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Research Article

A Novel Method for Optimal Synthesis of Reversible Circuits using Metaheuristic Algorithms

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Abstract

A reversible logic circuit is a circuit that consists of reversible gates and there is a one-to-one correspondence between its inputs and outputs. These circuits have the unique input corresponding to each output, and information loss does not occur as a result. So far, many attempts have been made in the field of automatic synthesis of reversible circuits, especially with the help of knowledge engineering methods. In this research, the problem of automatic synthesis of reversible circuits was innovatively modeled into a multi-criteria optimization problem, and then a new combination of genetic and bat metaheuristic algorithms was presented to solve this optimization problem. Compared to using any of these algorithms, the proposed method has better results, especially in terms of quantum cost and circuit delay.

Keywords: Reversible circuits, Optimization, Metaheuristic algorithms.

Highlights

- The study proposes an optimized synthesis method for reversible circuits by combining genetic and bat-inspired algorithms to address multi-objective optimization.
- The proposed hybrid method enhances efficiency by dynamically sharing populations between algorithms to avoid local optima and achieve improved quantum cost and circuit delay.
- Compared to existing methods, the proposed approach demonstrates superior performance in reducing both quantum cost and latency for reversible circuits while the synthesis process is fast.

Citation: [in Persian].