COM.Geo 2013

The 4th International Conference on Computing

for Geospatial Research & Application

July 22-24, 2013, San Jose, CA

PROGRAM

www.com-geo.org

Program at a Glance

Monday, July 22

7:30 - 16:30	**Registration**		
8:30 - 9:00	**Microsoft TechShow / NASA TechShow / MIT TechShow / COM.Geo TechShow**		
9:00 - 9:50	**OGC Keynote I**: **OGC Standards and Big Data Analytics**		
9:50 - 10:10	**Coffee Break** *(Club Regent Foyer)* & **TechShow**		
10:10 - 11:00	**Microsoft Keynote II: A Fresh Look at Mobile Location Sensing**		
11:00 - 11:50	**IFTF Keynote III**: **Unexplored 3D Worlds: The Futures of Focal Plane GIS**		
12:00 - 13:20	**Welcome Banquet** *(Pagoda)*		
13:20 - 15:00	**Full Paper Session I**	**Short Paper Session I**	**Brainstorm Corner**
	Club Regent Room	*Crystal Room*	*Pagoda Lounge*
15:00 - 15:20	**Coffee Break** *(Club Regent Foyer)* & **TechShow**		
15:20 - 17:20	**Full Paper Session II**	**Briefing Paper Session I (with Hot Talks)**	**Brainstorm Corner**
	Club Regent Room	*Crystal Room*	*Pagoda Lounge*
13:00 - 17:30	**Exhibition, Job Fair, Posters, Networking**		

Tuesday, July 23

7:30 - 16:30	**Registration**		
8:30 - 9:00	**Microsoft TechShow / NASA TechShow / MIT TechShow / COM.Geo TechShow**		
9:00 - 9:50	**Microsoft Keynote IV**: **To the edge of the Universe and back again: The evolution of the WorldWide Telescope and the ideas that inspired GeoFlow**		
9:50 - 10:10	**Coffee Break** *(Club Regent Foyer)* & **TechShow**		
10:10 - 11:00	**Google Keynote V**: **Big Data Storytelling through Interactive Maps**		
11:00 - 12:00	**NASA & Intelesense Keynote VI**: **NASA World Wind Infrastructure for Spatial Data**		
12:00 - 13:20	**Tech Banquet** *(Pagoda)*		
13:20 - 15:00	**Plenary Forum -- Emerging Tech Panel+: Geospatial Computing: An Eye Towards the Future**		
	Club Regent		
15:00 - 15:20	**Coffee Break** *(Club Regent Foyer)* & **TechShow**		
15:20 - 17:20	**Full Paper Session III**	**Short Paper Session II (with Posters)**	**Brainstorm Corner**
	Club Regent Room	*Crystal Room*	*Pagoda Lounge*
15:20 - 17:20	**Exhibition, Job Fair, Posters, Networking**		

Wednesday, July 24

7:30 - 11:30	**Registration**	
8:45 - 12:00	**NASA Workshop I**	**OGC Workshop II**
	Worldwide Geospatial Data Collaboration	**Location Based Access Control on Geospatial Data with GeoXACML Policies**
	Club Regent Room	*Crystal Room*
10:00 - 10:20	**Coffee Break** *(Club Regent Foyer)*	
8:30 - 18:00	**Tech Museum of Innovation -- Spirit of Silicon Valley**	
	Free Admission for COM.Geo 2013 Attendees	

Message from General Chair

It is our great pleasure to welcome you to the 4th International Conference on Computing for Geospatial Research and Application; in short form, COM.Geo 2013, which takes place in the capital of Silicon Valley, San Jose, California, U.S.A. on July 22-24, 2013.

The explosion of the power and sophistication of computing applications in the past few years has revolutionized the way we live and work. This marked trend is of especial significance for geospatial computing, which directly relates to the very foundations of our society and essentially embraces all the diversification of its activities. Geospatial information, already important in many scientific and engineering disciplines, is increasingly becoming an integral component in consumer-driven technologies. How to further improve or enhance geospatial information processing, organizing, analysis, and visualization? Especially, handling rising flood of digital data from many difference sources puts serious technical and scientific challenges.

With rapid progress of information processing and multiple disciplines, there are more and more promising computing technologies, which could be employed to solve these problems. At present, cloud computing, mobile computing, visual computing/GPU computing, business intelligence, Internet of Things (IoT), and social computing have been playing key roles in geospatial applications. Some latest computing advancements, such as big data computing, heterogeneous computing, IoT/sensor computing, and bio-computing, have great potentials for the effective realization of information processing in the geospatial environment.

The COM.Geo conference not only focuses on the latest computing technologies for multidisciplinary research and development that enables the exploration in geospatial areas, but also highlights the impacts of these current and prospective computing technologies on the future of the geo-world. Our consideration is intended to bring fresh thoughts to explore new directions for geospatial research and development. The conference also provides a vision and a combined outlook for both computer and geospatial communities, i.e., how computing technology is changing the landscape of geospatial applications and how diverse geospatial information processing requires the change of various computing technologies. COM.Geo is playing a guiding role to advancing the technologies in computing for geospatial fields.

COM.Geo conference is a leading-edge conference on computer science and technology for geospatial research and application. It is also an exclusive event that builds a bridge between

Message from General Chair

computing and geospatial fields. It connects researchers, developers, scientists, and application users from academia, government, and industry in all related fields. The previous COM.Geo conferences keynotes were delivered from White House Office/USGS, DOD, DOT, DHS, U.S. FCC, Microsoft, Oracle, Nokia, OGC, MIT, etc. The attendees were from more than 50 countries all over the world. COM.Geo publications, read and cited worldwide, have broad impact on the development of theory, method and practice in geospatial computing.

Innovative geospatial research and application technologies are the brightest spotlights at COM.Geo conference. COM.Geo 2013 has exciting and high quality technical program sessions including brainstorm plenary keynotes, leading-edge panels, emerging tech shows, workshops, full papers, short papers, briefing papers, tech talks, demo talks, posters, hot short talks, and exhibits for the conference. Furthermore, at the conference, Microsoft, NASA, IFTF, MIT, Stanford University, and OGC reveal their latest cool technologies and give the key insights about Microsoft GeoFlow for upcoming Excel 2013, energy efficient GPS sensing with cloud offloading for location-based services, Big Data analytics, worldwide geospatial data collaboration, innovative mobile city exploration, augmented reality, Location-based access control for geospatial data, etc. This year, the subfield program is also explored on computer vision and image processing with geospatial techniques. This strong combination is largely due to the technology improvements in both domains and strong commercial application incentives.

Special thanks to Keynote and Plenary Speakers, Dr. Carl Reed, Dr. Jie Liu, Mr. Mike Liebhold, Mr. Curtis Wong, Dr. Jayant Madhavan, Dr. Kristian Kloeckl, Mr. Patrick Hogan, and Dr. Kevin Montgomery, for their insightful vision to be delivered to our attendees. We appreciate the generosity of sponsors and partners: Computing for Geospatial Research Institute, NASA, Microsoft, Microsoft Research, Google, OGC, George Washington University, Stanford University, MIT, and IEEE & CPS. We also would like to acknowledge the invaluable efforts and contributions of COM.Geo team and student volunteers.

We look forward to an exciting week of sharing technical ideas and visions with colleagues from around the world. We thank you for attending the conference and being a part of this very important event.

Lindi Liao, Ph.D.

COM.Geo 2013 General Chair and Program Chair

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General Information

About COM.Geo Conference

COM.Geo Conference is a leading-edge conference on computer science and technology for geospatial information research and applications. It focuses on the latest computer and information technologies for multidisciplinary research and development that enables the exploration in geospatial areas.

Innovative computing for geospatial research and application technologies are the spotlights at COM.Geo conference. "Turn innovative ideas into reality" is the highlight of COM.Geo conference. COM.Geo is playing a guiding role to advancing the technologies in computing for geospatial fields.

COM.Geo Conference is an exclusive event that bridges the gap between computing and geospatial areas, and connects professionals from academia, government, and industry in all related fields. COM.Geo Conference provides a forum for researchers, decision-makers, developers, and application users to present and discuss the most recent innovations, trends, experiences and concerns in both fields of computer science and geospatial information. The conference features the presentation of research papers, application case studies, technical briefings, workshops, courses, panels, demonstrations, and updates on use of advanced computing for geospatial techniques in industry.

COM.Geo 2013 is the 4th International Conference and Exhibition on Computing for Geospatial Research and Applications on July 22-24, 2013 in San Jose, California, USA.

The COM.Geo 2013 Proceedings are published by IEEE and available at IEEE Digital Library for world distribution.

Alcohol

The COM.Geo conference expects all attendees to act responsibly when consuming alcoholic beverages. Consumption of alcohol by those under the age of 21 is prohibited.

Bags/Packages

For security reasons, the COM.Geo conference is unable to hold attendees' bags, packages, briefcases, coats, laptops or other personal items at registration. Be sure to keep your own safety and the security of your belongings.

Internet Access

The internet access connections are limited. Speakers can access internet through wired connections on the podium.

Non-Smoking Policy

The COM.Geo conference maintains a non-smoking policy in all meeting rooms, the exhibit room, and the registration room. Smoking is allowed only in designated smoking areas of the hotel.

Photography and Videography in Sessions

Photos and videos can be taken during presentations with the permission of the presenters.

Presentation Content

The COM.Geo conference is an open forum for sharing the results of research and application in computing for geospatial and related specialties. The contents of presentations by individuals or groups at the COM.Geo conference are their alone. The COM.Geo conference neither endorses nor disclaims the conclusions, interpretations, or opinions expressed by speakers at the conference.

Professional Conduct

Professional ideas and information are exchanged most effectively at the COM.Geo conference in an atmosphere free of abuse or harassment and characterized by courtesy and respect. To that end, the COM.Geo conference expects all individuals who attend to conduct themselves in a manner that establishes an atmosphere free from discriminatory practices.

Registration

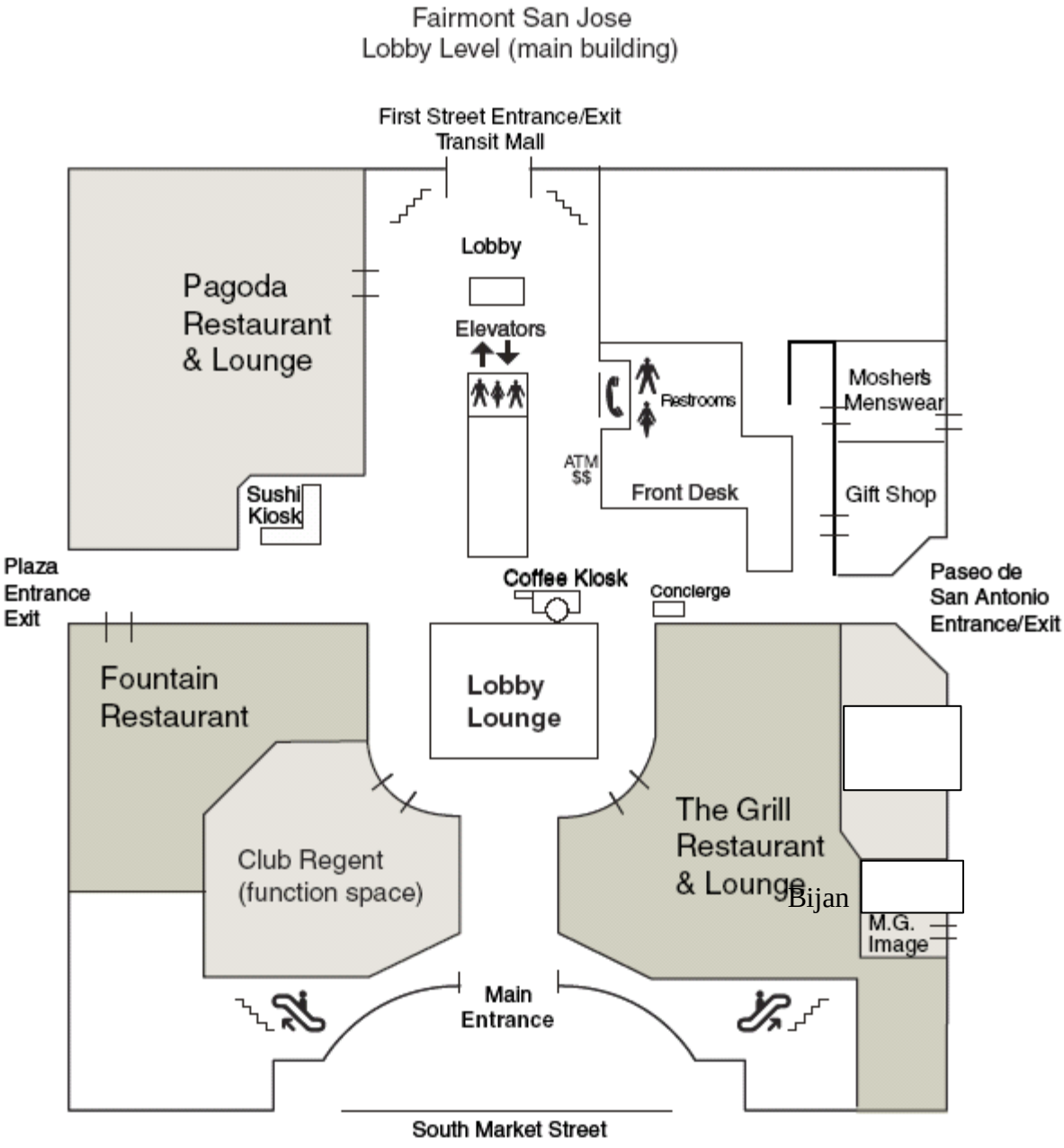
The COM.Geo conference Registration Desk will be located on the first level of the Fairmont San Jose hotel. Registration will be open during the following hours:

Monday July 22 7:40 a.m. – 4:30 p.m.
Tuesday July 23 8:00 a.m. – 4:30 p.m.
Wednesday July 24 8:00 a.m. – 12:30 p.m.

Venue Information

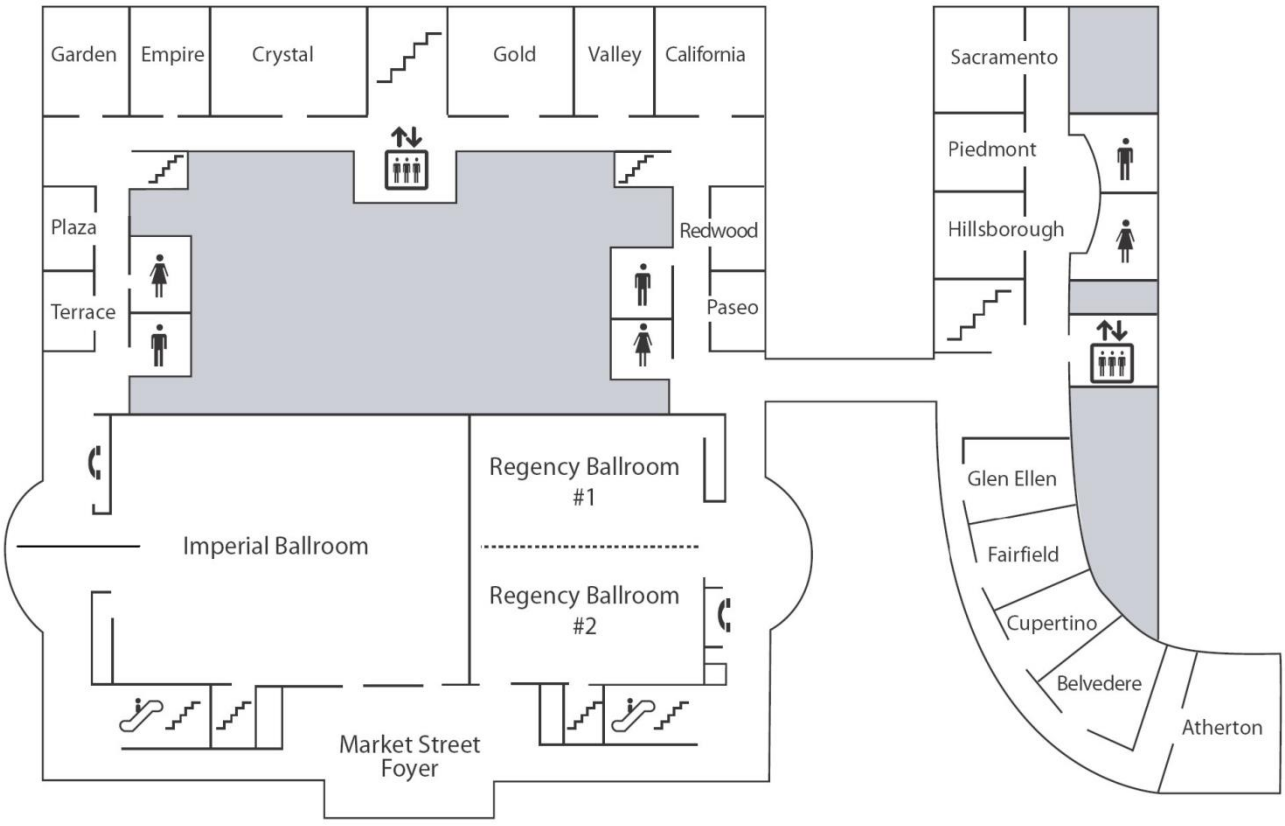
The Fairmont San Jose
170 South Market Street
San Jose, California, 95113
Tel: +1 408 998 1900
Fax: +1 408 287 1648
Toll Free: 1 866 540 4493
sanjose@fairmont.com

Location of Meeting Rooms



Location of Meeting Rooms

Banquet Level



Plenary Sessions Club Regent

Monday, July 22

Keynote Chair:
Mr. Patrick Hogan
NASA World Wind Manager, NASA

Opening Remarks July 22 8:45 AM - 9:00 AM

Keynote I: OGC

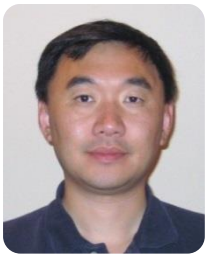
July 22 9:00 AM - 9:50 AM

Dr. Carl Reed
CTO, OGC

OGC Standards and Big Data Analytics

This talk will explore the use of Open Geospatial Consortium (OGC) standards in the context of Big Data requirements and analytics for accessing and processing geospatially-enabled content. A short description of the OGC is provided. This is followed by a discussion of how key OGC standards are or can be used for Big Data applications. The discussion of OGC standards and Big Data analytics is in the context of geospatial information and sensor fusion. Examples are provided. The talk concludes with a discussion of some of the key issues, such as provenance, quality, security and privacy, facing the use of geospatial data in Big Data applications.

Dr. Carl Reed is currently the Chief Technology Officer and an Executive Director of the Open Geospatial Consortium (OGC). Dr. Reed is responsible for facilitating the OGC standards development process, chairing the OGC Architecture Board, and Chairing the OGC Planning Committee. Dr. Reed also participates in and collaborates with other standards organizations, including OASIS, NENA, W3C, ISO, and the IETF. As a result, Reed has contributed to numerous internet and web standards. During his tenure at the OGC, Reed has written numerous book chapters and articles and presented dozens of keynotes at geospatial/GIS conferences. Prior to the OGC, Reed was the vice president of geospatial marketing at Intergraph and pervious to that President of Genasys Americas. Dr. Reed received his PhD in Geography, specializing in systems architectures for GIS technology, from the State University of New York at Buffalo in 1980. In 1995 and in 2009, Reed was voted one of the 10 most influential people in the GIS industry. For his contributions to the geospatial industry, in 2009 Reed was inducted into the URISA GIS Hall of Fame.



Keynote II: Microsoft Research

July 22 10:10 AM - 11:00 AM

Dr. Jie Liu
Principal Researcher & SERG Manager, Microsoft Research

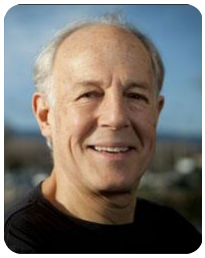
A Fresh Look at Mobile Location Sensing

Location-based services have become ubiquitous thank to the sensors like GPS and WiFi in our smart phones and other mobile devices. However, continuous location sensing such as logging, tracking, and geo-fencing, consume too much energy and shorten device battery life. In this talk, we take a fresh look at location sensing, in both outdoor and indoor settings. For outdoor location, we dive into the principles of GPS receivers and show that by offloading GPS processing to the cloud, we can reduce the device side energy consumption by three orders of magnitude. For indoor location, we discover that commercial FM signals are good sources of location signatures that work better than WiFi signatures by themself, and works even better if combined with WiFi signatures. These low energy approaches enable always-there location services without users paying battery life penalty.

Dr. Jie Liu is a Principal Researcher at Microsoft Research, Redmond, WA, and the manager of its Sensing and Energy Research Group (SERG). He is an ACM Distinguished Scientist. His research interests root in understanding and managing the physical properties of computing. Examples include timing, location, energy, and the awareness of and impact on the physical world. He has published broadly in areas like wireless sensor networks, mobile and embedded systems, ubiquitous computing, and energy efficient cloud computing. Dr. Liu is an Associate Editor of ACM Trans. on Sensor Networks, has been an Associate Editor of the IEEE Trans. on Mobile Computing, and has chaired a number of top tier conferences. Dr. Liu received his Ph.D. degree from Electrical Engineering and Computer Sciences, UC Berkeley in 2001. From 2001 to 2004, he was a research scientist at Palo Alto Research Center (formerly Xerox PARC).

Keynote III: Institute for the Future

July 2 11:00 AM - 11:50 AM



Mr. Mike Liebhold

Senior Researcher, Distinguished Fellow, Institute for the Future

Unexplored 3D Worlds: The Futures of Focal Plane GIS

In this talk we explore some future impacts and challenges of combinatorial innovations in sensing, mapping and rendering and computing technologies enabling humans and machines to intimately interact with rich 3D geospatial data in a vertical focal plane view. We'll start with a tour through recent developments in sensor fusion, machine vision, and liquid data cloud supercomputing and then tour a few of the more interesting cartographic frontiers including augmented reality, robotic SLAM (Simultaneous Location and Mapping) and geolocated simulations.

Mike Liebhold is a Senior Researcher And distinguished Fellow at IFTF.org, the Institute for the Future, focusing on the mobile and abundant computation, immersive media and geospatial web foundations for context-aware and ubiquitous computing. Previously, Mike was a Visiting Researcher, Intel Labs, working on a pattern language based on semantic web frameworks for ubiquitous computing. At IFTF MIke leads ongoing work in geospatial, and location services for companies like Intel, Nokia, Toyota, Daimler, Nissan, and Fujitsu, among others. In 2003 Mike was a producer and program leader for the Technology Horizons "New Geography" Conference at the Presidio of San Francisco for technologists and strategic planners from top tier companies and the public to better understand the emerging geospatial information infrastructure. The event included The Fort Scott Locative Experience, a hands-on field exercise for conference attendees exploring a prototype geospatial web combining digital geodata and modern web hypermedia - deploying a prototype geo browser to read and write W3C and OGC standard data objects. Prior to joining IFTF, Mike contributed to creation of GeoRSS, (the first web standard way to geocode web objects). Before that, during the late 1990s Mike worked on GPS enhanced precision agriculture in rural and remote regions. Mike is currently active in the AR, Augmented Reality community, launched the first ARdev camp, replicated worldwide, and was invited to join the W3C POI (Points of Interest) working group as an outside expert. Mike's work in geospatial computing began as an idea for a hypermedia atlas in the late '70s leading to a Lab Director's role at Atari labs working with early MIT augmented reality artists, and authors of the Aspen movie map - the pre-eminent model for heads-up geography. Later, from 1983 -1993 at Apple's Advanced Technology Group Mike created early hypermedia maps and lead work on the Terraform project - an early predecessor to a google earth-like computational framework, and on hyper-annotated video and augmented reality. In the '80s Mike was instrumental in forging a partnership between Apple, the National Geographic society, and Lucasfilm to produce new geographic digital media. Mike is a frequent speaker, has given keynotes at Where 2.0, Location Intelligence, URISA, NSDGIC and the UK Ordnance Survey conferences and has authored a number of papers, including one recently published in the Nieman Reports, the Harvard Journalism Review, entitled "Digital Immersion: Augmenting Places With Stories And Information" and an earlier co-authored paper published in a special edition of the IEEE Journal on Pervasive Computing, "Data Management in the World-Wide Sensor Web." Most recently Mike was profiled in the 12/2011 Ericson Business Review in the cover story entitled "Augmented Reality Check.

Tuesday, July 23

Keynotes Chair:
Dr. Lindi Liao
COM.Geo Institute

Keynote IV: Microsoft Research

July 23 9:00 AM - 9:50 AM

Mr. Curtis Wong

Principal Researcher, Microsoft Research

To the edge of the Universe and back again: The evolution of the WorldWide Telescope and the ideas that inspired GeoFlow

To the edge of the Universe and back again: The evolution of the WorldWide Telescope and the ideas that inspired GeoFlow

More than five years ago, WorldWide Telescope (WWT) was launched at the TED conference as the realization of a dream to build a high performance accurate interactive 3D model of the Universe populated by the highest resolution imagery of the heavens from ground and space based telescopes. The goal of the project was to build an interactive spatial temporal data visualization environment that could empower kids of all ages to explore and understand the Universe.

Since that time WWT has garnered more than ten million users of all ages on every continent on Earth. WWT features narrated interactive guided tours of the Universe produced by a wide spectrum of users from a 6 year old talking about the Ring Nebula to educators creating an interactive tour to help 6th graders understand the phases of the moon with a 3D simulation

of the Moon's movement around the Earth, to Astrophysicists telling the story of the research to visualize the large scale structure of the Universe. WWT also has the capability to do large scale visualization and is installed in some of the biggest planetariums in the US in San Francisco, New York and Chicago. The Adler Planetarium's 80 megapixel digital dome is showing Cosmic Wonder the first fully interactive planetarium show produced and completely using WWT.

A private internal version of WWT was also used as a prototyping platform to explore challenges of high performance interactive geospatial and temporal data visualization. This research work inspired the Microsoft Office product group to create Project GeoFlow a geospatial temporal data visualization capability for Office Excel 2013 which is now in public beta preview.

This talk will cover some of the key ideas within WorldWide Telescope and how they are relevant to interactive geospatial data visualization and the development of ideas within GeoFlow.

Curtis Wong, Principal Researcher at Microsoft Research, is responsible for basic and applied research in media and interaction. He has been granted more than 35 patents with 15 more pending. Recently, Curtis has led the effort to enable interactive spatial temporal data visualization as a broad capability for everyone to gain insight into the growing tide of data that is being generated from devices and services. This work, codenamed Project GeoFlow, will be released as part of Excel 2013 later in the year and is Microsoft's first geospatial temporal data visualization application for the broad market.

Previously, Curtis conceived and developed Project Tuva in collaboration with Bill Gates to make the Messenger Series Lectures by acclaimed Nobel Prize winning theoretical physicist Richard P. Feynman freely available over the Internet. In 2008 Curtis fulfilled a lifelong goal to create the WorldWide Telescope (WWT), which is a free, rich interactive virtual simulation of the entire visible Universe to enable kids of all ages to explore and understand the Universe.

Keynote V: Google

July 23 10:10 AM - 11:00 AM

Dr. Jayant Madhavan

Tech Lead for Google Fusion Table
Staff Software Engineer,
Structured Data Research group
at Google Inc.

Big Data Storytelling through Interactive Maps

Google Fusion Tables (GFT) is often used by data journalists to create interactive maps that are then embedded in their news articles. These maps offer journalists the ability to overlay large geo-spatial datasets on Google Maps, customize their presentation and combine them with complementary datasets, without needing any software development skills beyond cut-and-paste. More importantly, they do not have to worry about any systems and scalability issues associated with visualizing large datasets nor supporting massive user traffic. In this talk, I will highlight the motivation and design underlying GFT, a web offering that brings easy-to-use data management in the cloud to data enthusiasts. Such users have interesting datasets, but not necessarily the technical expertise to manage their datasets. By relieving our users of the need to deal with systems issues, we let them focus on their storytelling and advocacy, tasks that better suit their interests and make better use of their expertise.

Dr. Jayant Madhavan is a member of the Structured Data Research group at Google Inc. He is broadly interested in enabling users make better use of structured data on the Web. He is currently the technical lead for Google Fusion Tables, a cloud data management solution. He was the Chief Architect at Transformic Inc., a data integration portal that was acquired by Google. He is a co-recipient of the Ten Year Best Paper Award at VLDB 2011. He received a Ph.D. from the University of Washington in 2005.

Keynote VI: NASA

July 23 11:00 AM - 12:00 PM

Patrick Hogan

NASA World Wind Manager,
NASA

NASA World Wind Infrastructure for Spatial Data

Spatial information intelligence is a global issue that will increasingly affect our ability to survive as a species. Collectively we must better appreciate the complex relationships that make life on Earth possible. Providing spatial information in its native context can accelerate our ability to process that information. To maximize this ability to process information, three basic elements are required: data delivery (server technology), data access (client technology), and data processing (information intelligence). NASA World Wind provides open source client and server technologies based on open standards. The possibilities for data processing and data sharing are enhanced by this inclusive infrastructure for geographic

information. It is interesting that this open source and open standards approach, unfettered by proprietary constraints, simultaneously provides for entirely proprietary use of this same technology.

Why World Wind? Over ten years ago NASA World Wind began as a single program with specific functionality, to deliver NASA content. But as the possibilities for virtual globe technology became more apparent, we found that while enabling a new class of information technology, we were also getting in the way.

Researchers, developers and even users expressed their desire for World Wind functionality in ways that would service their specific needs. They want to add their own features. They want to manage their own data. They told us that only with this kind of flexibility, could their objectives and the potential for this technology be truly realized. World Wind is a set of development tools, a software development kit (SDK) that allows a software engineer to create applications requiring geographic visualization.

Modular Componentry. Accelerated evolution of a technology requires that the essential elements of that technology be modular components such that each can advance independent of the other elements. World Wind therefore changed its mission from providing a single information browser to enabling a whole class of 3D geographic applications. Instead of creating a single program, World Wind is a suite of components that can be selectively used in any number of programs.

World Wind technology can be a part of any application. Or it can be extended with additional functionalities by application developers. World Wind makes it possible to include virtual globe visualization and server technology in support of any objective. As open source, the world community can collectively collaborate in advancing this technology, and thereby continually benefit from optimization and increased functionality of this open source infrastructure.

Open Source + Open Standards = Accelerated Solutions. NASA World Wind is NASA Open Source software. This means that the source code is fully accessible for anyone to freely use, even in association with proprietary technology.

Facilitate Solutions. The ability to effectively deliver spatial data is an essential element of the US Executive Order 12906 for the National Spatial Data Infrastructure (NSDI). Open standards for data format facilitate data access. In the same manner, an open source 'standard' visualization tool facilitates the ability for others to generate spatial data solutions, proprietary or other. This open source technology for data access and visualization, also improves the ability for information intelligence, the analytical results, to be readily and more effectively shared. NASA World Wind open source technology provides the foundational tool for spatial data visualization and facilitates the creation and evolution of spatial data analysis and information exchange.

Mr. Patrick Hogan currently manages the NASA World Wind development team, a group of world class engineers producing open source software that has received National awards and NASA Software of the Year for 2009/2010. During his 20 years with NASA, Patrick managed environmental programs and more recently the NASA Learning Technologies (NLT) program. NLT was an incubation 'tank' for technologies to move NASA content into education. NLT is where World Wind was born. Patrick, a former pilot, deep sea diver and high school science teacher, has a Master's in Earth Science and is a Registered Geologist in the State of California.

Dr. Kevin Montgomery
CEO, Intelesense Tech.
Sr. Researcher, Stanford University

Dr. Kevin Montgomery is the Chief Executive Officer of Intelesense Technologies. He is also a Senior Researcher at the Center for Innovation in Global Health at Stanford University, and formerly the Director of the National Biocomputation Center there, where his team developed advanced technologies in medicine for NASA, DoD, NIH, and other clients. Dr Montgomery is a veteran of multiple startups, earned a Smithsonian Award in telemedicine, serves as a technical advisor to the DoD, and holds a Ph.D. in Computer Engineering from the University of California. He has over 25 years of technical experience and 20 years of management experience leading high-performance teams in academia, government, and industry.

Technical Full Paper Sessions

Technical Full Paper Session I

Monday, July 22 1:20 PM – 3:00 PM

Club Regent Room

Session Chair:
Dr. Hongli Deng, Object Video

Superpixel Clustering and Planar Fit Segmentation of 3D LIDAR Point Clouds
Hamid Mahmoudabadi, Timothy Shoaf, Michael Olsen

Terrestrial laser scanning (TLS, also called groundbased Light Detection and Ranging, LIDAR) is an effective data acquisition method capable of high precision, detailed 3D models for surveying natural environments. However, despite the high density, and quality, of the data itself, the data acquired contains no direct intelligence necessary for further modeling and analysis - merely the 3D geometry (XYZ), 3-component color (RGB), and laser return signal strength (I) for each point. One common task for LIDAR data processing is the selection of an appropriate methodology for the extraction of geometric features from the irregularly distributed point clouds. Such recognition schemes must accomplish both segmentation and classification. Planar (or other geometrically primitive) feature extraction is a common method for point cloud segmentation; however, current algorithms are computationally expensive and often do not utilize color or intensity information. In this paper we present an efficient algorithm, that takes advantage of both colorimetric and geometric data as input and consists of three principal steps to accomplish a more flexible form of feature extraction. First, we employ a Simple Linear Iterative Clustering (SLIC) superpixel algorithm for clustering and dividing the colorimetric data. Second, we use a plane-fitting technique on each significantly smaller cluster to produce a set of normal vectors corresponding to each superpixel. Last, we utilize a Least Squares Multi-class Support Vector Machine (LSMSVM) to classify each cluster as either 'ground', 'wall', or 'natural feature'. Despite the challenging problems presented by the occlusion of features during data acquisition, our method effectively generates accurate (>85%) segmentation results by utilizing the color space information, in addition to the standard geometry, during segmentation.

Keywords: LIDAR, Laser Point Cloud, Superpixel, Machine Learning, Clustering, SVM

Out-of-core Efficient Blending for Underwater Georeferenced Textured 3D Maps
Matthew Johnson-Roberson, Mitch Bryson, Bertrand Douillard, Oscar Pizarro, Stefan Williams

This paper presents a system for the creation of georeferenced 3D maps projectively textured with visual data gathered with an underwater robot. Using optical stereo cameras, maps are reconstructed and textured. Within the paper we propose a novel out-of-core 2D texture blending process that allows for high resolution texturing of complex 3D structure. Through the use of state-of-the-art model parameterization and texture atlasing the distortion of the final result can be minimized while the resolution of the original source imagery is maintained.We demonstrate both synthetic and real texturing results on 3D maps gathered with the Sirius Autonomous underwater vehicle (AUV). We discuss the implications for insufficient resolution when observing benthic features. Finally we conclude and discuss future directions for underwater 3D blending.

Road Segmentation in Aerial Images by Exploiting Road Vector Data
Jiangye Yuan, Anil Cheriyadat

Segmenting road regions from high resolution aerial images is an important yet challenging task due to large variations on road surfaces. This paper presents a simple and effective method that accurately segments road regions with a weak supervision provided by road vector data, which are publicly available. The method is based on the observation that in aerial images road edges tend to have more visible boundaries parallel to road vectors. A factorization-based segmentation algorithm is applied to an image, which accurately localize boundaries for both texture and nontexture regions. We analyze the spatial distribution of boundary pixels with respect to the road vector, and identify the road edge that separates roads from adjacent areas based on the distribution peaks. The proposed method achieves on average 90% recall and 79% precision on large aerial images covering various types of roads.

Ground Penetrating Radar Data Classification Using Hidden Markov Models and Support Vector Machines
Rebecca Williams, Laura Ray, James Lever, and Amy Burzynski

This paper presents methods to automatically classify ground penetrating radar (GPR) images of crevasses on ice sheets. We use a combination of support vector machines (SVM) and hidden Markov models (HMM) with down sampling, a pre-processing step that is un-biased and suitable for real-time analysis and detection. We performed modified cross-validation experiments with 129 examples of Greenland imagery from 2011, collected by a lightweight robot towing a GPR and a Pisten Bully tractor. The data were collected between Thule Air Base and Summit Station in Greenland. In order to minimize false positives, a HMM classifier is trained to pre-screen the data and mark locations in the GPR files to evaluate with an SVM, and we evaluate the classification results with a similar modified cross validation technique. The combined HMM-SVM method retains all the correct classifications by the SVM, and reduces the false positive rate to .0007. This method also reduces the computational burden in classifying GPR traces because the SVM is only being evaluated on select pre-screened traces. Our experiments demonstrate the promise, robustness and reliability of real-time crevasse detection and classification with robotic GPR surveys.

Keywords: Ground penetrating radar, support vector machines, hidden Markov models, crevasses

Technical Full Paper Session II

Monday Jul 22 3:30 PM -5:00 PM

Club Regent

Technical Full Paper Sessions

Session Chair:
Prof. Simon Berkovich, COM.Geo & GWU

A Benchmarking Framework for Efficient and Convenient Evaluation of Trajectory Compression Algorithms
Jonathan Muckell, Paul Olsen, Jeong-Hyon Hwang, Catherine T Lawson, S. S. Ravi

Trajectory compression algorithms eliminate redundant information in the history of a moving object. Such compression enables efficient transmission, storage, and processing of trajectory data. Although a number of compression algorithms have been proposed in the literature, no common benchmarking platform for evaluating their effectiveness exists. This paper presents a benchmarking framework for efficiently, conveniently, and accurately comparing trajectory compression algorithms. This framework supports various compression algorithms and metrics defined in the literature, as well as three synthetic trajectory generators that have different trade-offs. It also has a highly extensible architecture that facilitates the incorporation of new compression algorithms, evaluation metrics, and trajectory data generators. This paper provides a comprehensive overview of trajectory compression algorithms, evaluation metrics and data generators in conjunction with detailed discussions on their unique benefits and relevant application scenarios. Furthermore, this paper describes challenges that arise in the design and implementation of the above framework and our approaches to tackling these challenges. Finally, this paper presents evaluation results that demonstrate the utility of the benchmarking framework.

Geostatistical Approach for Computing Absolute Vertical Accuracy of Digital Terrain Models
Gev Ben-Haim, Sagi Dalyot, Yerach Doytsher

Digital Terrain Models (DTMs) are widely and intensively used as a computerized mapping and modeling infrastructure representing our environment. There exist many different types of wide-coverage DTMs generated by various acquisition and production techniques, which differ significantly in terms of geometric attributes and accuracy. In aspects of quality and accuracy most studies investigate relative accuracy relying solely on coordinate-based comparison approaches that ignore the local spatial discrepancies exist in the data. Our long-term goal aims at analyzing the absolute accuracy of such models based on hierarchical feature-based spatial registration, which relies on the represented topography and morphology, taking into account local spatial discrepancies exist. This registration is the preliminary stage of the quality analysis, where a relative DTM comparison is performed to determine the accuracy of the two models. This paper focuses on the second stage of the analysis applying the same mechanism on multiple DTMs to compute the absolute accuracy based on the fact that this solution system has a high level of redundancy. The suggested approach not only qualitatively computes posteriori absolute accuracies of DTMs, usually unknown, but also thoroughly analyzes the absolute accuracies of existing local trends. The methodology is carried out by developing an accuracy computation analysis using simultaneously multiple different independent wide-coverage DTMs that describe the same relief. A comparison mechanism is employed on DTM pairs using Least Squares Adjustment (LSA) process, in which absolute accuracies are computed based on theory of errors concepts. A simulation of four synthetic DTMs is presented and analyzed to validate the feasibility of the proposed approach.

Keywords: Digital Terrain Models; Quality Assessment of Spatial Data; Accuracy; Error Modeling; Geostatistics

Generating Bridge Structure Model Details by Fusing GIS Source Data using Semantic Web Technology
Pedro Maroun Eid and Sudhir Mudur

Many parameter values needed for creating high fidelity 3D models of components above and below the terrain of a region may not be explicitly present in the GIS source data gathered for that region, but may be implicit in the combined knowledge in these multiple types of data sets. Hence considerable effort from GIS experts is often involved in the creation of high fidelity 3D models. In this paper, we propose a Data Extractors framework which fuses data from shapefile, elevation, and imagery datasets and automatically derives specific parameter values needed for creating 3D models in the region of interest. The goal is to produce a virtual area in more detail with lower turnaround time than the state of the art in geospecific region modeling. We demonstrate the application of our framework for creating detailed models of bridge structures using data typically available from GIS datasets.

Keywords: 3D GIS; Landscape Visualization; Semantic Web; Automated Reasoning; Terrain Modeling

Internet of Things as a Methodological Concept
Nima Bari, Ganapathy Mani, Simon Berkovich

Nowadays, we are witnessing formation of a new technological marvel: Internet of Things. This construction is able to combine in a particular operational entity all the bits and pieces of the world around us. Thus, why could not this unique establishment present the long-sought essence in the Nature of Things? The two pillars of modern fundamental science-relativity and quantum mechanics-are just approximate descriptions of some properties of such a constructive possibility. The machinery of the physical world develops on a cellular automaton model employing as the transformation rule the mechanism of distributed mutual synchronization with the property of fault-tolerance. This infrastructure yields traveling wave solutions that exactly correspond to the spectrum of the stable elementary particles of matter with an upper bound on the propagation speed. On top of the considered cellular automaton infrastructure there appears a secondary formation that constitutes the mechanism of the Holographic Universe that is the basis for the Internet of Things. The holographic activities determine all the quantum mechanics properties of the physical world including the nonlocality entanglement. For living systems the arrangement of the Internet of Things elucidates the most puzzling biological capability of

morphogenesis that otherwise cannot find any reasonable explanation. In this paper, we present the world view of internet of things and the application of this methodology from geospatial computing to physics. We give specific details on applying IoT concept to geospatial analysis in various fields from agriculture to medicine. We also provide detailed analysis of the profound impact of internet of things on our physical world which is a vital knowledge when it comes to geospatial research. We present calendar variation of quantum world which can be used for geospatial data gathering by fine tuning the equipment based on the time of the year.

Keywords: Internet of Things (IoT); geospatial IoT; holographic mechanism; cosmic microwave background

Technical Full Paper Session III

Tuesday Jul 23 3:30 PM - 5:20 PM

Club Regent Room

Session Chair:
Dr. Hongli Deng, Object Video

Engaging Outdoor User Experience Based on High Fidelity 3D Terrain Representation on Mobile Apps
Umberto Di Staso, Marco Soave, Raffaele De Amicis

In recent years, several mobile devices with excellent performances have become accessible to people at affordable prices. The availability of this equipment, especially in the mobile sector, has encouraged research and development of increasingly complex applications ("Apps") for the visualization of large-scale scenes. However, 3D maps typically available through mobile version of so-called "spinning globes" do not allow the use of high definition data, due to their hardware limitations compared to desktop devices. As a result it often happens that a final user is navigating a real life familiar area, without being able to recognize its orography or specific features that are typical of the real world due to the poor resolution of the underlying 3D geometry. This is particularly amplified within mountain areas where crests, ridges and valleys are not adequately represented, due to the low resolution of the underlying digital terrain model, severely limiting the user's experience.

Keywords: component; Tourism, Location-Based Service, Mobile, Human Computer Interaction, Social, Terrain Rendering.

Geospatial Management and Utilization of Large-Scale Urban Visual Reconstructions
Clemens Arth, Jonathan Ventura, Dieter Schmalstieg

In this work we describe our approach to efficiently create, handle and organize large-scale Structure-from-Motion reconstructions of urban environments. For acquiring vast amounts of data, we use a Point Grey Ladybug 3 omnidirectional camera and a custom backpack system with a differential GPS sensor. Sparse point cloud reconstructions are generated and aligned with respect to the world in an online process. Finally, all the data is stored in a geospatial database. We incorporate additional data from multiple crowd-sourced databases, such as maps from OpenStreetMap or images from Flickr or Instagram. We discuss how our system could be used in potential application scenarios from the area of Augmented Reality.

Image Based Localization in Indoor Environments
Jason Zhi Liang, Nicholas Corso, Eric Turner, Avideh Zakhor

Image based localization is an important problem with many applications. In previous work, we presented a two step pipeline for performing image based localization of mobile devices in outdoor environments. In the first step, a query image is matched against a georeferenced 3D image database to retrieve the "closest" image. In the second step, the pose of the query image is recovered with respect to the "closest" image using cell phone sensors. As such, a key ingredient of our outdoor image based localization is a 3D georeferenced image database. In this paper, we extend this approach to indoors by utilizing a 3D locally referenced image database generated by an ambulatory depth acquisition backpack that is originally developed for 3D modeling of indoor environments. We demonstrate retrieval rate of 94% over a set of 83 query images taken in a indoor shopping center and characterize pose recovery accuracy of the same set.

Keywords: image retrieval, indoor localization, 3D reconstruction

The Personality of Venues: Places and the Five-Factors ('Big Five') Model of Personality
Vlad Tanasescu, Christopher B Jones, Gualtiero Colombo, Martin J Chorley, Stuart Allen, Roger Whitaker

Venues are often described by their type and characteristics, while their level of appreciation by users is indicated through a score (star rating). However the judgement on a particular venue by an individual may more influenced by the individual's experience and personality. In psychology, the five-factor model of personality, or 'Big Five' model, describes an individual's personality in terms of openness, conscientiousness, extraversion, agreeableness and neuroticism. This work explores the notion of 'personality of a venue' by reference to personality traits research in psychology. To determine the personality of a venue, keywords are extracted from reviews of venues, and matched to terms indicative of personality traits dimensions. The work is completed with a human experiment where participants qualify venues according to a set of personality descriptors. Correlations are found between the human annotators and the automated extraction approach

Keywords: Five Factor Model, place, personality, reviews, recommendation

Technical Short Paper Sessions

Technical Short Paper Session I

Monday, July 22 1:20 PM - 3:00 PM

Crystal Room

Session Chair:

Dr. Ge Jin, COM.Geo & Purdue University

Security Considerations on Processing of geospatial Information in the Cloud

Andreas Matheus

The strength of cloud computing is that it dramatically reduces the investment costs for users, required for processing high-volume geospatial data. But in order to have confidential or even classified geospatial data processed in the cloud, service level agreements must ensure the seamless protection of the data. This paper introduces standards for the implementation of security requirements applicable to cloud computing and discusses the concerns towards secure processing of information in the cloud

Demonstrating the utility of a new 3D visualization-based cost-benefit analysis tool for adaptation to sea level rise and storm surge

Samuel Merrill, Patrick Cunningham, Paul Kirshen, Derek Sowers, Chris Keeley

In summer 2011 the US EPA's Climate Ready Estuaries program awarded funds to the Piscataqua Region Estuaries Partnership in coastal New Hampshire to further develop and use COAST (COastal Adaptation to Sea level rise Tool) for sea level rise adaptation planning. The New England Environmental Finance Center (EFC) worked with municipal staff, elected officials, and other stakeholders to select specific locations, vulnerable assets, and adaptation actions to model using COAST. The EFC then collected the appropriate base data layers, ran the COAST simulations, and provided visual, numeric, and presentation-based products in support of the planning processes underway in both locations. These products helped galvanize support for the adaptation planning efforts, and demonstrate utility of this new GIS-based approach to community engagement for cost-benefit analysis of adaptations municipalities might take in response to sea level rise (SLR) and storm surge (SS).

Keywords: Sea level rise, storm surge, visualization, cost-benefit analysis. 3D visualization

DEM Generation with SAR Interferometry Based on Weighted Wavelet Phase Unwrapping

Maryam Rahnemoonfar

Synthetic aperture radar Interferometry (InSAR) is a significant 3D imaging technique to generate a Digital Elevation Model (DEM). The phase difference between the complex SAR images displays an interference fringe pattern from which the elevation of any point in the imaged terrain can be determined. Phase unwrapping is the most critical step in the signal processing of InSAR and especially in DEM generation. In this paper, a least squares weighted wavelet technique is used which overcomes the problem of slow convergence and the less-accurate Gauss-Seidel method. Here, by decomposing a grid to low-frequency and high-frequency components, the problem for a low-frequency component is solved. The technique is applied to ENVISAT ASAR images of Bam area. The experimental results compared with the Statistical-Cost Network Flow approach and the DEM generated from a 1/25000 scale map of the area shows the effectiveness of the proposed method.

Keywords: DEM, InSAR, Phase unwrapping, wavelet.

Similarity-Based Compression of GPS Trajectory Data

Jeremy Birnbaum, Hsiang-Cheng Meng, Jeong-Hyon Hwang, Catherine Lawson

The recent increase in the use of GPS-enabled devices has introduced a new demand for efficiently storing trajectory data. In this paper, we present a new technique that has a higher compression ratio for trajectory data than existing solutions. This technique splits trajectories into sub-trajectories according to the similarities among them. For each collection of similar sub-trajectories, our technique stores only one subtrajectory's spatial data. Each sub-trajectory is then expressed as a mapping between itself and a previous sub-trajectory. In general, these mappings can be highly compressed due to a strong correlation between the time values of trajectories. This paper presents evaluation results that show the superiority of our technique over previous solutions

Mapping the Internet: Geolocating Routers by Using Machine Learning

Armand Prieditis & Gang Chen

Knowing the geolocation of a router can help to predict the geolocation of an Internet user, which is important for local advertising, fraud detection, and geo-fencing applications. For example, the geolocation of the last router on the path to a user is a reasonable guess for the user's geolocation. Current methods for geolocating a router are based on parsing a router's name to find geographic hints. Unfortunately, these methods are noisy and often provide no hints. This paper presents results on using machine learning methods to "sharpen" a router's noisy location based on the time delay between one or more routers and a target router or end user IP address. The novelty of this approach is that geolocation of the one or more routers is not required to be known.

Keywords: Geolocation, Machine Learning, Prediction, Clustering

Technical Short Paper Session II

Tuesday, July 23 3:30 PM - 5:20 PM

Crystal Room

Session Chair:

Prof. Simon Berkovich, COM.Geo & GWU

Asking spatial questions to identify GIS functionality

Song Gao, Michael F. Goodchild

Current desktop-GIS software cannot answer users' spatial questions directly. The GIS functionality is hard to identify and use without specific training of GIS skills because of the complex hierarchical organization and the gap between users' spatial thinking and systems' implement descriptions. In order to bridge this gap, we propose a semantic framework for designing a question-based user interface that integrates different levels

of ontologies (spatial concept ontology, domain ontology and task ontology) to guide the process of extracting the core spatial concepts and translating them into a set of computational or operative GIS tasks. We also list some typical spatial questions that might be posed for spatial analysis and computation. The principle introduced in this paper could be applied not only to desktop-GIS software but also to web map services. The semantic framework would be useful to enhance the ability of spatial reasoning in web search engines (e.g. Google semantic search) and answering questions in location-based services as well (e.g. iPhone Siri assistant).

Keywords: GIS; functionality; spatial questions; ontology; semantic

Analysis of Spatial Autocorrelation for Traffic Accident Data based on Spatial Decision Tree

Bimal Ghimire, Shrutilipi Bhattacharjee, S. K. Ghosh

With rapid increase of scope, coverage and volume of geographic datasets, knowledge discovery from spatial data have drawn a lot of research interest for last few decades. Traditional analytical techniques cannot easily discover new, implicit patterns, and relationships that are hidden into geographic datasets. The principle of this work is to evaluate the performance of traditional and spatial data mining techniques for analysing spatial certainty, such as spatial autocorrelation. Analysis is done by classification technique, i.e. a Decision Tree (DT) based approach on a spatial diversity coefficient. ID3 (Iterative Dichotomiser 3) algorithm is used for building the conventional and spatial decision trees. A synthetically generated spatial accident dataset and real accident dataset are used for this purpose. The spatial DT (SDT) is found to be more significant in spatial decision making.

Keywords: Spatial Knowledge Discovery, Spatial Decision Tree, Spatial Autocorrelation, Traffic Accident Data

CARL: Crash Attribute and Reference Locator

Kyle Schutt, Joe Newman, Kitty Hancock, Peter Sforza

Customizable tools that extend the functionality and enhance existing features within a software system are the keys to continued innovation. Depending on complexity, current and proposed projects tend to push the limits of existing functionality and require new tools to perform unique processes. Fortunately, software engineers and designers have taken this paradigm to heart and have created software systems with extensible architectures and frameworks. This paper presents one such customization for Esri ArcGIS that addresses the unique concerns and requirements of an ongoing project at the Center for Geospatial Information Technology involved with geolocating police reported vehicle crashes in the Commonwealth of Virginia. The tool takes advantage of theories and concepts from both computer science and geographic information systems to assist geocoders with evaluating, locating, and attributing crash data. Additionally, the tool provides a centralized web-based administrative portal for project managers.

Keywords: ArcGIS, Esri, Information Theory, Vehicle Crash, Geocoding

Application of Statistical Methods in City Economic and Living Standard Study -a Case of China (2003-2008)

Wenjing Cao

In recent years, statistical methods are used more and more in the field of economic and living standard, which is a very important indicant reflecting the degree of society development and people' living quality. This paper uses 14 economic and living indexes to analyze and evaluate economic and living standard of China from year 2003 and 2008. The results show that three components can be extracted as 'income and expense capability', 'asset investment situation' and 'whole economical strength (poor or rich)' from these 14 indexes. Besides, all study areas in this study can be divided into three groups according to their living standard, which is related with development degree and geographical location.

Keywords: economic and living standard; regression analysis; principal component; cluster analysis

Evaluation of Geospatial Settings for Expanded Motions

Michaela Demuth, Reinhard Mueller

In task executing it is necessary to make decisions. Very often decisions depend on special conditions and circumstances. A decision support may be helpful if the best choice search is based on a multidimensional space of possibilities. In geospatial based applications positioning and localization are essential criteria for most ongoing decisions. Where are you and where do you want to go? The general navigation problem along a valid path is still served and optimized by intelligent algorithms. The focus of this paper is highlighted by the quest of associated spaces for navigation if the maneuver motions need expanded locations. An approach method for detection and evaluation of such environment based on geospatial data will be introduced and demonstrated using a maritime example of application.

Keywords: Cellular Automata, discontinued path, vehicle maneuvering

Posters *(Abstracts in Page 23-25)*

Characterization of Moving Point Objects in Geospatial Data;
Representing Spatiotemporal Context of Public Space for Urban Design;
Efficient Online Sharing of Geospatial Big Data Using NoSQL XML Databases;
3D Geographic Feature Data Collections Applying LiDAR Remote Sensing for Street and Highway Maintenance Applications - A Case Study for the New York State Thruway Authority;
GIS-based gold potential mapping in the Muteh deposit area, Iran with respect to a new mineralization concept;
Coupling Simulations of Human Driven Land Use Change with Natural Vegetation Dynamics

Technical Briefing Papers Session (with Hot Short Talks)

Monday, July 22 3:20 PM - 5:20 PM

Crystal Room

Session Chair:

Prof. Ge Jin, Purdue University/COM.Geo

Agent Based Modeling of Moving Point Objects in Geospatial Data

Sambit Bhattacharya, Bogdan Czejdo, Rakesh Malhotra, Nicolas Perez, Rajeev Agrawal

We describe a framework for agent based modeling of moving point objects. Spatial movements are generated based on two overlapping ontologies. The first ontology includes the landmarks and descriptive outdoor behavior attributes. The second ontology includes indoor space and descriptive indoor behavior attributes. The modeling is based on ontology that includes the landmarks and descriptive behavior attributes of moving objects. The goal of our research in this area is to generate various spatial movements of point objects that can be classified into different known patterns. The agent behaviors can be modified semi-automatically based on changes in ontologies. This modeling is accomplished over a representation of a real-world data like road networks.

Keywords: moving point objects; agent based modeling; ontology; geospatial data

Detecting Dynamic and Static Geo-Social Communities

Frank Lin, Ray Renner

How communities form can depend on the geospatial location of people within a social network. Here, we investigated the implementation of the label propagation algorithm (LPA) and LabelRankT community detection algorithm in Gephi, a graph visualization tool. We researched extending these community detection algorithms to incorporate the geospatial distance between nodes in a network as a limiting factor for the automatic detection of community formation.

Keywords: Social Network Analysis, Geo-Social Community Detection, Label Propagation Algorithm

Monitoring Sensor Measurement Anomalies of Streaming Environmental Data Using a Local Correlation Score

Ian Taylor, Julia Sharp, David Lawrence White, Jason Hallstrom, Gene Eidson, J. Barr von Oehsen, Edward B Duffy, Charles V Privette, III, Charles T Cook, Aravindh Sampath, Gyanas Radhakrishnan

Real-time quality control (QC) of streaming natural resource data is needed to support the delivery of high quality data to system users. QC processes need to enable the identification of aberrations, as well as trends that may indicate degradation or component failures. These QC processes form a framework to support the goal of verified data delivered in a timely manner. In this paper, we investigate a method of computing Local Correlation Score (LCS) to detect anomalous patterns among sensor platforms in a concurrent manner. We use the R programming language and OpenMPI. Using empirical tests, we determine the benefits of computing the LCS in parallel, and on various sizes of clusters. We also analyze its use for realtime mapping of Intelligent River data. Our results show that the LCS computed concurrently is an effective means for prompt quality assurance of natural resource data.

Keywords: real-time data; Local Correlation Score; quality control; R; OpenMPI; parallel file system; clusters

The development of Automatical ITS facility Arrangement System Using Open S/W

Sang-Yong Kang, Changsup Keum

This project developed a new application platform software system to support automatically ITS facility's location decision-making system. The system, called PEDS (Platform for displacement Expert Design System), is in harmony with GIS, GPS and Artificial Intelligence Software to make design the position of ITS road facilities, automatically. We define the reference architecture for merging the heterogeneous technology such as Geoserver for open GIS, Postgre for open DataBase and Drools for open expert software. We then implement a prototype model for developing ITS facility's location decision system. Finally, we discuss critical issues related to developing and operating a PEDS in an open source environment.

Balanced Block Design Architecture for Parallel Computing in Mobile CPUs/GPUs

G. Mani, S.Y. Berkovich, D. Liao

To increase performance, processor manufacturers extract parallelism through shrinking transistors and adding more of them to single-core chips and create multi-core systems. Although microprocessors performance continues to grow at an exponential rate, this approach generates too much heat and consumes too much power. These architectures not only introduce several complications but require tremendous efforts for organization of special software for parallel processing. In many cases, these difficulties are insurmountable. The programmers have to write complex code to prioritize the tasks or perform the task in parallel like extracting parallelism through threads in GPUs. One of the key issues for the programmers is how to divide the tasks in to sub-tasks. A faulty calculation may lead to increased data dependency which will slow the processor. Processor that performs more parallel operations can simultaneously increase the queuing delays. In both of the scenarios mentioned above, the relative cost of communication (also known as data transportation energy) between processing elements in microprocessor (or objects in parallel programming) is increasing relative to that of computation. This trend is resulting in larger caches for every new processor generation and more complex and costly latency tolerant mechanisms. Here we introduce a combinatorial architecture that has a unique property-multicore running on a sequential code. This architecture can be used for both CPUs and GPUs. Some minor adjustments to a regular compiler are needed for loading. Especially, current mobile GPUs technologies are still relatively immature and require

substantial improvements to enable wireless devices to perform the complex graphics-related functions. Our new architecture is more suitable for mobile GPUs/CPUs, i.e., mobile heterogeneous computing, with limited resources and relative greater performance.

Keywords: combinatorial architecture; parallel computing; mobile gpu; fault-tolerance;

Storm System Database: A Big Data Approach to Moving Object Databases

Mark McKenney, Brian Olsen

Rainfall data is often collected by measuring the amount of precipitation collected in a physical container at a site. Such methods provide precise data for those sites, but are limited in granularity to the number and placement of collection devices. We use radar images of storm systems that are publicly available and provide rainfall estimates for large regions of the globe, but at the cost of loss of precision. We present a moving object database called Storm DB that stores decibel measurements of rain clouds as moving regions, ie., we store a single rain cloud as a region that changes shape and position over time. Storm DB is a prototype system that answers rain amount queries over a user defined time duration for any point in the continental United States. In other words, a user can ask the database for the amount of rainfall that fell at any point in the US over a specified time window. Although this single query seems straightforward, it is complicated due to the expected size of the dataset: storm clouds are numerous, radar images are available in high resolution, and our system will collect data over a large timeframe; thus, we expect the number and size of moving regions representing storm clouds to be large. To implement our proposed query, we bring together the following concepts: (i) image processing to retrieve storm clouds from radar images, (ii) interpolation mechanisms to construct moving regions with infinite temporal resolution from region snapshots, (iii) transformations to compute exact point in moving polygon queries using 2-dimensional rather than 3-dimensional algorithms, (iv) GPU algorithms for massively parallel computation of the duration that a point lies inside a moving polygon, and (v) map/reduce algorithms to provide scalability. The resulting prototype lays the groundwork for building big data solutions for moving object databases.

Complex GIS Query Based on Rule Engine

Chenfan Liu, Haiyan Liu, Xingui Liu

In previous geographic information inquiry, query condition is either fixed in program or providing an SQL inquiry mode for users. The former condition is unalterable while the latter demands users to be equipped with certain SQL query language knowledge. The article introduces how to use rule engine to make inquiries through simple combination between natural semantic modules with the support of rule base. First, users formulate query plans through simple combination between natural language modules according to their own demands. Then, users deliver the query scheme to rule engine for reasoning & matching, find the correct matching rule, and execute this rule. Ultimately, execution results are returned to users.

Keywords: User-defined query, Rule Engine, rule base, Rete, Nature language

You Can Go Your Own Way... But You Wont: Exploring Highway Utilization in the Bay Area

Rob Semmens

Researchers have long endeavored understand how individuals navigate space. A common criticism of the psychological research is that the environment in which experiments take place or the tasks that people perform are not representative of the world writ large, and may appear to overstate the importance of small behavioral differences. In the broader world, a few milliseconds is hardly noticeable, but it can be highly informative to understanding how the mind works. Spatial analysis of large scale data provides an opportunity to see if findings from laboratory experiments replicate the behavior of the masses. This paper attempts to operationalize two wayfinding familiar heuristics for large scale route finding behavior, and examine evidence that would correlate with the theories.

WhirlyGlobe-Maply: Open source high performance geodata display on mobile devices

Steve Gifford

In this talk we present an open source toolkit for high performance geodata display on mobile devices, currently iPad and iPhone. The toolkit, WhirlyGlobe-Maply is used to present an interactive 3D globe or 2D map to a user. Based on the embedded version of OpenGL, this toolkit is used in a number of shipping products on Apple's app store. These apps range from simple displays of a static data to complex combinations of multiple data sets fetched on demand over the network. Mobile resources are necessarily limited, but user expectations are high so we discuss our strategies for dealing with limited resources and high performance interactivity. Mobile developers come from a wide variety of backgrounds, often being new to their platform and to geodata so we discuss our simplified approach to presenting these concepts at the toolkit level. Lastly, the WhirlyGlobe-Maply toolkit is open source so we will briefly cover how it has interacted with the commercial world of mobile development.

Hot Short Talks *(Abstracts in Page 25-26)*

Progress report on quantifying existing and potential floodplain environments for California's coho salmon using LiDAR technology

Citation Map: Visualizing the Spread of Scientific Ideas through Space and Time

Evaluating a Socio-Ecological Indicator-Based System for Decision Making Support in Watershed Management

Panels+

Plenary Forum -- Emerging Tech Panel+

Tuesday, July 23 1:30 PM - 3:00 PM

Club Regent

Geospatial Computing: An Eye towards the Future

Moderator

Dr. Lindi Liao: *President & Chief Scientist,* ***Computing for Geospatial Research Institute***

Panelists

Dr. Carl Reed: *CTO,* ***OGC***
Mr. Mike Liebhold: *Senior Researcher, Distinguished Fellow,* ***Institute for the Future***
Patrick Hogan: *NASA World Wind Program Manager,* ***NASA***
Dr. Kevin Montgomery: *CEO,* ***Intelesense Technologies, Inc.;***
Sr. Researcher, ***Stanford University***
Dr. Jayant Madhavan: *Staff Software Engineer at Structured Data Research Group, Google* ***Inc.***
Dr. Simon Y. Berkovich: *Senior Advisor,* ***Computing for Geospatial Research Institute***
Professor of Computer Science, ***George Washington University***

Prof. Berkovich's 10-min Tech Talk

The concept of the Internet of Things and powering global sensor networks

Realization of a system needs a continuous supply of energy to its elements for information control and actuation impacts. Normally, the required influx of energy is separated into centralized and autonomous lines of supply. Particularly, in the largest synthetic system of the Internet of Things the basic information processing facilities employ a centralized supply of energy, while a host of auxiliary devices is dependent on autonomous sources of energy. In certain cases, like for large global networks of sensors, maintaining autonomous supply of energy becomes a serious problem. At this conference, we have presented a paper on the Internet of Things as a methodological concept where we have found analogies with the construction of the physical Universe. A distinctive specific of this Universe construction is that it provides energy to all its constituents in a unified all-embracing manner through the reference beam pulses of the holographic mechanism. In this short talk, we will discuss how the given surmised effect in Nature could be beneficial for artificial sensor networks of the pervading Internet of Things.

Dr. Carl Reed's 10-min Tech Talk

Ripe Issue for Geospatial Standards Development

The OGC Staff and Members monitor technology trends that could (or will) impact the focus of geospatial, sensor and location services standards development and use. This presentation titled "Ripe Issue for Geospatial Standards development" will present a short overview of ten "ripe" market and technology issues that are shaping the standards landscape now and into the future. This analysis and synopsis is based on review of dozens of technology forecasting articles and publications, numerous discussion with OGC members, collaboration with other standards organizations, and conference presentations.

Workshops

Wednesday July 24 8:30 AM - 1:00 PM
Club Regent Room

Intelesense Technologies & Stanford University
Worldwide Geospatial Data Collaboration

Dr. Kevin Montgomery
CEO, Intelesense Technologies, Inc.
Sr. Researcher, Stanford University

As we look to the future, humankind faces challenges that are increasing, while our resources are ever dwindling. To survive and thrive we need to work together- no one individual or organization, agency or even government can address these global challenges all by themselves. As we look across many groups in government, academia, and industry, we see similar trends and needs emerge- the need to access and integrate many types of multimodal data from many sources, the need to collaborate with others both inside and outside our own organizations irrespective of geographic location, and the desire to develop a shared understanding, better decision-making, and to coordinate action.

What if we could integrate our data and leverage our shared resources? What if we could harness our shared knowledge and enthusiasm? What if together we could be much more than we could be alone? How would the world be impacted if such a shared, global collaboration and geospatial infrastructure were available?

Wednesday July 24 8:30 AM - 1:00 PM
Crystal Room

OGC
Location Based Access Control on Geospatial Data with GeoXACML Policies

Dr. Andreas Matheus
Elected member of the OGC Architecture Board
Member of OGC Technical Committee
Editor of OGC Draft Implementation Specification "OpenGIS Geospatial eXtensible Access Control Markup Language (GeoXACML)"

Introduction

Many different types of high quality and up-to-date geospatial information are available from different providers. Often, Intranet solutions exist where trusted users can access information with very few access constraints. In contrast, making information available to users outside of a trusted environment requires the implementation of many security requirements of which Access Control is paramount.

Challenge

When implementing access control systems, a challenge exists in enabling access rights that are highly dependent on many different things. Therefore, it is usually a good idea to separate the implementation and the configuration of the access control system. This allows the use of mature software that can be configured to enforce specific access rights.

About the Workshop

This workshop is divided in two parts:

1. The theoretical base of the GeoXACML Policy Language:

GeoXACML is the OGC standard language aimed specifically at declaring and enforcing geo-specific access rights, which protect access to geospatial data or services. This workshop will introduce GeoXACML and will illustrate how to write GeoXACML Policies for OGC WMS and WFS services.

2. The practical portion of the workshop will provide attendees an environment for hands-on exercises to experiment writing GeoXACML policies and testing them in a demo environment.

Workshops

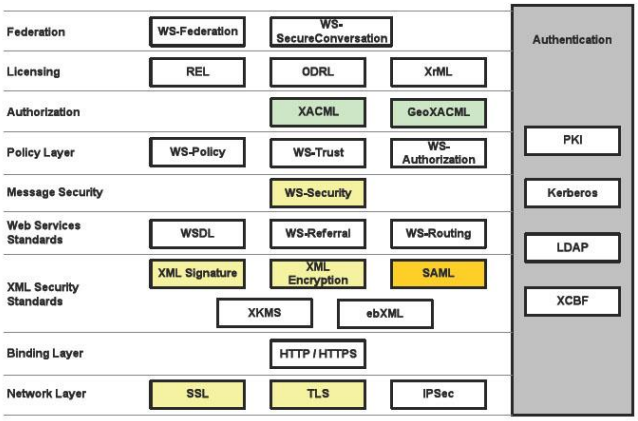
Workshop Agenda

09:00 – 09:15 Speaker and audience intro
09:15 – 10:00 Brief introduction to security requirements and standards including GeoXACML
10:00 – 10:15 “Cross Border” Use – Full system integration demo focusing on Access Control
10:15 – 11:15 Hands-On session
11:15 – 11:45 Use Case “Fire at the airport” walk-through
11:45 – 12:00 Wrap-up

Brief introduction to security requirements and standards

Requirements are
• Authentication
• Access Control
• Integrity
• Confidentiality
• Availability
• Authenticity
• (Non-Repudiation)

Available standards for implementing the requirements:



Tech Demo Shows

Monday July 22 8:15 AM - 3:30 PM
Tuesday July 23 8:15 AM - 3:30 PM
Regency Ballroom

COM.Geo OfficeMap Demo Show

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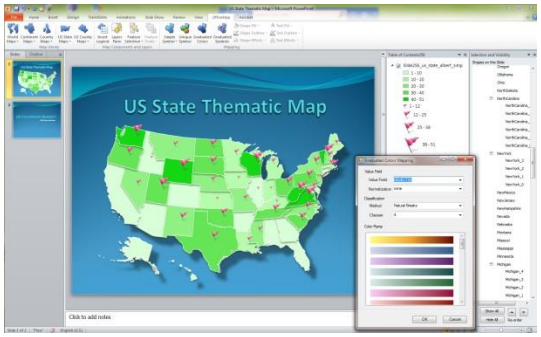

COM.Geo OfficeMap is the latest Microsoft PowerPoint Add-in. It provides a fast and easy way to directly create various kinds of maps on PowerPoint slides.

OfficeMap offers many map templates. The map templates for MS Office is an impressive collection of dozens of categorized maps with appropriate projections for PowerPoint slides. They include world maps, continental maps, country maps, US state maps, and US county maps. All boundary maps and some satilliate maps are provided.

OfficeMap offers three different symbol collections for simple symbols, color ramp symbols, and point symbols (i.e., markers, icons, and fonts).

The maps created by OfficeMap are composed of PowerPoint shapes, texts, and pictures. All of operations for texts and illustrations in PowerPoint can be directly employed to those maps within PowerPoint.

OfficeMap provides a friendly and powerful graphics user interface for users to easily insert the maps, select the symbols for the maps, and set the features for map shapes, texts, and pictures.

Microsoft CLEO Demo Show

Energy Efficient GPS Sensing with Cloud Offloading

The goal of project CLEO is to develop device and services to encourage and enable participatory sensing and citizen scientists. A core technology developed in the project is to make location sensing energy efficient, so devices can

be small, light, sample more frequently, and low cost. The approach is called Cloud-Offloaded GPS (or CO-GPS). A second service is a web-based sensor data management service called CLEO DB. It leverage SQL Azure and OData interface to support open data access.

Location is a fundamental service for mobile computing. Typical GPS receivers, although widely available, consume too much energy to be useful for many applications. Observing that in

many sensing scenarios, the location information can be post-processed when the data is uploaded to a server, we design a Cloud-Offloaded GPS (CO-GPS) solution that allows a sensing device to aggressively duty-cycle its GPS receiver and log just enough raw GPS signal for postprocessing. Leveraging publicly available information such as GNSS satellite ephemeris and an Earth elevation database, a cloud service can derive good quality GPS locations from a few milliseconds of raw data. Using our design of a portable sensing device platform called CLEO, we evaluate the accuracy and efficiency of the solution. Compared to more than 30 seconds of heavy signal processing on standalone GPS receivers, we can achieve three orders of magnitude lower energy consumption per location tagging.

NASA & Intelesense Technologies

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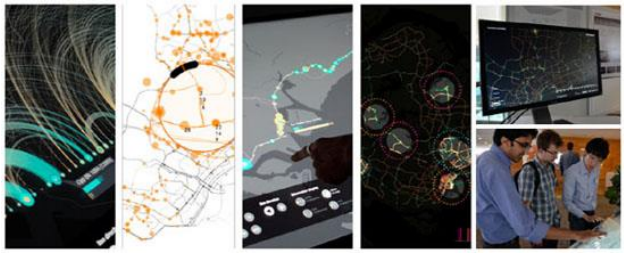
In the future, we need to work together to address the challenges we will all face- across individuals, NGOs, academia, and governments. We will need a collaboration and geospatial data infrastructure to empower that synergy, leverage our shared resources, and coordinate our actions. Collaborate.org is an open global online community of people, working together and sharing resources, expertise and enthusiasm, empowered with advanced collaboration and geospatial visualization technologies, to empower people to do Great Things.

MIT

Visual Explorations of Urban Mobility



As digital technologies are increasingly deployed in transport networks, data generated by their operations can offer new perspectives onto a city's overall dynamics. When people move through the city, sensors and digital networks are at play, supporting their movements: electronic road pricing gantries, car-counting loop detectors, and public transport smart cards, to name a few, generate data as part of their operations.

In collaboration with Singapore's Land Transport Authority, MIT's Senseable City Lab has developed three interactive applications that provide insight into the wealth of information

that the data generated by Singapore's transportation infrastructure offer.

Through these applications, experts and citizens alike can gain a better understanding on how people move through urban space, and explore the various narratives found within urban mobility. The interactive combination, and exploration, of these different data can also inspire new services and tools supporting current, and future, urban mobility options.

As part of the LIVE Singapore! initiative, these three applications further explore how we can meaningfully enable the combination of real-time urban data to enhance the design of new solutions that address the opportunities and challenges of our future cities.

Touching Bus Rides

Singapore's public transport system requires passengers to tap their smart card passes when boarding and alighting subways and buses. While these actions translate into different, distance-based, fare prices for travelers, they also offer perspective on the passengers aboard those vehicles at any given time.

This interactive application puts that knowledge literally at your fingertips. A multi-touch interface enables users to actively explore Singapore's bus network, and see where most passengers get on and off buses, how people connect between the island’s stations, and the way these patterns changes throughout the day.

Visualizing data on a large-scale multi-touch surface allows for the application of novel interaction techniques to engage a broad audience. The fluidity of the visualizations, with smooth transitions and highly responsive interactions, creates an enjoyable user experience to keep users engaged, and to stimulate an informed debate.

Data Lenses

Data provided by the Land Transport Authority enable the accurate monitoring of bus activity at bus stops in Singapore. Due to the large volume of data, exploring the information at individual bus stops while also maintaining their geographic context is a challenge visually.

The data lenses proposed here are an interactive visualization tool that address this challenge. The lens acts like a magnifying glass, allowing the user to uncover layers of information that reveal at greater detail the activity of Singapore's bus network.

Traffic Origins

We all know that road accidents sometimes result in congestion, but how exactly does this happen?

By combining road-speed and traffic-flow data derived from LTA’s network of detectors with information regarding the location and time of traffic incidents, one can explore the dynamics of this phenomenon.

This visualization can furthermore be combined with simulation models to better understanding and predict how such disruptions may affect network performance, and how cities can better respond to traffic incidents and design a more robust road network..

Posters & Hot Short Talks Session

Monday, July 22
Tuesday, July 23

Storm System Database A Big Data Approach to Moving Object Databases

Brian Olsen and Mark McKenney

Rainfall data is often collected by measuring the amount of precipitation collected in a physical container at a site. Such methods provide precise data for those sites, but are limited in granularity to the number and placement of collection devices. We use radar images of storm systems that are publicly available and provide rainfall estimates for large regions of the globe, but at the cost of loss of precision. We present a moving object database called Storm DB that stores decibel measurements of rain clouds as moving regions, ie., we store a single rain cloud as a region that changes shape and position over time. Storm DB is a prototype system that answers rain amount queries over a user defined time duration for any point in the continental United States. In other words, a user can ask the database for the amount of rainfall that fell at any point in the US over a specified time window. Although this single query seems straightforward, it is complicated due to the expected size of the dataset: storm clouds are numerous, radar images are available in high resolution, and our system will collect data over a large timeframe; thus, we expect the number and size of moving regions representing storm clouds to be large. To implement our proposed query, we bring together the following concepts: (i) image processing to retrieve storm clouds from radar images, (ii) interpolation mechanisms to construct moving regions with infinite temporal resolution from region snapshots, (iii) transformations to compute exact point in moving polygon queries using 2-dimensional rather than 3-dimensional algorithms, (iv) GPU algorithms for massively parallel computation of the duration that a point lies inside a moving polygon, and (v) map/reduce algorithms to provide scalability. The resulting prototype lays the groundwork for building big data solutions for moving object databases.

GIS-based gold potential mapping in the Muteh deposit area, Iran with respect to a new mineralization concept

Farid Javadnejad, Brian A. Waldron, Firooz Alinia

The Muteh deposit is a major Iranian gold mine that is located in the Sanadaj-Sirjan metallogenic zone. Gold deposition in Muteh has been previously interpreted to be Precambrian in age, but new studies propose the deposits may be younger and of late Eocene age. Therefore, geologic unit ages of and older than late Eocene are likely exploration targets for gold deposits. The focus of this study is to build a predictive model for mapping gold mineralization in the Muteh region. Based on the new gold mineralization concept in the Muteh deposits, the following conditions appear to be favorable for gold occurrence: (1) proximity to granite/leucogranite intrusive bodies as heat source; (2) presence of hydroxyl alteration minerals; (3) proximity to northeast-oriented lineaments/faults; (4) presence of geochemical gold anomalies; (5) co-occurrence of gold pathfinder elements; and (6) presence of heavy mineral signatures. For this study, the potential heat sources were delineated from regional geological maps. The hydroxyl alteration minerals were extracted by applying the Crosta method on ETM+ satellite data, and the fusion of the ETM+ and DEM data was used to interpret structural features. The factor analysis on stream sediment data were utilized to reveal mineralization related geochemical anomalies. Mapping was carried out using a knowledge-based fuzzy logic overlay of evidential maps. Fuzzy scoring was assigned to different classes of evidential maps based on their favorability in gold potential mapping. The final gold deposition potential map generated from fuzzy integration of geo-exploration dataset suggests 4.4 % of the study area is favorable for gold mineralization. Known gold depositional environments were matched using the fuzzy logic approach, and one new potential gold prospect was identified.

Coupling Simulations of Human Driven Land Use Change with Natural Vegetation Dynamics

Aashis Lamsal, Zhihua Liu, Michael Wimberly

Land cover change is the result of interactions and feedbacks between processes operating at different spatial and temporal scales. As human impact on the environment becomes more pronounced, there is growing interest in understanding the effects of environmental and scocio-economic changes on landscape dynamics. Computer simulation models provide a tool for studying the causes and consequences of landscape dynamics and projecting short- and long-term landscape changes. Currently, there is a need for a model that can simulate multiple drivers of land cover change, including natural disturbances vegetation succession along with anthropogenic effects such land use transitions and land management practices. The available land cover change models typically simulate only a subset of these disturbances, which is not sufficient for realistically simulating land cover change over large heterogeneous areas. To addressing this need, we developed a novel simulator that combines two existing modeling frameworks: human-driven land use change (derived from the FORE-SCE model) with natural disturbances and vegetation dynamics (derived from the LADS model) and will incorporate novel feedbacks between human land use and natural disturbance regimes. The simulator is a raster-based, spatially explicit, stochastic computer model that combines a demand-allocation land use change model, a state-and transition for natural vegetation dynamics, and spatially explicit fire initiation and spread. The simulator is being designed to incorporate the effects of climate change, land management, and human demand on resource on land use over and natural vegetation dynamics to provide realistic, high resolution, and scenario-based land cover products. The simulator is a stand-alone program written in Visual C++ environment for use in Microsoft Windows Operating System environment, and in continuous development. This poster highlights the conceptual and technical design of the model integration.

Characterization of Moving Point Objects in Geospatial Data

Sambit Bhattacharya, Bogdan Czejdo, Rakesh Malhotra, Nicolas Perez, Rajeev Agrawal

Geospatial data that exhibit time varying patterns are being captured faster than we are able to process them. We thus need machines to assist us in these tasks. One such problem is the automatic understanding of the behavior of moving objects for finding higher level information such as goals, intention etc. We propose a system that can solve one part of this complex task: automatic classification of movement patterns made by objects. In addition our system makes some simplifying assumptions: a) the object can be approximated as a moving point object (MPO) b) we consider interaction of a single MPO such as a car or mobile human, with static elements such as road networks and buildings e.g. airports, bus stops etc. on a terrain c) interactions between multiple MPOs are not considered. We use supervised machine learning algorithms to train the proposed system in classifying various patterns of spatiotemporal data. Algorithms such as Support Vector Machines and Decision Tree learning are trained with human labeled feature vectors that mathematically summarize how an MPO interacts with a landmark over time. Our feature vector incorporates a variety of geometric and temporal measurements such as the variable distances of the MPO to different points on the landmark, rate of change with time of variables such as distances and angles that are formed by the MPO with respect to the landmark. Simulated data created through graphical user interaction and agent-based modeling techniques are used to simulate MPO patterns over a representation of a real-world road network. The open source agent-based modeling tool NetLogo along with its GIS extension, and also the Agent Analyst module of ArcGIS are used to simulate large data sets. As future extensions, we are working on classification and prediction problems that involve multiple MPOs and landmarks.

Efficient Online Sharing of Geospatial Big Data Using NoSQL XML Databases

Pouria Amirian, Anahid Basiri, Adam Winstanley

Today a huge amount of geospatial data is being created, collected and used more than ever before. The ever increasing observations and measurements of geo-sensor networks, satellite imageries, point clouds from laser scanning, geospatial data of Location Based Services (LBS) and location-based social networks has become a serious challenge for data management and analysis systems. Traditionally, Relational Database Management Systems (RDBMS) were used to manage and to some extent analyze the geospatial data. Nowadays these systems can be used in many scenarios but there are some situations when using these systems may not provide the required efficiency and effectiveness. More specifically when the geospatial data has high volume, high frequency of change (in both data content and data structure) and variety of structures, the conventional data storage systems cannot provide needed efficiency in online systems in terms of performance and scalability. In these situations, NoSQL solutions can provide the efficiency necessary for applications using geospatial data. This paper provides an overview of the characteristics of geospatial big data, possible solutions for managing and processing them. Then the paper provides an overview of the major types of NoSQL solutions, their advantages and disadvantages and the challenges they present in managing geospatial big data. Then the paper elaborates on serving geospatial data using standard geospatial web services with a NoSQL XML database as a backend.

Representing Spatiotemporal Context of Public Space for Urban Design

Jie-Eun Hwang

Public space is one of the most important indicators of the quality of urban life. From a perspective of traditional urban planning, public spaces such as square, street, and plaza are significant elements of city environment to be designed. Designing public space in contemporary practice is rather a complicated decision-making process among diverse role players. It penetrates multiple layers of interest, ownership, and governance. This study stems from the crucial necessity of the common ground for understanding spatiotemporal context of public space. Since rapid urbanization increases complexity of the urban scene, the history of the place became difficult to be interpreted on site. Moreover, it is a quite compelling issue to determine cohesive spatial configuration across public and private spaces in urban design process. In this poster, we illustrated a series of experiments on data modeling and user interface design for four-dimensional media of urban design. Referring to data schema of empirically accessible data systems, we defined basic components that consist of public space including indoor public space in the private building, privately owned public open space, using Building Information Model (BIM) standard and geospatial Application Programming Interface (API) standard. The experiment delivers the scenario of dynamic timelines that conveys diverse user interaction over such physical description of urban space. The fundamental goal of this study is to develop an ontology of public space for mutually comprehensible design process among diverse role-takers over time.

3D Geographic Feature Data Collections Applying LiDAR Remote Sensing for Street and Highway Maintenance Applications - A Case Study for the New York State Thruway Authority

Tao Tang

LiDAR or laser scan technology is a newly developed remote sensing method. LiDAR sensors use the reflected laser pulses to detect x, y, and z coordinate locations of detailed parts on a geographic object. The data collections of three dimensional (3D) geometric shapes of terrain or earth's surface geographic features are very fast. LiDAR data carries more information than the satellite images in Google Earth or Google Maps. It can be applied for variety of design, engineering, and construction projects. The ground based and vehicle based (or mobile) LiDAR systems were applied to collect the 3D digital data. Two specific projects were conducted during the residence of the equipment in Western New York: 1) shoreline and close shore 3D survey along the east part of the Lake Erie; and 2)

demonstration project of 3D survey for the New York State Thruway Authority along highway I-90 and I-190. This report of the research focuses on the New York State Thruway Authority project. The static LiDAR was used to survey the highway interchanges and overpasses. The mobile one was applied to collect data along the highway the data files were named by their time of collections, and saved in ASCII text format. A large database was created for about 60 miles of the total length of highway I-90 and I-190, which filled a 700GB hard drive. Processing the point clouds were not only time consuming, but also very difficult in current software environment in remote sensing and GIS. Detailed trees, signs, and cracks on or along the highway were detected or can be detected. Although LiDAR survey can provide detail information on the highways, more researches and development are needed for post data collection processing and software handling.

Keywords: LiDAR, 3D design, highway maintenance

Progress report on quantifying existing and potential floodplain environments for California's coho salmon using LiDAR technology

Adam H. Fleenor

The Coho salmon (Oncorhynchus kisutch) Central California Coast Evolutionary Significant Unit (CCCESU) has declined from an estimated 50,000-125,000 adult returns to approximated 500 spawning adults, and is at high risk for extinction. Lagunitas Creek (Marin County, CA) supports 10% of the remaining population where all but a small reach has incised stream banks and disconnected floodplain. Previous studies has implicated that juvenile overwintering habitat is a limiting factor and the priority for restoration efforts. We used two Light Detection and Ranging (LIDAR) datasets (2007 and 2010) to compare the floodplain attributes in areas of Lagunitas Creek where coho juveniles are successfully overwintering and areas with poor smolt production. Creating sharp bare-earth raster layers provide evidence of good overwintering habitat that is characterized by channel form, refugia from predators, connected floodplains, and riparian vegetation. An understanding of the geomorphic landscape attributes and vegetation structure on floodplains that support productive overwintering salmon habitat will contribute to a multiple-agency effort to save the last remaining wild coho on the California coast. We also are testing flood inundation models using to identify and prioritize disconnected floodplain habitat for ongoing restoration. During this Hot Short Talk I will summarize the progress and challenges of this research.

Citation Map: Visualizing the Spread of Scientific Ideas through Space and Time

Song Gao

Knowledge is power. The power of knowledge is not only about the knowledge itself but also how it spreads out. In research areas, the number of citation is an important criterion to measure the quality of a scientific publication. A large number of citations generally indicate a wide acceptance of the idea proposed or the knowledge introduced by the paper. Therefore, many academic search engines, such as Google Scholar, Microsoft Academic Search, and Arnetminer have stored citation information and provided related web services to users. However, is it enough to evaluate a publication only based on the number of citations? Can we know how a brilliant scientific idea spreads through space and time? The team from the space and time knowledge organization (STKO) lab at University of California, Santa Barbara has developed a Citation Map web application which allows users to visually explore research topics, authors, publications, as well as their citation relations on a world map. This mashup-application allows users to search publications and their corresponding citations through topic keywords or author names, to geolocate publications using the first author's institution, to map citation information all over the world and in different years, to discover the top-ten authors who have cited a publication most frequently, and to share publication and citation information through social media like Facebook, Twitter, and Google Plus. The Citation Map can be accessed from http://stko- work.geog.ucsb.edu:8080/map/

The concept of the Internet of Things and powering global sensor networks

Simon Y. Berkovich

Realization of a system needs a continuous supply of energy to its elements for information control and actuation impacts. Normally, the required influx of energy is separated into centralized and autonomous lines of supply. Particularly, in the largest synthetic system of the Internet of Things the basic information processing facilities employ a centralized supply of energy, while a host of auxiliary devices is dependent on autonomous sources of energy. In certain cases, like for large global networks of sensors, maintaining autonomous supply of energy becomes a serious problem. At this conference, we have presented a paper on the Internet of Things as a methodological concept where we have found analogies with the construction of the physical Universe. A distinctive specific of this Universe construction is that it provides energy to all its constituents in a unified all-embracing manner through the reference beam pulses of the holographic mechanism. In this short talk, we will discuss how the given surmised effect in Nature could be beneficial for artificial sensor networks of the pervading Internet of Things.

Evaluating a Socio-Ecological Indicator-Based System for Decision Making Support in Watershed Management

Georgina Sanchez

The dynamics and relationships between society and nature are complex and difficult to predict. Anthropogenic activities affect the ecological integrity of our natural resources, specifically our streams. Further, it is well-established that the costs of these activities are born unequally by different human communities. This study considered the utility of integrating stream health metrics, based on stream health indicators, with socio-economic measures of communities, to better characterize these effects. This study used a spatial multi-factor model and bivariate mapping to produce a novel assessment for watershed management, identification of vulnerable areas,

decision making, and allocation of resources. The study area is the Saginaw River watershed located in Michigan. In-stream hydrological and water quality data were used to predict fish and macroinvertebrate measures of stream health. These measures include the Index of Biological Integrity (IBI), Hilsenhoff Biotic Index (HBI), Family IBI, and total number of Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa. Stream health indicators were then compared to spatially coincident socio-economic data, obtained from the United States Census Bureau (2010), including race, income, education, housing, and population size. Statistical analysis including spatial regression and cluster analysis were used to examine the correlation between vulnerable human populations and environmental conditions.

Overall, limited correlation was observed between the socio-economic data and ecological measures of stream health, with the highest being a negative correlation of -0.18 between HBI and the social parameter household size. Clustering was observed in the datasets with urban areas representing a second order clustering effect over the watershed. Regions with the worst stream health and most vulnerable social populations were most commonly located nearby or down-stream to highly populated areas and agricultural lands.

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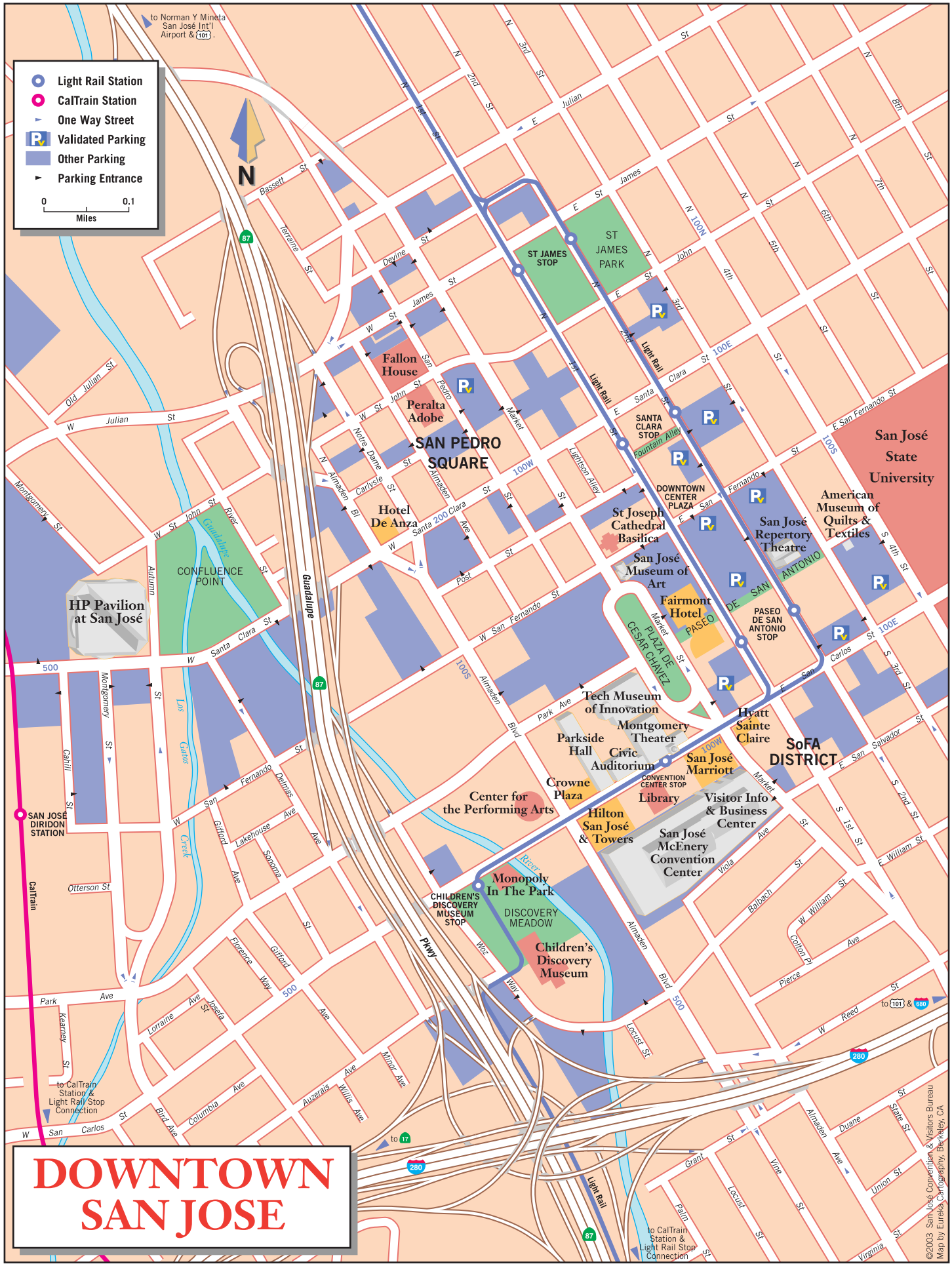
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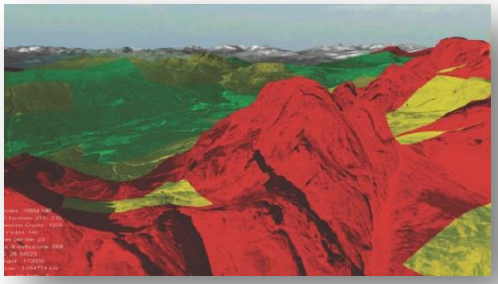

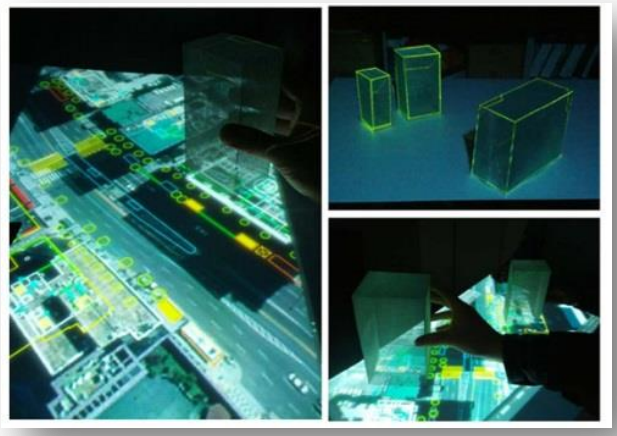

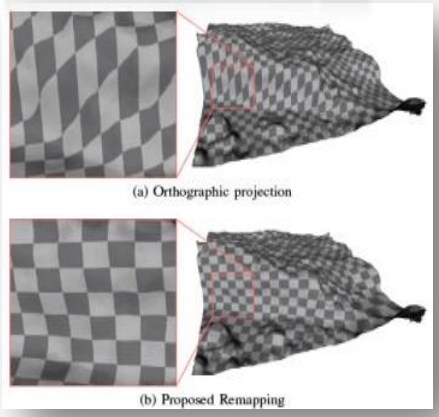

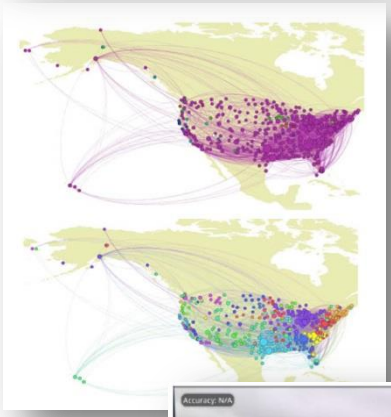

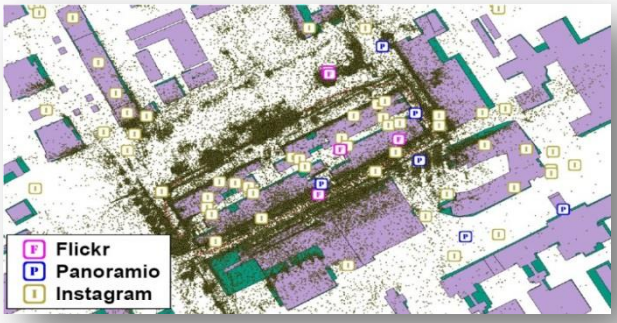

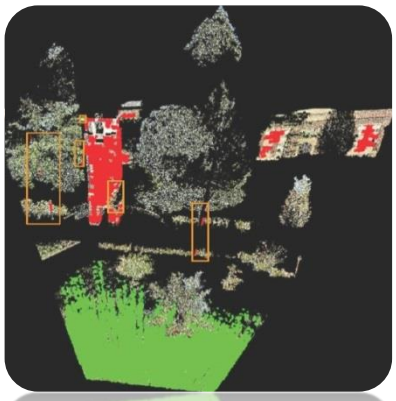

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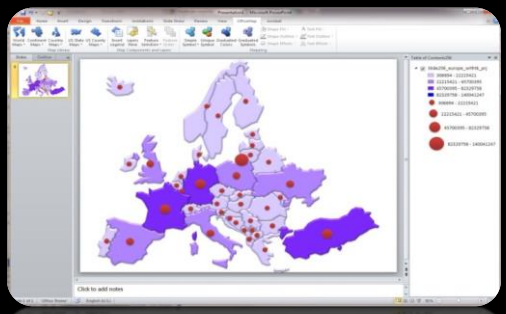

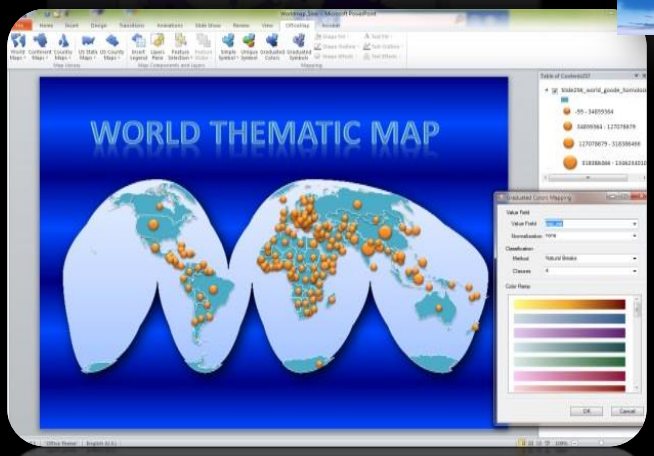

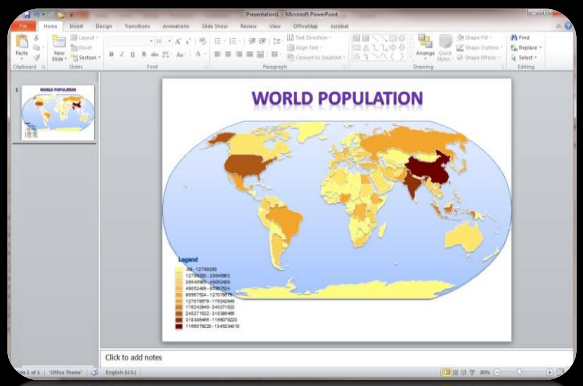

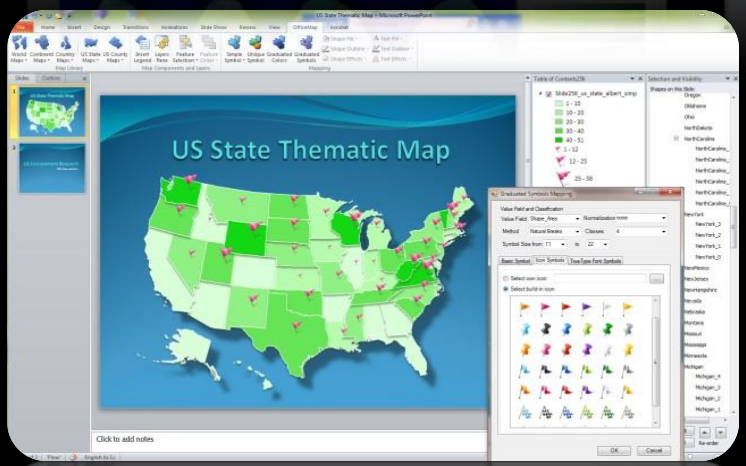

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- Boundary maps, satellite maps
- powerful user interfaces
- simple symbols, color ramp symbols, and point symbols
- Consistent operations for maps as PowerPoint shapes, texts, and pictures

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