantum Algorithm for the Bin Packing Problem", IEEE-SSCI 2022. (2022)

[3] M. Garcia de Andoin, A. Bottarelli, S. Schmitt, I. Oregi, P. Hauke, and M. Sanz, "Formulation of the Electric Vehicle Charging and Routing Problem for a Hybrid Quantum-Classical Search Space Reduction Heuristic", arXiv:2306.04414 (2023)

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