

Editorial

GIScience Research at the Thirty-second Annual Esri International User Conference

The eight articles included in this issue of *Transactions in GIS* were gathered from a call for abstracts and will be presented in three research sessions scheduled for the third day of the Thirty-second Annual Esri International User Conference to be held in San Diego, California. A total of 32 abstracts were submitted and nine were selected by the journal editors for preparation of full journal articles. Each of the manuscripts has been through the usual journal peer review process and the final versions of the eight research articles included in this special issue have been revised in light of both the reviewer's and editor's feedback. They cover a wide range of topics and address some of the key concepts and applications of geographic information science from a variety of perspectives. Two of the articles describe new methods for movement pattern analysis, several describe ontology engineering and various ways to support data interoperability and data exchange, two consider various aspects of spatial decision system design and performance, another examines methods for assessing the vertical accuracy of surfaces, and many focus some attention on methods for spatio-temporal analysis.

The first article, by Jennifer A. Miller explores how spatially explicit simulated data can be used to analyze dynamic interactions, using a case study of hyenas in northern Botswana. Five different techniques were used to quantify dynamic interactions based on GPS data of pairs of individuals, and all were compared in the context of spatially explicit simulated data intended to represent biologically realistic null models for individual movement, and subsequently paired interactions. This is but one example of the kinds of innovations that will be needed to take full advantage of the large volumes of highly accurate data on moving objects provided by GPS and related satellite tracking systems. The interactions between individuals that were the focus of this study can be considered a second order property of movement and are a fundamental aspect of a species' behavioral ecology, including their mating and territorial behavior, resource use, and infectious disease epidemiology.

The second article, by Simon Jirka, Arne Bröring, Peter C. Kjeld, Jon Maidens and Andreas Wytzisk, describes a practical scenario in which Sensor Web Enablement (SWE) technology enables the exchange of near real-time environmental data on a large scale. The main contribution of this article is a lightweight profile for the Open Geospatial

Consortium's Sensor Observation Service that ensures the necessary interoperability for seamlessly integrating the environmental data provided by the European Environment Agency's (EEA's) member states and supporting a variety of data exchange mechanisms. The resulting Sensor Web architecture and the integration into the EEA's existing IT infrastructure are also described.

The third article, by Naicong Li, Robert Raskin, Michael F. Goodchild and Krzysztof Janowicz, describes a collaborative effort by the Spatial Decision Support (SDS) Consortium to build a SDS knowledge portal. The authors start by presenting the formal representation of knowledge about SDS, the various ontologies captured and made accessible by the portal, and the processes used to create them. They next describe the portal in action, and the ways in which users can search, browse, and make use of its content, and they close with a discussion of the lessons learned from this effort, and future development directions. By doing this, the authors demonstrate how ontologies and semantic technologies can support the documentation and retrieval of dynamic knowledge in GIScience using flexible schemata in place of fixed data structures.

The fourth article, by Ola Ahlqvist, Thomas Loffing, Jay Ramanathan and Austin Kocher, describes the initial development of a generic framework for integrating Geographic Information Systems (GIS) with Massive Multi-player Online Gaming (MMOG) technology to support the integrated modeling of human-environment resource management and decision-making. They describe their use of a design-based research approach to develop a prototype "GeoGame" framework that allows users to play board-game-style simulations on top of an online map, and they draw on several lines of evidence to argue that their MMO GeoGame-framework offers a viable approach to addressing the complex dynamics of human-environmental systems, which require a simultaneous reconciliation of both top-down and bottom-up decision making where stakeholders are an integral part of a modeling environment.

The fifth article, by Krzysztof Janowicz, notes the massive amounts of heterogeneous data that are now available and argues that this trend requires a radical paradigm shift in ontology engineering away from a small number of authoritative, global ontologies developed top-down, to a high number of local ontologies driven by application needs and developed bottom-up out of observation data. He also argues that the next generation of knowledge infrastructures must enable users to become knowledge engineers themselves; and to that end, he proposes an observation-driven ontology engineering framework, shows how its layers can be realized using specific methodologies, and relates the framework to existing work on geo-ontologies.

The sixth article, by Christopher E. Oxendine, Mukul Sonwalkar and Nigel Waters, proposes a multi-objective, multi-criteria approach to improve situational awareness in emergency response and evacuation routing situations using cell phone data. Their method calculates evacuation routes for individual cell phone locations, minimizing the time it would take for a sample population to evacuate to designated safe zones based on both distance and congestion criteria, and seeks to maximize coverage of individual cell phone locations, using the criteria of underlying geographic features, distance and congestion. The overarching goal of their network-based methodology is to provide additional analytic support to emergency services personnel for evacuation planning.

The seventh article, by XiaoHang Liu, Peng Hu, Hai Hu and Jason Sherba, presents approximation theory as a new method for analyzing the vertical accuracy of digital elevation models (DEMs). This article dismisses the traditional approaches that rely on error propagation theory and statistics like the Root Mean Square Error (RMSE) because the critical assumption behind it cannot be satisfied and the non-random, non-normal, and non-stationary nature of DEM error makes it very challenging to apply statistical

methods. With this as background, the article goes on to present approximation theory, explain the computation of the key terms, and illustrate how this new methodology based on approximation theory effectively facilitates DEM accuracy assessment and quality control.

The final article, by Diansheng Guo, Xi Zhu, Hai Jin, Peng Gao and Clio Andris, takes us back to the mobility theme introduced in the first article, by proposing a new method for discovering spatial structure in massive mobility data. This article focuses on a special type of mobility data, i.e. origin-destination pairs, and presents a new approach to the discovery and understanding of spatio-temporal patterns in the movements. Their two-step approach relies on spatial clustering of massive GPS points to recognize potentially meaningful places and the extraction and mapping of flow measures of clusters to understand the spatial distribution and temporal trends of movements. The authors present a case study with a large dataset of taxi trajectories in Shenzhen, China to demonstrate and evaluate their methodology (and to show that it is scalable to large data sets).

These eight articles, taken as a whole, illustrate the breadth and depth of geographic information science scholarship and best practices across a variety of collaborative disciplines (e.g. computer science, environmental science and engineering, geography, information science, and urban planning) and application domains (e.g. data management, ecology, emergency response, ontology engineering, simulation, spatial analysis and spatial decision support). Special thanks are owed to the authors and especially those who provided the peer reviews for helping to move these articles from extended abstracts to reality in just a few short months. I trust that all involved will see how these contributions bore fruit when you read the final versions of the articles in this fifth issue of *Transactions in GIS* organized around three research sessions that are hosted by Esri and given a prominent place in its International User Conference program.

John P. Wilson
Editor