**PhD Project Proposal**

School of Electronics, Electrical Engineering and Computer Science

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| **Proposed Project Title:** FPGA-based Graph Signal Analysis |
| **Principal Supervisor:** Dr. J. McAllister  **Second Supervisor:** Prof. N. Robertson |
| **Project Description:** Detecting attacks on computing networks or infrastructure, or communities in social media networks all rely on graph signal analysis. Given the scale of networks and their graphs, this is an extremely computationally demanding problem which can only be realised by large-scale cloud computing resources. However, in order to allow a system to react to events in a graph, such as attacks on a computer network, this analysis needs to be performed close to the sensors where performance and power budgets so tight as to make them infeasible.There are three key challenges in making this possible.1. Dramatically increasing the performance-per-Watt of the devices used to realise graph signal analysis problems.
2. Effectively exploiting sparsity in the problems.

Devices which address the first challenge already exist – Field Programmable Gate Array (FPGA) being a leading example. However, architectures to support graph signal analysis in general, or more specifically the sparse matrix arithmetic on which they rely do not exist and are a critical enabling technology.This project addresses this challenge. It will develop a custom graph signal analysis processor which increases the performance-per-Watt of these operations on FPGA by at least an order-of-magnitude (factor 10). Key to this capability is the effective exploitation of sparse matrix arithmetic.The specific objectives of the project are: * Develop an understanding of spare matrix arithmetic and its application to graph signal analysis.
* Develop a custom computing architecture for graph signal analysis for FPGA.
* Use to proposed platform to realise key graph signal analysis algorithms.
* Optimise the architecture and/or its use based on observed performance/power metrics.
* Present your work in leading international journals and conferences in the area.
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