The Final Oral Examination
for the Degree of

DOCTOR OF PHILOSOPHY
Department of Geography

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2006 University of Guelph BSc
2007 Centre of Geographic Sciences Ad.Dip. GIS
2009 University of Victoria MSc

“Developing Quantitative Methods for Movement Data”

Monday, July 15, 2013
10:00am
Social Science & Mathematics Building, B25

Supervisory Committee:
Dr. T. Nelson, Department of Geography, Uvic (Supervisor)
Dr. R. Canessa, Department of Geography, Uvic (Member)
Dr. F. Nathoo, Department of Mathematics, Uvic (Outside Member)

External Examiner:
Dr. M. Goodchild, University of Washington

Chair of Oral Examination:
Dr. Mijung Kim, Department of Curriculum and Instruction, UVic
Abstract

Scientists are now able to collect ubiquitous data on individual-level movement at increasingly fine spatial and temporal resolutions. Despite this surge in data availability, methods for extracting relevant information about spatial-temporal movement patterns remain limited in scope and sophistication. The objective of this PhD research is to develop novel quantitative approaches for analyzing spatial-temporal patterns in modern movement datasets. A review of the state-of-the-art in quantitative movement analysis identifies the current breadth of available methods, while highlighting key limitations and fragmentation in the literature across multiple disciplines. Existing theory from the geographical literature, namely time geography is applied to a novel application – wildlife movement ecology (termed the PPA home range), in an attempt to expose these ideas to wildlife researchers. The PPA home range method has several advantages over existing methods, most notably its ability to identify omission and commission error in existing home range techniques. Next, an advance to time geography theory is proposed for incorporating object kinetics (i.e., velocity and acceleration) into a probabilistic movement model termed kinetic-based probabilistic time geography. Kinetic-based probabilistic time geography provides a more accurate model for predicting object movement when object kinetics are relevant (e.g., with fast moving vehicles, or athletes). A novel method (termed the DI index) for quantifying dynamic interactions between moving objects is presented, focusing specifically on examining cohesive movement behaviour. The DI index is advantageous over existing dynamic interaction measures in that it is computed at the local level, facilitating a finer treatment of interactive movement behaviour. The DI index is then contrasted with seven alternative measures of dynamic interaction to examine the effectiveness of each at identifying expected and unexpected interactive behaviour, at a range of sampling resolutions, in the context of wildlife movement ecology. The
results highlight the value of the DI index, especially as a local level index, capable of identifying variable and infrequent interactions in pairs of moving objects. In summary, this dissertation contributes to the rapidly expanding body of quantitative movement research by providing: 1) a cross-disciplinary methodological review, 2) expanding the application of core time geography theory to wildlife ecology, 3) advancing time geographic theory in development of kinetic-based probabilistic time geography, 4) developing a novel index (the DI index) for measuring inter-object interactions, and 5) examining the effectiveness of available dynamic interaction measures, and their sensitivity across sampling resolutions, in the context of wildlife ecology.

**Awards, Scholarships, Fellowships**

2012 Howard E. Petch Research Scholarship, University of Victoria  
2012 MA & DE Breckenridge Graduate Award, University of Victoria  
2012 Melva J. Hanson Graduate Scholarship, University of Victoria  
2012 W.R. Derrick Sewell Scholarship, University of Victoria  
2010 NSERC PGS-D Fellowship

**Presentations**

   CAG GIScience Study Group Award for Best Student Presentation.


**Publications**


