NOTICE OF THESIS PROPOSAL PRESENTATION

Geodesy and Geomatics Engineering

Doctor of Philosophy

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Friday, February 12, 2016 @ 11:30 am
Head Hall – ADI Studio C-25

Supervisor:	Monica Wachowicz, Geodesy and Geomatics Engineering
Supervisory Committee:	Dave Coleman, Geodesy and Geomatics Engineering
	Trevor Hanson, Civil Engineering
	Joanna Lumsden, Aston University, UK
Chair:	TBA

Towards a Spatially-Aware Synchronization Model for Predicting Vehicular Flows

ABSTRACT

Nowadays we are witnessing a paradigm shift in gathering mobility data with greater spatial granularity and temporal frequency that were not possible before. Predicting vehicular flows brings additional challenges on how to handle across-scale effects when using vehicle mobility data gathered from different sources. There are several mathematical models proposed in the literature for modeling vehicular flows, but they have been developed based on a single scale setting, i.e. micro-, meso-, and micro- scale. The modeling of the vehicular flows across scales using heterogeneous data sources is, therefore, still elusive. This research proposal advocates the use of synchronization for predicting vehicular flows across scales. Synchronization is a hierarchical physical process wherein many oscillators adjust a given property due to interactions among themselves over a period of time. Although the synchronization models allow the integration of different mobility metrics (e.g. velocity, acceleration, or heading) from data gathered from a variety of technologies, they have never been used for modeling vehicular flows. In their present form, the synchronization models have no spatial structure, meaning that synchronization models do not consider the location nor the movement of oscillators in geographical space, which leads to these research questions: Would the geographical location of vehicles have an influence on the synchronization of their speed? Would neighbor vehicles reach synchronization sooner if they are moving closer to each other in a highway? To answer them, the overall research goal of this research proposal is to extend an existing synchronization model, the Kuramoto Model, in order to introduce the spatial structure and the spatial movement of the oscillators (i.e. vehicles), obtaining as a result a spatially-aware synchronization model for predicting vehicular mobility flows across scales. This research proposal proposes the use of a spatial network, which will allow modeling the interactions between oscillators. The spatial network will represent the vehicles as nodes and the links of the network will represent the interaction between these vehicles. The research challenge is to determine the hierarchical rules for the synchronization levels that will allow the prediction of the flows across scales. The knowledge about how flows are created, exist and end at various spatial and temporal scales using a unique model will advance our current understand about self-organization in vehicular flows.

Faculty Members and Graduate Students are invited to attend the presentation