AIMS | African Institute for Mathematical Sciences SOUTH AFRICA

6 Melrose Road, Muizenberg
Cape Town 7945, South Africa
Tel: +27 (0)21 787 9320 Fax: +27 (0)21 7879321
Email: info@aims.ac.za Web: www.aims.ac.za

Postgraduate Report Form

Name of student: Alice Nanyanzi **Student number:** 20350201

Degree: Research masters in Mathematics **Full time / Part Time:** Full time

Supervisor: Dr. Franck Kalala Mutombo/ Dr. Simukai Utete

Co-supervisor:

Title of research project: Dynamic processes on complex networks and applications

Year of registration: 2017 **Expected submission date:** December 2018

To be completed by the student

Research aims and plan for the past six months:

- Complete the implementation and documentation of accounting for long range interactions in diffusion over networks.

- Implement long range interactions in the random walker algorithm for image segmentation and ascertain whether a better image segmentation can be obtained by this method.

- Identify a centrality measure that can be used to identify the most important financial institution (too interconnected to fail) in a financial network. Possible idea is to introduce a new centrality measure based on the generalized degree (which accounts for long range interactions) and then apply it to the ranking of financial institutions based on this centrality measure.

- Extending the concept of Laplacian centrality of a node to Laplacian centrality of an edge. Ascertain whether the edge Laplacian centrality can aid in the partitioning of networks.

Research aims and plan for the next six months:

- Studying robustness of a network on both random and targeted edge removal. In targeted edge removal, we consider the removal of edges in order of their Laplacian centrality rankings.

- Complete the analysis of results of long-range interactions in the random walker algorithm for image segmentation.

- Develop an algorithm for approximating the generalized degree for larger networks.

- Accounting for the effect of noise on consensus in networks. First, accounting for only direct interactions among agents. Second, account for both direct and long-range interactions among agents in reaching consensus.

- Impact of long range interactions on communicability in networks.

To be completed by the supervisor

Progress: Exceptional / Very good / Good / Satisfactory / Unsatisfactory

Comments by the supervisor:

Will the degree be completed in the time frame as originally planned? If not, furnish reasons:

Yes.

Signature of Student: [signature] **Date:** 01/12/17

Signature of Supervisor: [signature] **Date:** 01/12/17