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## FPGA-based emulation of qudit quantum Fourier transform circuit

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### Abstract content <br> &nbsp; (Max 300 words)

Quantum computing is the exploitation of quantum mechanical concepts such as entanglement and superposition to process quantum information. In some aspects of computing, quantum computing is known to outperform its classical counterpart. However, a full-scale quantum computer has not yet been realised. Therefore, in order to gain a deeper understanding of quantum circuits; which are building blocks of quantum computers, they are modelled either in software or hardware. Software simulation of quantum circuits is however limited, since it does not efficiently use parallelism, which is intrinsic in quantum computation. On the other hand, hardware-based emulation closely mimics quantum computation due to its parallelism, and the fact that emulation gives further insight on the issues of signal propagation delays and errors.

Currently, the emulation of quantum circuits has focused mainly on emulating two-dimensional quantum circuits [1-3]. In this paper, we report on the emulation of  $d$ -dimensional Quantum Fourier Transform (QFT) circuit using Field Programmable Gate Array (FPGA). We also compare the performance between software-based simulation and FPGA-based emulation.

#### REFERENCES

- [1] Negovetic G, Perkowski M, Lukac M and Buller A 2002 Evolving quantum circuits and an FPGA-based quantum computing emulator Proc. Fifth Intern. Workshop on Boolean Problems pp 15-22
- [2] Khalid A, Zilic Z and Radecka K 2004 FPGA emulation of quantum circuits Computer Design: VLSI in Computers and Processors, 2004. ICCD 2004. Proceedings. IEEE International Conference on pp 310-315 ISSN 1063-6404
- [3] Aminian M, Saeedi M, Zamani M and Sedighi M 2008 FPGA-Based circuit model emulation of quantum algorithms Symposium on VLSI, 2008. ISVLSI '08. IEEE Computer Society Annual pp 399-404

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Yes

### Level for award<br>&nbsp;(Hons, MSc, <br> &nbsp; PhD)?

PhD

### Main supervisor (name and email)<br>and his / her institution

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No

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