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An Online Testing Technique for the Detection of Control Nodes Displacement Faults (CNDF) in Reversible Circuits

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Abstract

ensure fault-free circuit, appropriate testing model to be invoked and here in this paper we present an online testing technique that effectively detects control node displacement fault (CNDF) in quantum circuit designed with reversible gates.

Our testing approach involves two steps. In the very first step, the input circuit is transformed to its corresponding testable design by appending additional gates and lines (auxiliary lines). Next, appropriate test vectors are generated and subsequently are applied to find possible node displacement faults in the circuit. The proposed online testing approach is suitable for all type of quantum circuits built with reversible gates (MCT gates). More interestingly, some small changes in the design turn this scheme very effective for ESOP based representation as well. We have extensively tested our approach over a large spectrum of benchmarks and comparison with existing testing algorithms is also summarized in the result tables.

Keywords

Multi control toffoli (MCT) | Reversible circuit | ESOP circuit | Control node displacement fault | Online testing | Auxiliary lines

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An Online Testing Technique for the Detection of Control Nodes Displacement Faults (CNDF) in Reversible Circuits

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Abstract. With the advancements of Quantum Computing and its implementing technologies like NMR, IoN trap, the necessity of constructing fault-free quantum circuit is observed. But in way to ensure fault-free circuit, appropriate testing model to be invoked and here in this paper we present an online testing technique that effectively detects control node displacement fault (CNDF) in quantum circuit designed with reversible gates.

Our testing approach involves two steps. In the very first step, the input circuit is transformed to its corresponding testable design by appending additional gates and lines (auxiliary lines). Next, appropriate test vectors are generated and subsequently are applied to find possible node displacement faults in the circuit. The proposed online testing approach is suitable for all type of quantum circuits built with reversible gates (MCT gates). More interestingly, some small changes in the design turn this scheme very effective for ESOP based representation as well. We have extensively tested our approach over a large spectrum of benchmarks and comparison with existing testing algorithms is also summarized in the result tables.

Keywords: Multi Control Toffoli (MCT), Reversible circuit; ESOP circuit; Control node displacement fault; Online testing; Auxiliary lines.