COM.Geo 2012

International Conference on Computing for Geospatial Research & Application

July 1-3, 2012
Washington, DC

PROGRAM

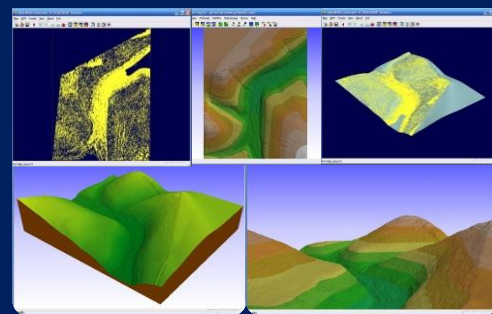
www.com-geo.org

COM.Geo

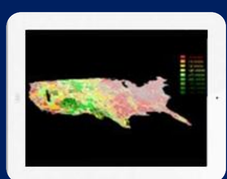
Computing for Geospatial Research Institute

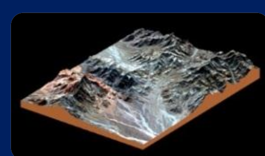
Meet Today's Challenges, Create Tomorrow's Opportunities

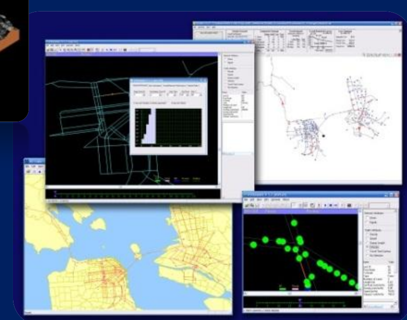
Visual Simulation

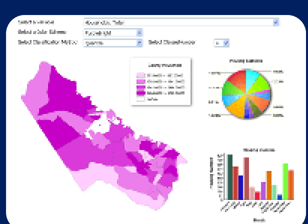


LiDAR Data Modeling & Visualization



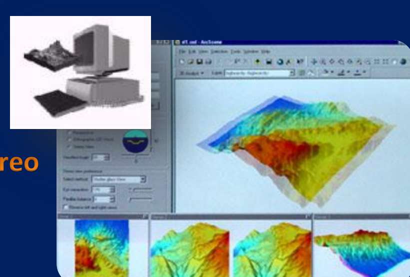




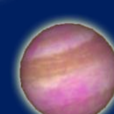


Mobile/Web
2D/3D GIS

GIS for Transportation



3D Stereo



Geo
Universe

Big Data Computing
GPU Computing
Heterogeneous Computing
Internet of the Things (IoT)
Sensor Web
Mobile Computing
Cloud Computing
Geospatial Augmented Reality
LiDAR Computing and Visualization
Geospatial Intelligence
Smart Digital City
Intelligent Transportation Systems

Web GIS, Mobile GIS, 3D GIS
Visual Simulation & Virtual Reality
3D Stereo graphics
Spatial Analysis & Modeling
Image Processing, Computer Vision
Distributed/Cluster Systems

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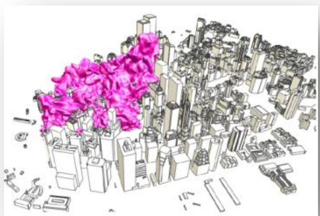

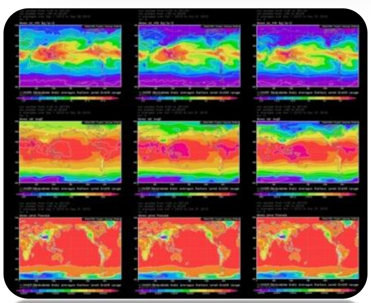

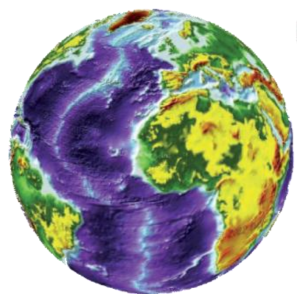

Images Courtesy of Selected COM.Geo 2012 Papers

Images Courtesy of Internet Source

Program at a Glance

Sunday, July 1	7:30 AM - 4:30 PM	**Registration**		
	8:45 AM - 10:15 AM	**Full Papers I** Regency Ballroom A	**Short Papers I** Regency Ballroom B	**Brainstorm Corner** Lake Thoreau Room
	10:15 AM - 10:30 AM	**Coffee Break** Regency Ballroom Foyer		
	10:30 AM - 12:00 PM	**Full Papers II** Regency Ballroom A	**Short Papers II** Regency Ballroom B	**Brainstorm Corner** Lake Thoreau Room
	12:00 PM - 1:15 PM	**Lunch Break**		
	1:15 PM - 2:45 PM	**Full Papers III** Regency Ballroom A	**Technical Briefing Papers /Tech Talks/Demo Talks I** Regency Ballroom B	**Brainstorm Corner** Lake Thoreau Room
	2:45 PM - 3:00 PM	**Coffee Break** Regency Ballroom Foyer		
	3:00 PM - 4:30 PM	**Full Papers IV** Regency Ballroom A	**Technical Briefing Papers /Tech Talks/Demo Talks II** Regency Ballroom B	**Brainstorm Corner** Lake Thoreau Room
	1:00 PM – 5:00 PM	**Exhibition, Posters, Networking** (Regency Ballroom Foyer & Terrace)		
Monday, July 2	8:00 AM - 4:30 PM	**Registration**		
	9:00 AM - 10:00 AM	Regency Ballroom	9:00 am - 9:15 am 9:15 am - 10:00 am	**Opening Remarks/Demo Show** **Keynote I: COM.Geo**
	10:00 AM - 10:15 AM	**Coffee Break** (Regency Ballroom Foyer), **Demo Videos** (Regency Ballroom)		
	10:15 AM - 11:45 AM	Regency Ballroom	10:15 am - 11:00 am 11:00 am - 11:45 am	**Keynote II: USGS** **Keynote III: COM.Geo/GWU**
	11:45 AM - 1:15 PM	**Welcome Banquet** (Grand Ballroom F&G)		
	1:15 PM - 2:45PM	Regency Ballroom	1:15 pm - 2:00 pm 2:00 pm - 2:45 pm	**Keynote IV: OGC** **Keynote V: Oracle**
	2:45 PM - 3:00 PM	**Coffee Break** (Regency Ballroom Foyer), **Demo Videos** (Regency Ballroom)		
	3:00 PM - 4:30 PM	**Emerging Tech Panel+ I** Grand Ballroom	**Emerging Tech Panel+ II** Robert E. Simon Boardroom	**Brainstorm Corner** Lake Thoreau Room
	9:00 AM – 5:00 PM	**Exhibition, Posters, Networking** (Regency Ballroom Foyer & Terrace)		
Tuesday, July 3	8:00 AM - 2:30 PM	**Registration**		
	8:45 AM - 10:05 AM	Regency Ballroom	8:45 am - 9:25 am 9:25 am - 10:05 am	**Keynote/Featured Note VI: Nokia** **Keynote/Featured Note VII: ICF**
	10:05 AM - 10:15 AM	**Coffee Break** (Regency Ballroom Foyer), **Demo Videos** (Regency Ballroom)		
	10:15 AM - 11:15 AM	**Emerging Tech Panel+ III** Regency Ballroom		
	11:15 AM - 12:15 AM	**Emerging Tech Panel+ IV** Regency Ballroom		
	12:15 AM - 1:30 PM	**Cloud Banquet** (Grand Ballroom F&G)		
	1:30 PM - 5:00 PM	**Microsoft Windows 8 Cloud & Mobile Computing Workshop** Regency Ballroom A **COM.Geo Boot Camp for Microsoft Mobile American Contest** Regency Ballroom A	**ORNL Course** Modeling Spatial Dependencies and Semantic Concepts in Data Mining Regency Ballroom B	
	9:00 AM - 4:00 PM	**Exhibition, Posters, Networking** (Regency Ballroom Foyer & Terrace)		

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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 2012 is the 3rd International Conference and Exhibition on Computing for Geospatial Research and Applications on July 1-3, 2012 in Washington DC.

The COM.Geo 2012 Proceedings are published by ACM (ISBN: 978-1-4503-1113-7) and available at ACM 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

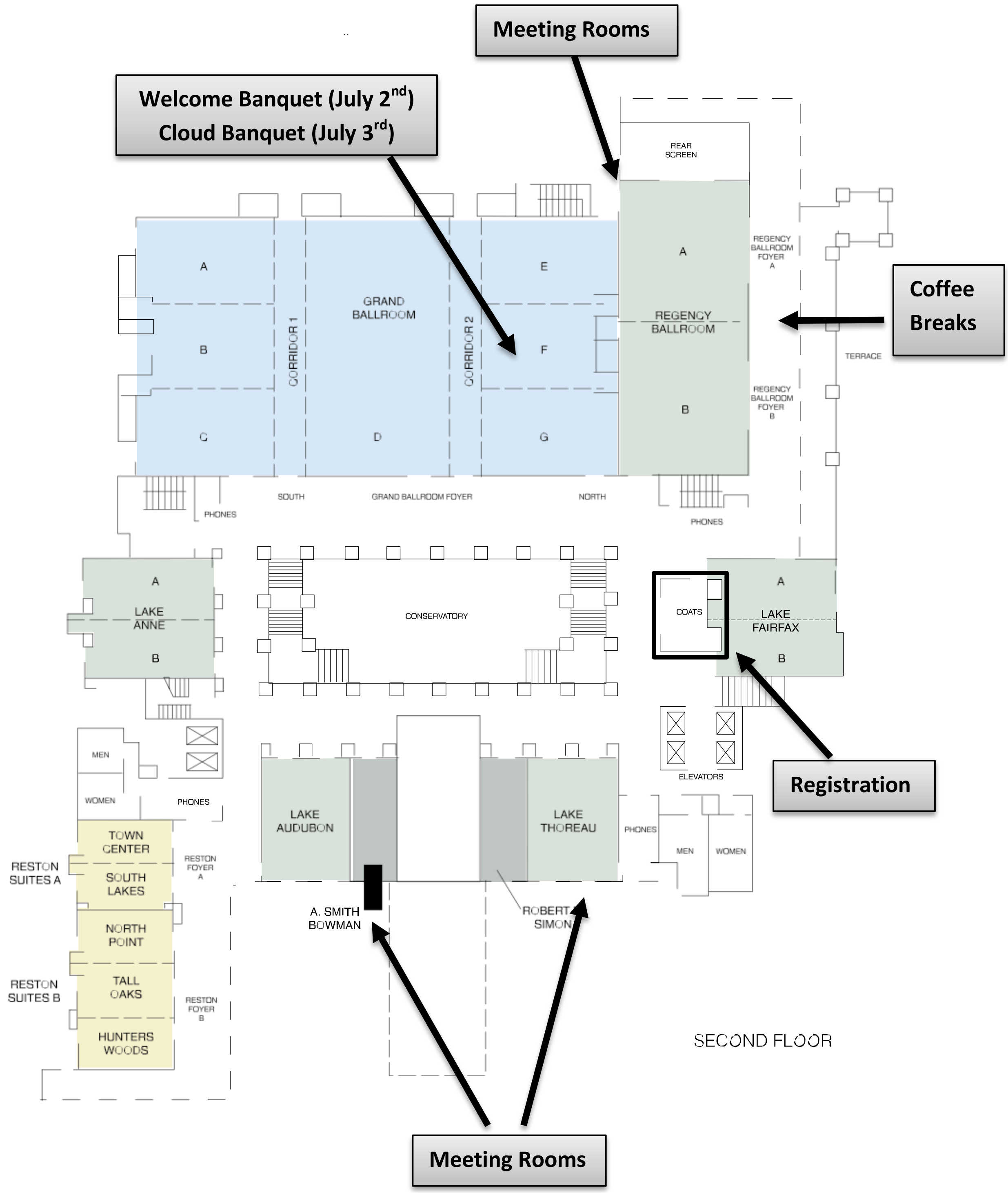
The COM.Geo conference Registration Desk will be located on the second level of the Hyatt Regency Reston hotel. Registration will be open during the following hours:

Sunday, July 1 7:40 a.m. – 4:30 p.m.
Monday, July 2 8:00 a.m. – 4:30 p.m.
Tuesday, July 3 8:00 a.m. – 2:30 p.m.

Venue Information

Hyatt Regency Reston
1800 Presidents Street
Reston, Virginia 20190
Tel: +1 703 709 1234
Fax: +1 703 925 8295
USA

Location of Meeting Rooms



COM.GEO 2012 HIGHLIGHTS

Big Data Computing for Geospatial R&A

US President Barack Obama's administration announced a 'Big Data' research and development initiative in response to processing the large amount of data collected by geospatial and other systems. Under this initiative, several federal government agencies, NSF, USGS, DARPA, DOD, NIH, and DOE, commitment for the programs total $200 million.

Big Data refers to the rising flood of digital data from many different sources, including the sensors, digitizers, scanners, mobile phones, cameras, software-based tools, internet, and social network communications, and so on. "Immense" and "diverse" are two important characteristics of the "Big Data". The diversity of the "Big Data", such as text, geometry, image, video, or sound, also increases difficulties of big data processing. Many of such data are directly or indirectly related to geospatial information. The emerging opportunity arises from combining these diverse data sources with greatly improving computing tools and techniques needed to access, organize, analyze, visualize, and extract useful information from huge diverse data sets.

GPU Computing for Geospatial R&A

GPUs are accelerating everything! GPUs have been widely used for computer graphics and visualization geospatial applications for years. But today's GPUs are powerful for general purpose computing -- General Purpose Computing on the Graphics Processing Unit (GPGPU). GPGPU leverages the microprocessors that power many modern graphics cards. GPGPU has great promise for bringing the distributing processes to the geospatial research and application, such as point clouds based LiDAR data processing and large remote sensing image processing, etc.

Sensor Computing for Geospatial R&A

Sensors Everywhere! An increasing number of pervasive and connected sensors are intelligently monitoring our daily lives. Sensors are gathering and reporting data on a variety of areas including transportation, energy, security, medical, general consumer and industrial manufacturing. This sensor revolution is creating a new layer of the Internet -- "Internet of Things".

What will be a world characterized by sensors everywhere? How to handle sensor data explosion in such a world? At COM.Geo 2011, the workshop, Expanding Geoweb to An Internet of Things, was introduced. This year, COM.Geo 2012 will further bring more new thoughts to explore sensor computing for geospatial research and application.

Monday, July 2

Keynote Chair:
Dr. Phil W. Yen
U.S. DOT - FHWA

Opening Remarks July 2 9:00 AM - 9:15 AM

Keynote 1: COM.Geo July 2 9:15 AM - 10:00 AM

Dr. Lindi Liao
President & Chief Scientist
COM.Geo Conference General Chair

A Promising Future of Computing for Geospatial Technologies

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, and social computing have been playing key roles in geospatial applications. Some latest computing advancements, such as big data computing, heterogeneous computing, Internet of Things (IoT) / sensor computing, and bio-computing, have great potentials for the effective realization of information processing in the geospatial environment.

This talk 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 talk also provides a vision of the ".geo" term 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.

Dr. Liao has 20 years of in-depth technical experience in both computer science & Geographic Information System (GIS) and nearly 10 years of management experience in government, industry, and academia. Since 2002, she has worked for the U.S. federal government agencies (DOT/FHWA, FAA, etc.) on PC-clustered highway driving simulator systems, 3D graphics & visualization, virtual reality, GIS, air traffic, multi-core architectures, heterogeneous computing, etc. She ever worked at ESRI and developed the earliest version of Stereo Viewer for ArcGIS in 2001. In 1996, she pioneered the product development of the PC-based high-resolution quad-buffered 3D stereographic accelerators with 3D Labs' chips. Dr. Liao has authorized many publications and two professional books on GPU-based research and OpenGL programming. She has been invited to give the talks by the federal governments, universities, and leading industries. She was an adjunct professor at George Mason University. She is a member of ACM and IEEE. She received a Ph.D. and a M.S. in Computer Science from George Washington University and Purdue University, respectively.

Dr. Liao has broad interests in various computing technologies, such as GPU computing, mobile computing, cloud computing, Internet of Things (IoT), heterogeneous computing, Big Data computing, etc. As a key COM.Geo initiator, she, with the team, is striving to explore the latest computing technologies for multidisciplinary research and application in geospatial areas.

Keynote 2: USGS July 2 10:15 AM - 11:00 AM

Dr. David Applegate
Dr. David Applegate
Associate Director for Natural Hazards at USGS
Chair for the National Science and Technology Council's Subcommittee
on Disaster Reduction for the White House Office

Science in Times of Crisis: Delivering Situational Awareness to Emergency Managers and the Public When Disaster Strikes

When the White House National Science and Technology Council laid out a series of grand challenges for disaster reduction, the first was to provide hazard and disaster information where and when it is needed. Earth observation and monitoring capabilities are only as good as their ability to reach those in harm's way and inform those who must respond when disaster strikes. At the U.S. Geological Survey (USGS), our scientists work on many different natural hazards across the US and around the globe in close collaboration with federal, state and academic partners. We support monitoring networks, generate hazard assessments, and study the natural processes and societal factors that shape the risks we face from hazard events.

The USGS has delegated federal responsibility to provide notifications and warnings for geologic hazards, including earthquakes, volcanic eruptions, and landslides. For a number of other hazards, USGS monitoring capabilities support the statutory responsibilities of our partners. Data from USGS national and global seismic networks are fed directly to the National Oceanic and Atmospheric Administration (NOAA) tsunami warning centers. USGS streamgages and storm-surge monitors support NOAA's flood and severe weather warnings, including those for hurricanes. The USGS maintains a network of 14 geomagnetic observatories around the US and its territories, which are used by NOAA and the U.S. Air Force to measure the intensity of geomagnetic storms caused by solar flares and other space weather.

For earthquakes, the USGS Advanced National Seismic System generates situational awareness tools that include e-mail and text alerts to over 300,000 subscribers worldwide and the Prompt Assessment of Global Earthquakes for Response (PAGER) system's rapid estimates of fatalities and economic losses to help focus and prioritize response. Disaster information has increasingly become a two-way flow thanks to crowdsourcing and social media. The USGS actively engages with the public, who report on what they experienced through our Did You Feel It website. Tens of thousands of these reports come in after widely felt earthquakes, and that citizen science information is then used to augment instrumental data to refine impact estimates.

For volcanoes, the USGS is modernizing and expanding its monitoring capabilities through the National Volcano Early Warning System. Common nationwide alerts and notifications characterize the threats to aviation and nearby communities due to unrest and eruptive activity at the 169 active U.S. volcanoes. For landslides, a prototype debris-flow warning system has been established in southern California in partnership with NOAA with plans to expand up the West Coast.

USGS geospatial information supports response operations for wildfires and many other types of disasters. The web-based GeoMAC application provides fire managers and increasingly the public with current geospatial information on the status, location, and proximity of wildfires to natural resources, property, and infrastructure. Through its Hazard Data Distribution System, the USGS coordinates the acquisition and provision of satellite imagery and authoritative geospatial information for use in disaster preparations, rescue and relief operations, damage assessments, and reconstruction efforts.

Millions of people worldwide look to USGS for rapid, reliable hazard information, either directly or through our partners. We are continually looking for ways to innovate in the face of ever-increasing expectations to deliver the right information to the right people at the right time.

Dr. David Applegate is the Associate Director for Natural Hazards. In this position, he oversees the geologic hazards and coastal and marine programs of the USGS and coordinates the long-term planning and hazard response activities for earthquakes, volcanic eruptions, landslides, geomagnetic storms, floods, severe storms, tsunamis, and wildfires.

Dr. Applegate came to the USGS in 2004 as the first senior science advisor for earthquake and geologic hazards. Since 2006, he has chaired the National Science and Technology Council's Subcommittee on Disaster Reduction, an interagency body providing guidance to the White House Office of Science and Technology Policy. In addition to his USGS duties, Dr. Applegate is an adjunct full professor in the University of Utah's Department of Geology and Geophysics.

Dr. Applegate recently completed a 4-year term on the council of the Geological Society of America, received GSA's Eugene and Carolyn Shoemaker Public Service Award in 2005, and became a fellow in 2006. In 2010, he received the USGS Shoemaker Award for Lifetime Achievement in Communication. He is also a fellow of the American Association for the Advancement of Science and a past president of the Geological Society of Washington.

Prior to joining the USGS, Dr. Applegate spent 8 years with the American Geological Institute, where he served as the director of government affairs and as the editor of Geotimes. Dr. Applegate has also served with the U.S. Senate Committee on Energy and Natural Resources as the American Geophysical Union's Congressional Science Fellow and as a professional staff member.

Dr. Applegate has a B.S. in geology from Yale University and a Ph.D., also in geology, from the Massachusetts Institute of Technology.

Keynote 3: GWU/COM.Geo

July 2 11:00 AM - 11:45 PM

Dr. Simon Y. Berkovich
Professor of Engineering and Applied Science,
Department of Computer Science,
The George Washington University,
Senior Advisor in COM.Geo Advisory Board

On Clusterization in "Big Data" Streams

Big Data refers to the rising flood of digital data from many different sources, including the sensors, digitizers, scanners, mobile phones, cameras, software-based tools, internet, and so on. "Immense" and "diverse" are two important characteristics of the "Big Data".

Coping with the expanding variety of the Big Data, such as text, geometry, image, video, sound, etc. requires a radical change in the philosophy of the organization of information processing. Primarily, the Big Data approach has to modify the underlying computational model in order to manage the uncertainty in the access to information items in a huge nebulous environment. As a result, the produced outcomes are directly influenced only by some active part of all information items, while the rest of the available information items just indirectly affect the choice of the active part. An analogous functionality exhibits the organization of the brain featuring the unconsciousness, and a characteristic similarity shows the retrieval process in Google.

In this talk, we introduce a novel method for on-the-fly clusterization of amorphous data from diverse sources. The devised construction is based on the previously developed FuzzyFind Dictionary reversing the error-correction scheme of Golay Code. This clusterization involves processing of intensive continuous data streams that can be effectively implemented using multi-core pipelining with forced interrupts. The suggested clusterization is especially suitable for the Big Data computational model as it materializes the requirement of purposeful selection of information items in unsteady framework of cloud computing and stream processing. Furthermore, the uncertainties in relation to the considered method of clusterization are moderated due to the idea of the bounded rationality, an approach that does not require a complete exact knowledge for sensible decision-making.

Professor Simon Y. Berkovich played a leading role in a number of research and development projects on the design of advanced hardware and software systems. Those projects include construction of superconductive associative memory, development of large information systems for economics, investigation of computer communications for multiprocessor systems, and enhancement of information retrieval procedures. Dr. Berkovich has several hundred professional publications in various areas of physics, electronics, computer science, and biological cybernetics. He is an author of six books and holds 30 patents. Among his inventions is a method for dynamic file construction that later become known as B-tree and extendible hashing. In 2002, he was elected a member of the European Academy of Sciences "for an outstanding contribution to computer science and the development of fundamental computational algorithms". Professor Berkovich received an M.S. in Applied Physics from Moscow Physical-Technical Institute and a Ph.D. in Computer Science from the Institute of Precision Mechanics and Computer Technology of the USSR Academy of Sciences.

Keynote 4: OGC July 2 1:15 PM - 2:00 PM

George Percivall
Chief Architect & Executive Director - Interoperability Program

Connecting Islands in the Internet of Things

With the increasing pace of change in computing technology, islands of relative stability become important to reaping the benefits of geospatial information. Geospatial standards are bases for persistent developments in the complex adaptive ecosystem of geospatial computing technology. Standards are the backbone of the Geoweb and will be also for the Internet of Things (IoT).

At COM.Geo 2011, the workshop, "Expanding Geoweb to An Internet of Things", explored ways in which the success of the Geoweb were a basis for the emerging Internet of Things. COM.Geo 2012 aims to continue this discussion of sensor and mobile computing for geospatial research and application.

IoT can be seen as a fuller expression of a vision of The Computer for the 21st Century (M. Weiser, 1991, Sci. Amer.). That vision of "Ubiquitous Computing" anticipated computers disappearing into the fabric of everyday life. What perhaps could not have been anticipated was how computing would be changed by the WWW making information ubiquitously accessible via the internet. Now, everyday objects with embedded computers are becoming ubiquitously accessible and interactive via the internet and mobile communications to the benefit of researchers, decision-makers, developers, and application users.

Sensor webs and RFID are major elements of IoT. Beginning in 2000, the Open Geospatial Consortium (OGC) anticipated the proliferation of network-accessible sensors and defined a set of Sensor Web Enablement (SWE) standards. SWE allows sensors to be used in user applications not anticipated with the initial deployment of the sensors. The AutoID lab is a pioneer identifying how RFID systems and SWE can work together to for understanding real world objects both from physical measurements and identity.

Geospatial location is fundamental to IoT with the spaces in which IoT operates going beyond the geographic positioning technologies currently on mobile devices. Fusion of information from new sensors on-board mobile devices will enable positioning indoors and other locations where GPS is not present. "Indoor maps" with the complexity of 3 dimensions and complex route topology are needed for IoT be placed and used in a rich spatial computing context.

End user applications will reap the benefits of ubiquitous information from IoT. Augmented Reality applications will allow users to view a rich set of information about the space around them both historical information and real-time information. The many domains of Business Intelligence will be informed by this stream of information enabling better decisions.

OGC brings several innovative, yet stable standards to the computing and geospatial world of IoT. The second generation of SWE standards is currently being finalized. CityGML and IndoorGML meet the need for indoor maps. And the Augmented Reality Markup Language is poised to bring IoT information into a context aware visualization on mobile devices. OGC will continue to work with other standards developing organizations that address IoT, e.g., ITU, JTC1, IETF, OMA.

Mr. George Percivall is an accomplished leader in the development of information systems and international standards for geospatial information. As OGC's Chief Architect, he is responsible for the overall vision for the OGC baseline and its evolution through developments by OGC members. As Executive Director of OGC's Interoperability Program, he is responsible for managing OGC's Interoperability Program, which involves planning and executing testbeds, pilot projects, interoperability experiments etc., and for running OGC's compliance testing program.

Prior to joining OGC, Mr. Percivall had leadership roles on several NASA projects. He was Chief Engineer of the Earth Observing System Data and Information System (EOSDIS) for the Landsat/Terra release; Principal engineer for NASA's Geospatial Interoperability Office; and, represented NASA in OGC, ISO TC211, and CEOS. He was the Director of the Geospatial Interoperability Group of GST, Inc. Previously, he led developments in Intelligent Transportation Systems with the US Automated Highway Consortium and General Motors Systems Engineering. He holds a BS in Physics and an MS in Electrical Engineering from the University of Illinois - Urbana.

Keynote 5: Oracle July 2 2:00 PM - 2:45 PM

Dr. Xavier Lopez
Director, Spatial and Semantic Technologies
Oracle Corp.

Big Data and Advanced Spatial Analytics

Today's business and government organizations are challenged when trying to manage and analyze information from enterprise databases, streaming servers, social media and open source. This is compounded by the complexity of integrating diverse data types (relational, text, spatial, images, spreadsheets) and their representations (customers, products, suppliers, events, and locations) - all of which need to be understood and re-purposed in different contexts. Identifying meaningful patterns across these different information sources is non-trivial. Moreover, conventional IT tools, such as conventional data warehousing and business intelligence alone, are insufficient at handling the volumes, velocity and variety of content at hand. A new framework and associated tools are needed. Dr. Lopez outlines how data scientists and analysts are applying Spatial and Semantic Web concepts to make sense of this Big Data stream. He will describe new approaches oriented toward search, discovery, linking, and analyzing information on the Web, and throughout the enterprise. The role of Map Reduce is described, as is importance of engineered systems to simplify the creation and configuration of Big Data environments. The key take away is use of spatial and linked open data concepts to enhance content alignment, interoperability, discovery and analytics in the Big Data stream.

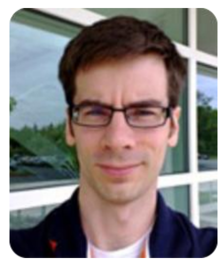
Dr. Xavier Lopez is Director of Product Management for Oracle's Spatial products group. For the past thirteen years, he has led Oracle's efforts to incorporate spatial technologies across Oracle's database, application server, and application business. He has twenty years of experience in the area of GIS and spatial databases. He is currently focusing on high performance spatial computing and linked open data. He holds advanced degrees in engineering and planning from University of Maine, MIT, and the University of California, Davis. He is currently a member of the US National Geospatial Advisory Committee (NGAC). Xavier is past member of the Mapping Science Committee of the National Academy of Science that advises the nation on mapping activities.

Tuesday, July 3

Keynotes Chair:
Prof. Simon Y. Berkovich
George Washington University

Keynote/Featured Note 6: Nokia

July 3 8:45 AM - 9:25 AM



Dr. Olli-Pekka Tossavainen
Researcher at Nokia Research Center

Big Data Computing for Traffic Information by GPS Sensing

Real time traffic monitoring systems perform spatial and time dependent analysis of measurement data of different types such as traditional inductive loop detector data, microwave radar data, and GPS data. The goal of these systems is to provide information such as average speeds, volumes and densities on a given segment of a roadway. One of the fastest growing data source for traffic monitoring systems is GPS data collected from mobile devices. To some extent, in the industry GPS data is already replacing the traditional traffic sensing technologies.

There is a large demand in industry and transportation agencies to have access to high resolution state of traffic on highways and arterial roads globally. This means that traffic information providers have to provide traffic information on a resolution that goes beyond the widely used TMC code based representation of the roadway.

In order to obtain the high resolution state of traffic, noisy observations need to be fused into a mathematical model that represents the evolution of the system either based on physics or statistics. Common frameworks for fusing the data into physical models include for example Kalman filtering and particle filtering.

Prior to the data fusion stage in the real time system, offline geospatial modelling has already been done. For example, construction and calibration of an accurate physics based traffic model includes tasks such as building a directed graph of the road network, detection of road geometry at lane level and speed limit detection. In all these tasks, GPS data is vital.

Real time systems that use GPS data include geospatial pre-processing components such as map matching and path inference. The rapidly growing volume of GPS data cannot be handled using traditional methods but instead parallel computing systems are needed to handle the future volumes.

Also, the new high resolution algorithms are developed to leverage the parallel processing frameworks.

In this talk Dr. Tossavainen will discuss directions taken to respond to the demand of providing high resolution information about the state of the traffic both in the context of modeling and implementation of a large scale system.

Dr. Olli-Pekka Tossavainen joined Nokia in 2010 after three years at UC Berkeley's Civil Engineering Department where he worked as a postdoctoral researcher. Currently he is a researcher at Nokia Research Center North America Lab. He received his PhD in physics at the University of Kuopio in 2007. His principal research interests are state-space modeling, Kalman filtering techniques, development of both physical traffic flow models as well as statistical models for traffic. Dr. Tossavainen has been awarded two significant inventions at NAVTEQ LLC and he has co-authored over a dozen of publications in the field of mathematical modeling and state estimation.

Keynote/Featured Note 7: ICF International

Jul 3 9:25 AM - 10:05 AM

Dr. Robinson E. Pino
Senior Scientist,
ICF International

Computational Intelligence and Neuromorphic Computing Potential for Geospatial Research and Applications

In today's highly mobile, networked, and interconnected internet world, the flow and volume of information is overwhelming and continuously increasing. Therefore, it is believed that the next frontier in technological evolution and development will rely on our ability to develop intelligent systems that can help us process, analyze, and make-sense of information autonomously just as a well trained and educated human expert. In computational intelligence, neuromorphic computing promises to allow for the development of computing systems able to imitate natural neuro-biological processes that will form the foundation for intelligent system architectures. This is achieved by artificially re-creating the highly parallelized computing architecture of the mammalian brain. As an interdisciplinary technology inspired from biology, artificial neural systems have been successfully utilized in many applications, such as control systems, signal processing, pattern recognition, vision systems, and robotics etc. In addition, the emerging neuromorphic computing field can also exploit the characteristic behavior of novel material systems with advanced processing techniques to achieve very large scale integration with highly parallel neural architectures for the fabrication physical architectures. This talk will focus on the technological challenges that we are seeking to overcome to enable intelligent parallel neuromorphic computing systems.

Dr. Robinson E. Pino is a senior scientist with ICF International working to advance the state of the art in cyber security by developing and applying autonomous cognitive and neuromorphic computing application solutions for the DoD, Army Research Laboratory (ARL). Recently, Senior Electronics Engineer and Principal Investigator with the Air Force Research Laboratory (AFRL) High Performance Computing branch leading a team of scientists and engineers to perform basic research and development on advanced computing architecture technologies with primary focus on neuromorphic computing. During his tenure, Dr. Pino was recognized winning both AFRL/RI Scientist of the Year and AFRL Early Career Awards. Also, Dr. Pino was adjunct professor at the University of Vermont where he taught graduate and undergraduate courses in electrical engineering. Upon receipt of his Ph.D., Dr. Pino joined IBM Microelectronics where he was responsible for Compact Model development and model extraction characterizing IBM's newest CMOS technologies. Also, Dr. Pino worked within IBM's Photomask Technology Business Unit where he was responsible for operations management: such as unit revenue, expense budgets, capacity planning, business processes automation, Lean Manufacturing and control systems. In addition, Dr. Pino was elected as an adjunct member of IBM's distinguished Technical Vitality Council due to his many contributions to the company. Dr. Pino has a Ph.D. and M.S. in Electrical Engineering from the Rensselaer Polytechnic Institute, NY USA, and a B.E. in Electrical Engineering with honors from the City College of New York, NY USA.

Technical Full Paper Sessions

Technical Full Paper Session I

Sunday, July 1 8:45 AM - 10:15 AM

Regency Ballroom A

Session Chair:

Dr. Olli-Pekka Tossavainen, Nokia Research

Fast k-clustering Queries on Embeddings of Road Networks

James McClain, Piyush Kumar

In this paper, we study the k-clustering query problem on road networks, an important problem in Geographic Information Systems (GIS). Using previously developed Euclidean embeddings and reduction to fast nearest neighbor search, we show and analyze approximation algorithms for these problems. Since these problems are difficult to solve exactly - and even hard to approximate for most variants - we compare our constant factor approximation algorithms to exact answers on small synthetic datasets and on a dataset representing Tallahassee, Florida, a small city. We have implemented a web application that demonstrates our method for road networks in the same small city.

Keywords: Road Network, Aggregate Nearest Neighbor, k-means, k-medians, k-centers

Wavelet-based Automated River Network Generalization

Moshe Gutman, Chris Weaver

We have created an interactive map that can smoothly zoom to any region. The core of our system utilizes wavelets to achieve this e ect. The system is implemented to view hydrographic owline data, such as in the USGS National Hydrography Dataset (NHD). The map demonstrates that a wavelet-based approach is well suited for basic generalization operations. It provides smoothing and pruning that is continuously dependent on map scale. The method is applied to the Vermont river network, with the goal of creating an interactive map visualization. The process involves removing cycles from the network, prioritizing the segments according to their Strahler numbers, and extracting tributaries. Then each tributary is decomposed into wavelet details. When the user requests a map of a region B, the window size infers the scale s. Two functions determine the accuracy and the pruning level. The tributaries that are visible in B are synthesized to the required accuracy and displayed according to the pruning function. In our system, the pruning is designed to be continuous with respect to the scale. Our implementation shows that the interactive map renders views in subsecond time. We have determined experimentally that the FBI (9-7) biorthogonal wavelet family provides the best compromise between quality of approximation and computation time.

Keywords: Generalization, hydrography, wavelets, cartography

Exploring Multivariate Spatio-Temporal Change in Climate Data Using Image Analysis Techniques

Michael McGuire, Aryya Gangopadhyay, Vandana Janeja

Spatio-temporal data from earth observation systems and models are increasing at astronomical rates in the climate domain. This results in a massive dataset that is increasingly difficult to navigate to find interesting time periods where the spatial pattern of a process changes. The ability to navigate to such areas can lead to new knowledge about the factors that contribute to a spatio-temporal process. This paper proposes a method to automatically characterize multi-variate spatio-temporal datasets using basic image processing techniques and an efficient distance measure. The approach uses a measure of local image entropy combined with edge detection to find naturally occurring boundaries in the dataset. Then a distance measure is used to track the change in these boundaries over time. The resulting measure of spatio-temporal change can be used to explore spatio-temporal datasets to find new relationships between the spatial pattern of variables over time. Experiments were performed on a real-world climate dataset and the results were promising in that new patterns emerged and interesting relationships between variables were found.

Keywords: Spatio-temporal data mining, Image processing, Change detection, climate data

Technical Full Paper Session II

Sunday Jul 1 10:30 AM - 12:00 PM

Regency Ballroom A

Session Chair:

Prof. Jianting Zhang, City University of New York

CiVicinity Events: Pairing Geolocation Tools with a Community Calendar

Blaine Hoffman, Harold Robinson, Keith Han, John Carroll

In this paper, we introduce the design of a location-sensitive calendar as part of an ongoing community portal project. CiVicinity's Events page supports the aggregation and presentation of activities and events throughout the community in one centralized location. The integration of location-aware features, including map visuals and distances based on a user's current location, enhances the locality of the online calendar. We support the design rationale of this calendar through a brief user evaluation study focusing on the benefits and additions of the location-sensitive features.

Keywords: Design method, community network, community awareness, geolocation, locality, hyperlocality

MIMIC : MobIle Mapping point densIty Calculator

Conor Cahalane, Tim McCarthy, Conor P. McElhinney

The current generation of Mobile Mapping Systems (MMSs) capture increasingly larger amounts of data in a short time frame. Due to the relative novelty of this technology there is no concrete understanding of the point density that different hardware configurations and operating parameters will exhibit on objects at specific distances. Depending on the project requirements, obtaining the required point density impacts on survey time, processing time, data storage and is the underlying limit of automated algorithms. A limited understanding of the capabilities of these systems means that defining point density in project specifications is a complicated process. We are in the process of developing a method for determining the quantitative resolution of point clouds collected by a MMS with respect to known objects at specified distances. We have previously demonstrated the capabilities of our system for calculating point spacing, profile angle and profile spacing individually. Each of these elements are a major factor in calculating point density on arbitrary objects, such as road signs, poles or buildings - all important features in asset management surveys. This paper will introduce the current version of the MobIle Mapping point densIty Calculator (MIMIC), MIMIC's visualisation module and finally discuss the methods employed to validate our work.

Keywords: LiDAR, mobile mapping, point density

LiDAR Data Management Pipeline; from Spatial Database Population to Web-Application Visualization

Paul Lewis, Conor McElhinney, Timothy McCarthy

While the existence of very large and scalable Database Management Systems is well recognized, it is the usage and extension of these technologies to managing spatial data that has seen increasing amounts of research work in recent years. A focused area of this research work involves the handling of very high resolution Light Detection and Ranging (LiDAR) data. While LiDAR has many real world applications, it is usually the preserve of organizations interested in capturing and monitoring our environment where it has become pervasive. In many of these cases it has now become the de facto minimum standard expected when a need to acquire very detailed 3D spatial data is required. However, significant challenges exist when working with these data sources, from data storage to feature extraction through to data segmentation all presenting challenges relating to the very large volumes of data that exist. In this paper we present the complete LiDAR data pipeline as managed in our spatial database framework. This involves three distinct sections; populating the database, building a spatial hierarchy that describes the available data sources and spatially segmenting data based on user requirements which generates a visualization of these data in a WebGL enabled web-application viewer. All work presented is in an experimental results context where we show how this approach is runtime efficient given the very large volumes of LiDAR data that are being managed.

Keywords: LiDAR, Spatial Database, WedGL, PostGIS

Technical Full Paper Session III

Sunday Jul 1 1:15 PM - 2:45 PM

Regency Ballroom A

Session Chair:

Prof. Yerach Doytsher, Technion - Israel Institute of Technology

Temporally Coherent Real-Time Labeling of Dynamic Scenes

Mikael Vaaraniemi, Marc Treib, Rüdiger Westermann

The augmentation of objects by textual annotations provides a powerful means for visual data exploration. Especially in interactive scenarios, where the view on the objects and, thus, the preferred placement of annotations changes continually, efficient labeling procedures are required. As identified by a preliminary study for this paper, these procedures have to consider a number of requirements for achieving an optimal readability, e.g. cartographic principles, visual association and temporal coherence. In this paper, we present a force-based labeling algorithm for 2D and 3D scenes, which can compute the placements of annotations at very high speed and fulfills the identified requirements. The efficient labeling of several hundred annotations is achieved by computing their layout in parallel on the GPU. This allows for a real-time and collision-free arrangement of both dynamically changing and static information. We demonstrate that our method supports a large variety of applications, e.g. geographical information systems, automotive navigation systems, and scientific or information visualization systems. We conclude the paper with an expert study which confirms the enhancements brought by our algorithm with respect to visual association and readability.

Keywords: Labeling, force-based, real-time, annotation, graph, GIS, navigation

Towards a Collaborative GeoSocial Analysis Workbench

Arie Croitoru, Anthony Stefanidis, Jacek Radzikowski, Andrew Crooks, Justin Stahl, Nicole Wayant

Social media contributions are manifestations of humans acting as sensors, participating in activities, reacting to events, and reporting issues that are considered important. Harvesting this information offfers a unique opportunity to monitor the human landscape, and gain unparalleled situational awareness, especially as it relates to sociocultural dynamics. However, this requires the emergence of a novel GeoSocial analysis paradigm. Towards this goal, in this paper we present a framework for collaborative GeoSocial analysis, which is designed around data harvesting from social media feeds (starting with twitter and flickr) and the concept of a collaborative GeoSocial Analysis Workbench (G-SAW). We present key concepts of this framework, and early test implementation results in order to demonstrate the potential of the G-SAW framework for enhanced situational awareness.

Keywords: Geographic Information Systems, Social Media, Situational Awareness, Twitter, Flickr

Retrieving Large-Scale High Density Video Target Tracks from Spatial Database

Hongli Deng, Kiran Gunda, Zeeshan Rasheed, Niels Haering

With more and more live sensors being added to geospatial applications, huge amount of sensor data are generated and saved in spatial database. Managing and mining these large-scale ever-changing data becomes new challenges for geospatial studies. In this paper, we present an application-oriented case study to show how to retrieve target tracking data from big dataset saved in spatial database. Our video event retrieval system collects thirty days (8790 GB) high definition video data from six surveillance cameras, analyze them and extract roughly ten million video target tracks. These tracks are projected onto world coordinates and pumped into a spatial database. The system performance of inserting and retrieving these tracks is analyzed in terms of spatial data type design, spatial index configuration, online operation capacity, query optimization and scalability handling. Our insights of saving, managing and retrieving target tracks in a large-scale are presented.

Keywords: Video event search, spatial database, spatial index, large-scale spatial data retrieval, video surveillance

Technical Full Paper Session IV

Sunday Jul 1 3:00 PM - 4:30 PM

Regency Ballroom A

Session Chair:

Dr. Alexander Davydov, COM.Geo

City-Scale Urban Transport and Dispersion Simulation Using Geographic Information System Footprints

Jyh-Ming Lien, Fernando Camelli, Yanyan Lu, David Wong

A large volume of urban models describing urban objects in major international cities has been re-constructed and become freely and publicly available via software like ArcGlobe and Google Earth. However, these models are mostly created for visualization and are loosely structured. For example, current GIS software such as ESRI ArcGIS and urban model synthesis methods typically use overlapping 2D footprints with elevation and height information to depict various components of buildings. In this paper, we present a robust and efficient framework that generates seamless 3D architectural models from these footprints that usually contain small, sharp, and various (nearly) degenerate artifacts due to machine and human errors. We demonstrate the benefits of the proposed method by showcase an atmospheric dispersion simulation in a New York City (NYC) dataset. Finally, we discuss several examples of visualizing and analyzing the simulated Computational Fluid Dynamics (CFD) data into the GIS for further geospatial analysis.

Keywords: Geometry processing, simulation, GIS, experiments

A Practical Approach to Developing a Web-based Geospatial Workflow Composition and Execution System

Jianting Zhang

Motivated by lacking the capability of supporting geospatial workflow composition and execution in a Web environment from leading GIS (such as ESRI ArcGIS), we have developed a prototype system by integrating mature open source and commercial software packages in an innovative way. Our prototype system includes a client module for visual and interactive workflow editing based on Ptolemy II (a modeling and design system), a geospatial actor library representing 500+ ArcGIS geoprocessing tools for drag-and-drop-based workflow composition, a middleware as a workflow engine to schedule and execute ArcGIS Geoprocessing tools based on composed geospatial workflows, and, a Web-GIS to visualize original and derived data along a workflow processing pipeline. By reusing the mature software packages, we are able to complete the prototype development within weeks instead of months or years. A site selection problem that involves multiple geospatial operations are used to demonstrate the functionality and features of the prototype system.

Keywords: Geospatial, Workflow, Web, Middleware, Integration, Reuse

An Open Source Virtual Globe Framework for iOS, Android and WebGL Compliant Browser

José P. Suárez, Agustín Trujillo, Manuel de la Calle, Diego D. Gómez-Deck, Jose M. Santana

We introduce Glob3Mobile, an efficent Virtual Globe framework, testable and freely accessible from the web and providing a truly 3D navigation experience with smooth flying. We discuss software design and native code implementation for familiar iOS and Android mobile devices. In addition a novel web experience is facilitated by supporting the globe in a WebGL compliant browser. Glob3 mobile enjoys an user friendly API that allows testing and scripting new features on the globe. The paper discusses software design, technical choices in the development and provides a comparative with other existing similar solutions.

Keywords: Virtual globe, mobile device, geospatial application

Technical Short Paper Sessions

Technical Short Paper Session I

Sunday, July 1 8:45AM - 10:15 AM

Regency Ballroom B

Session Chair:
Dr. Hongli Deng, ObjectVideo

Spatial Analysis of Ohio Police Station Locations Using Geographical Information Systems

Serdar Turedi

This study aims to investigate the relationship between socio-economic factors and crime, and to understand the underlying criteria of new police station locations decisions. Factor analysis, multiple criteria decision analysis and genetic algorithm methods have been used to define the relationship, to decide the number of necessary police stations in each county, and to locate these police stations respectively. This model is applied to state of Ohio. The results showed that nine counties out of eighty can be considered as high crime areas in state of Ohio and at least forty three new police stations should be established in these nine counties.

Keywords: Crime patterns, geographic information systems, census 2000, population, unemployment, police station locations

Query Optimization with Value Path Materialization in Column-Stored DWMS

Bin Zhang, Xiaoling Xia, Xiaohu Huang, Mei Wang, Jiajin Le

Materialization is a key issue for query execution in column-oriented Data Warehouse Management System (DWMS) due to the fact that it has direct influence on the query efficiency. Focusing on the defects of traditional strategies Early Materialization and Late Materialization, this paper propose a new materialization strategy called VPMS (Value path Materialization Strategy) to solve those problem. First, VPMS define a new descriptor structure pass block for the intermediate results during physical execution. For a given physical query tree, VPMS generates value path. Depending on the value path, the values of the column are saved in the value area of the pass block when needed by the upper nodes, otherwise, only save the location information. Finally, during the query execution, the physical sub-operation is specified according to the materialization path and the query object itself, which effectively reduces the unnecessary duplication of judgments. Experiments on benchmark dataset SSB demonstrate the overall effectiveness of our approach.

Keywords: Data warehouse, column-store, value path materialization strategy, query optimization

Performance Comparisons of Spatial Data Processing Techniques for a Large Scale Mobile Phone Dataset

Apichon Witayangkurn, Teerayut Horanont, Ryosuke Shibasaki

Mobile technology, especially mobile phone, is very popular nowadays. Increasing number of mobile users and availability of GPS-embedded mobile phones generate large amount of GPS trajectories that can be used in various research areas such as people mobility and transportation planning. However, how to handle such a large-scale dataset is a significant issue particularly in spatial analysis domain. In this paper, we aimed to explore a suitable way for extracting geo-location of GPS coordinate that achieve large-scale support, fast processing, and easily scalable both in storage and calculation speed. Geo-locations are cities, zones, or any interesting points. Our dataset is GPS trajectories of 1.5 million individual mobile phone users in Japan accumulated for one year. The total number was approximately 9.2 billion records. Therefore, we conducted performance comparisons of various methods for processing spatial data, particularly for a huge dataset. In this work, we first processed data on PostgreSQL with PostGIS that is a traditional way for spatial data processing. Second, we used java application with spatial library called Java Topology suite (JTS). Third, we tried on Hadoop Cloud Computing Platform focusing on using Hive on top of Hadoop to allow SQL-like support. However, Hadoop/Hive did not support spatial query at the moment. Hence, we proposed a solution to enable spatial support on Hive. As the results, Hadoop/hive with spatial support performed best result in large-scale processing among evaluated methods and in addition, we recommended techniques in Hadoop/Hive for processing different types of spatial data.

Keywords: GPS, Mobile Phone, Spatial Query, Cloud Computing, Hadoop.

On Clusterization of "Big Data" Streams

S. Y. Berkovich, D. Liao

Current technology provides wonderful facilities for operating with extremely vast amounts of data. These facilities are expanding due to capabilities of "Cloud Computing." The developing situation gives rise to the "Big Data" concept posing specific engineering and organizational challenges. Big data refers to the rising flood of digital data from many sources, including the sensors, digitizers, scanners, software-based modeling, mobile phones, internet, videos, e-mails, and social network communications. The data type could be texts, geometries, images, videos, sounds, or their combination. Many of such data are directly or indirectly related to geospatial information. In this paper, we suggest to enhance the available information processing resources with a novel software/hardware technique for on-the-fly clusterization of amorphous data from diverse sources. The presented approach is based on the previously developed construction of FuzzyFind Dictionary utilizing the error-correction Golay Code. Realization of this technique requires processing of intensive continuous data streams, which can be effectively implemented using multi-core pipelining with forced interrupts. The objective of this paper is to bring forward a new simple and efficacious tool for one of the most demanding operations of this "Big Data" methodology - clustering of diverse information items in a data stream mode.

Improving our ability to extract knowledge and insights from large and complex collections of digital data promises to solve some the Nation's most pressing challenges. Furthermore, the paper reveals a parallel between the computational model integrating "Big Data" streams and the organization of information processing in the brain. The uncertainties in relation to the considered method of clusterization are moderated due to the idea of the bounded rationality, an approach that does not require a complete exact knowledge for sensible decision-making.

Keywords: "Big Data" concept, on-the-fly processing, clustering algorithms, Golay code, "Meta Knowledge" ontology, multi-core pipelining, heterogeneous computing, stream processing

Technical Short Paper Session II

Sunday, July 1 10:30AM - 12:00 PM

Regency Ballroom B

Session Chair:

Prof. Peter C. Chang, University of Maryland

Fast Visibility Analysis in 3D Procedural Modeling Environments

Oren Gal, Yerach Doytsher

This paper presents a unique solution to the visibility problem in 3D urban environments generated by procedural modeling. We shall introduce a visibility algorithm for a 3D urban environment, consisting of mass modeling shapes. Mass modeling consists of basic shape vocabulary with a box as the basic structure. Using boxes as simple mass model shapes, one can generate basic building blocks such as L, H, U and T shapes, creating a complex urban environment model computing visible parts. Visibility analysis is based on an analytic solution for basic building structures as a single box. A building structure is presented as a continuous parameterization approximating of the building's corners. The algorithm quickly generates the visible surfaces' boundary of a single building and, consequently, its visible pyramid volume. Using simple geometric operations of projections and intersections between these visible pyramid volumes, hidden surfaces between buildings are rapidly computed. Real urban environment from Boston, MA, approximated to the 3D basic shape vocabulary model demonstrates our approach.

Keywords: 3D Visibility, Urban environment, Spatial analysis, Efficient algorithms

Constructing Natural Neighbor Interpolation Based Grid DEM Using CUDA

Simin You, Jianting Zhang

Constructing digital elevation model (DEM) from dense LiDAR points becomes increasingly important. Natural Neighbor Interpolation (NNI) is a popular approach to DEM construction from point datasets but is computationally intensive. In this study, we present a set of General Purpose computing Graphics Processing Unit(GPGPU) based algorithms that can significant speed up the process. Evaluating three real world LiDAR datasets each contains 6~7 million points shows that our CUDA based implementation on a NVIDIA GTX 480 GPU card is several times to nearly 2 orders faster than the current state-of-the-art NNI based DEM construction using graphics hardware acceleration.

Keywords: GIS, LiDAR, DEM, Natural Neighbor Interpolation, Voronoi Diagram, GPU, CUDA

Airborne Geo-Location for Search and Rescue Applications

Maxwell Love, Hannah Burgess, Scott Mead, Matt Greene, Matthew Luehrmann, Thomas Babbitt

Radio direction finding is used in many search and rescue applications. The ability to accurately reduce a search area helps focus limited resources properly, which increases the probability of a search and rescue operations success. This paper examines the application of vector geometry, radio line-of-sight, and a terrain-based cost calculation in order to improve the accuracy of the FORTRAN Fix (FFIX) algorithm when used by airborne platforms. By conditioning data sets to be used by FFIX, airborne platform locations can be shifted to more accurately reflect changes in aircraft and antenna orientation. Additionally, we can reduce the area produced by eliminating low probability search areas.

Keywords: FFIX, vector geometry, airborne platforms, terrain-based cost calculation

Image-Based Structural Damage Assessment with Sensor Fusion

Peter C. Chang, Dr. Liao

This paper presents a new approach to improve the accuracy and time needed to assess the structural damage based on imaging and sensor fusion technologies. The major structural properties (i.e., global properties, temperature, and deformation) are employed, which can be obtained through different kinds of sensors. Enhancements of visual images including thermal imaging and historical data are important methods to determinate both visible and invisible structural stability. Crack detection is given to further enhance the assessment. The latest GPGPU (General-Purpose Graphics Processing Unit) technology to help improve computation performance is introduced in briefly. An expert system is created to assist final sensor fusion and analysis for structural stability determination.

Keywords: Structural assessment, Finite element modeling, Computer vision, Thermal imaging, Crack detection, GPGPU, Sensor Fusion, Expert system

Technical Briefing Papers Session I

Sunday, July 1 1:15PM - 2:45 PM
Regency Ballroom B

Session Chair:
Prof. Ge Jin, Purdue University/COM.Geo

Real-time 3D Mapping for Robotic Applications
William Smith, Dr. Bingcai Zhang

BAE Systems is pursuing research in real-time 3-D mapping technology that can be used to navigate an unmanned autonomous vehicle (UAV). Geospatial technology, such as digital photogrammetry and GIS, offers advanced capabilities to produce 2-D and 3-D static maps using UAV data. The goal is to develop real-time UAV navigation through increased automation. We believe the next breakthrough may be automatically identifying 3-D objects. Consequently, our team has developed software that recognizes certain types of 3-D objects within 3-D point clouds. Although our software is developed for modeling, simulation, and visualization applications, it has the potential to be valuable in robotics and UAV applications.

Keywords: Automatic 3-D Feature Extraction

A Machine Learning System for Recognizing Subclasses
Ranga Raju Vatsavai

Thematic information extraction from remote sensing images is a complex task. In this demonstration, we present *Miner machine learning system. In particular, we demonstrate an advanced subclass recognition algorithm that is specifically designed to extract ner classes from aggregate classes.

ArchaeoSTOR Map: Publishing Archaeological Geodata on the Web
Yuma Matsui, Aaron Gidding, Thomas E. Levy, Falko Kuester, Thomas A. DeFanti

Modern field science, including archaeology, utilizes a massive amount of digital data captured by state-of-the-art measurement instruments. Large archaeological data sets may include images, geospatial data, analytical data, and meta- data. Geospatial information plays a central role in the life cycle of those data; information is collected, organized, and published for analyses and visualization as final output using geospatial data as an index. The web is an ideal place to publish scientific data and promote diverse collaboration, and thus we need a system to publish digital archaeological data efficiently so that it is also integrated in our data management workflow. In order to realize this goal, we designed and implemented a web-based application named ArcheoSTOR Map, which visualizes and publishes raw archaeological data onto a map.

Keywords: Archaeology, Data Management, Geospatial, Visualization, Web, Workflow

Variation of Flow Pattern in Waterways due to Degradation and Aggradation
Ashraf Ghaly

The cross section and profile of waterways are constantly subjected to alteration due to changes in flow volume and velocity. Banks and beds of waterways could experience excessive scouring especially at locations with sharp bents. At these locations, the soil constituting the cross section of the waterway could be subjected to considerable degradation, which could significantly alter the flow pattern at these locations. With severe degradation, the volume of sediment transport increases and may exceed the water carrying capacity resulting in the phenomenon known as aggradation. Contrary to degradation, aggradation results from the deposition of carried aggregate transport, which can hinder water flow in the waterway and obstruct its path. As degradation and aggradation take hold at some location along the waterway, their effect gets compounded over time which exacerbates the problem and make it difficult for the waterway to recover. Geographic Information Systems (GIS) is used to study the effect of degradation and aggradation along the Schoharie Creek, which is one of the major tributaries of the Mohawk River in upstate New York. The change in the selected locations will be examined over time to show the gradual alteration that a given section experiences and its effect on flow pattern and waterway profile. The analysis will also include a Digital Elevation Model (DEM) study of bank slopes based on the creation of a contour map. The August and September 2011 Tropical Storms Irene and Lee, respectively, left in their wake tremendous change to the waterway due to excessive degradation and aggradation. This effect was sensed due to the severe brunt it brought on the area landscape and its infrastructure. This study will identify the areas most in need for buffering and most susceptible to the impact of these natural phenomena. This will help implement proper protection methods, and in case of a damage, it will help plan for effective restoration systems.

Keywords: Flow, Degradation, Aggradation, GIS, Digital Elevation Models, Infrastructure

Metadata Management and Revision History Tracking for Spatial Data and GIS Map Figures
Yongmin Yan, Tracy McLane

This paper describes how Bechtel maintains metadata for both spatial data and GIS map figures, and how revision histories of each are tracked in an enterprise-level Oracle Spatial database via a set of customized GIS metadata management tools. First of all, Bechtel has adopted a standardized data model called Spatial Data Standard for Facilities, Infrastructure, and Environment (SDSFIE) and has developed standard workflows and procedures around it for data cataloging, processing, and deployment in an enterprise Oracle Spatial geodatabase environment. Secondly, Bechtel has adopted the concept of feature level metadata, i.e., each feature or geometry also carries metadata. Thirdly, Bechtel keeps up-to-date the relationship between map figures and spatial data. Lastly, Bechtel has developed a set of GIS automation tools for metadata management, making otherwise a very time consuming process totally manageable. The capability of keeping track of revision history for both spatial data and map figures enables Bechtel to rapidly and accurately respond to requests for information from the clients regarding changes of spatial data and map figures, resulting in quick turnaround and significant cost savings.

Keywords: Metadata, Spatial Data, Map Figures, Revision History Tracking, GIS, Enterprise GIS, Oracle Spatial

MapMyTrip App for Andoid Smartphone
Thu Nguyen

Our classical methods of tracking a journey while on vacation usually consist of a digital camera, camcorder, hard-print, and/or scrapbook, all of which cost so much time and money. Usually after each vacation, most of us have to go back to our daily busy schedules, and we never have time to organize our collection of memorable trips into a scrapbook to share with friends and family. The small, portable smart phone technology has created a new revolution in application development [2]. The unique GPS, camera, social network and computing capabilities on smart phones introduce a convenient and cost-effective method to collect simple positions' coordinate data and create maps that can become the basis for photo album / video clips for a trip. The purpose of the MapMyTrip app is to save the travelers a tremendous amount of time by utilizing the all-in-one capability of smart phone technology to instantly track coordinates, create map of destinations with the link to photo or video clips taken in real-time, and share on Social Network media while on the go.

Identical Entity Matching from Multi-source Spatial Data
Liu Hai-yan, Liu Xin-gui, Liu Chen-fan

As the key technique of spatial data integration and updating, identical entity matching is to establish the relationship between geographic entities from multi-source spatial databases. It aims to make full use of diverse data from multiple sources. This paper discusses several geometric matching methods for entities with the same names, including geometry matching for same scale road networks, geometry matching for multi-scale road networks, and vector data and image matching.

Keywords: Identical Entity, Geometric Matching, Multi-source Spatial Data , Buffer Zone, Same Scale Road Networks, Different Scale Road Networks, Vector Data and Image Matching

Technical Briefing Papers Session II

Sunday, July 1 3:00PM - 4:30 PM
Regency Ballroom B

Session Chair:
Kipp Jones, Chief Architect at Skyhook Wireless

Evidence Theory for Reputation-based Trust in Wireless Sensor Networks
Andreas Matheus, Björn Stelte

Attacks like fault data injection are not easy to prevent in resource-limited sensor networks. Especially in environments with urgent decision making trustworthy sensor net- works are mandatory. Redundancy can be used to detect and isolate malicious behaving nodes and thus to secure the network. The presented approach implements trust based on o -the-shelf wireless sensor nodes and is more power efficient than one-single trusted node implementations with TPM technology.

Automatic 3D Analysis of Large Areas using Stereo Vision Technology
Dipl.-Ing. Jan Tischer

In the last years the market for 3D geo data like 3D city maps has been growing continuously. The users of many applications benefit a lot from extending their data basis from 2D to 3D. This presentation will show what concepts can be used to generate e. g. 3D buildings automatically, fast and cost-efficient from stereo aerial or satellite imagery. New software algorithms use very dense point clouds generated from stereo imagery as data source for automatic 3D mapping. For this, algorithms of SGM (semi global matching) type are implemented and adapted. The acquisition of stereo imagery as well as laser scanning is carried out in remote sensing projects on mobile carriers such as aeroplanes, helicopters, unmanned aerial vehicles, cars and high resolution satellite sensors. These source data from remote sensing systems are more and more available for many regions and can be used to generate 3D data automatically, fast or even in real-time as well as cost-effective even though very large data volumes need to be processed. In a further step, aerial or terrestrial digital close-range photography is processed to do an automatic facade analysis in order to texture roof and wall faces photorealistically or to reconstruct facades from meta information deduced from the source. Parametric building reconstruction is used for high optical quality combined with low data volume. The development of fast and fully-automatic three-dimensional data processing is important for various applications in the following sectors: military and homeland security, disaster control, civil cartography and geodata services, navigation, internet services and the automobile industry.

Real-time Spatio-temporal Analysis of West Nile Virus Using Twitter Data
Ramanathan Sugumaran, Jonathan Voss

West Nile virus (WNV) is one of the most geographically widespread arboviruses in the world with cases occurring on all continents except Antarctica. The goal of study is to understand a real-time spatial temporal WNV activity using Twitter data. In our study, we collected tweets for the entire world using Twitter Search API with tags #WestNileVirus, and #WNV from August 31, 2011. Collected tweets were stored, cleaned, and geocoded. The Google API was used to display information on the web. The changes per week showed that the numbers were relatively high from August through October then gradually slowed down from December through March. We also found a very large increase in tweet numbers from March and April. This may be due to unusual higher temperature and mosquito activities in March and April this year compared to previous years.

Modeling Urban Extent and Density Using Radio Artifacts from Cellular and WiFi Beacons

Richard Sutton, Kipp Jones

Skyhook provides location to more than 100 million mobile devices, generating over a quarter billion location requests daily. This provides us with a large set of radio artifacts logged with high accuracy both temporally and spatially. The signal information returned with each of these location requests allows us to extend, refine and self heal the Skyhook beacon database across thousands of urban areas worldwide.

Beacon density may be measured and discretized to produce accurate representations of underlying real world features. Since Wi-Fi beacons have become ubiquitous in all major cities worldwide, mapping their distribution provides a dependable signal for delineating urban boundaries. In addition to defining general urban polygons, features such as lakes, parks and other signal-starved areas may be captured as isopleths derived from beacon density raster surfaces. This is especially useful in parts of the world where high quality polygonal data is scarce or non-existent. And because of the ubiquitous sampling method, areas of new development tend to self-register nearly instantly.

Quality of feature extraction can be assessed and validated against aerial imagery as well as existing geospatial layers. We find that Skyhook's radio artifact-derived features generally provide superior positional accuracy to existing geospatial resources from both public sources and commercial vendors for determining urban boundaries as well as sub-urban features.

Mapping Environmental Pollution, Contamination, and Waste in the United States

Ashraf Ghaly

Businesses operating facilities with environmental focus dealing with waste, contamination, or pollution are legally required to detail their degree of compliance with environmental rules and regulations, and to report on their activities to the United States Environmental Protection Agency (EPA). Such activities include substances related to air pollution, land or water contamination, waste disposal, and toxic or radioactive materials. Due to the on-going nature of reporting, the EPA established a repository where all reported data related to business activities can be found. EPA developed EnviroMapper, a search engine that can be used to map, for any given area, the facilities dealing with issues related to air, water, waste, land, toxics, and radiation. The interactive nature of the search is very convenient and makes it easy for the user to learn about business activities and get more information from filed reports. Furthermore, the system has several features including information on air emission, superfund sites, toxic release, hazardous waste, water dischargers, brownfields, and toxic substances. This is supplemented with an extensive searchable list of chemicals used in the activities of various industries such as agriculture, forestry, manufacturing, mining, transportation, communications, and electric, gas, and sanitary services. This elaborate system is designed to help researchers, planners, developers, and the public in general learn about environmentally-related activities in a given location. In addition, Geographic Information Systems (GIS) data can be downloaded and used to plot maps necessary for variety of purposes such as research studies, environmental impact assessment, public health, planning, and development. This presentation intends to use GIS data downloaded from the system for the city of Albany, the Capital of New York State, to illustrate how this data can be used as a research tool to study the factors that lead to the concentration of environmentally-related businesses in a specific area and their effect on the standard of living and quality of life in that area.

Spatial Analysis in the Cloud

Frank Hardisty

Cloud computing services are increasingly popular. However, GIS is still approached mainly as a desktop endeavor. If we define GIS as consisting of a spatial data store, spatial analysis, and mapping of results, we can find cloud services for data stores and for mapping, but not for spatial analysis. Our contention is that cloud computing for spatial analysis at cloud scales requires moving away from a computing paradigm revolving around mutable objects. For example, the leading commercial GIS (ArcGIS) seems hampered by its legacy programming model revolving around mutable objects. We describe the prospects for spatial analysis in cloud computing, paying special attention to programming paradigms for parallel computing, and looking ahead to what advances in functional programming imply for spatial analysis. We also look at the trend towards big data computing, and show how spatial analysis is an excellent fit for Hadoop, non-relational data stores, and other computational services that can handle massive amounts of data. We also examine what kinds of computing architectures could support real-time interaction with millions or billions of geospatial data items.

Effectiveness of Scalable Vector Graphics (SVG)

Theresa Firestine, Frank Hardisty

Scalable Vector Graphics (SVG) is an effective web map technology for client-side vector mapping. We demonstrate this through a web map application developed for the Trans-Border Institute of the University of San Diego. The Trans-

Border Institute currently releases reports summarizing data on the number of drug-related homicides in Mexico and produces maps to show drug-related killings in each Mexican state. Together, the reports and maps are used to inform U.S. audiences about the public security situation in Mexico and the effects of the war on drugs. The deadly consequences of the drug-war in Mexico become clear in the maps produced by the Trans-Border Institute. The maps, however, are not as effective as they could be because they are released as static images. These static images do not allow for the exploration of the data themselves and make it difficult to view changes over time. To facilitate data exploration and thereby assist the Trans-Border Institute in more effectively disseminating information on the drug-war in Mexico, an interactive web map was developed using SVG. For client side vector graphics, SVG provides clear advantages in that it is open, interoperable, and extensible and is resolution independent. In addition, behaviors, including animation, can be included in the markup file itself or added through scripting. These advantages make SVG optimal for developing high quality interactive (and non-interactive) vector maps. Despite these advantages, SVG has not been widely adopted. However, recent technological changes and trends have made competing systems, like Flash, less optimal and have heightened the awareness and ease of using SVG. Combined, these changes have paved the way for SVG becoming the most widely used client-side vector standard. Its effectiveness is demonstrated in an SVG-based, interactive web map developed for the Trans-Border Institute and shown in this presentation.

National Fire Alert and Monitoring System

Juan M. Escamilla Mólgora

Since 2000 CONABIO has processed and published in near real time geospatial information of occurring wild fires in Mexico and Central America as part of the "Hotspot detection with remote sensing techniques" program. Currently the Fire Alert System receives via direct-broadcast raw data from MODIS (Aqua and Terra platforms) and VIIRS (NPP). This raw data is processed to L1A, L1B, MOD14, MOD13 and MOD11 products (at the moment we only process VIIRS to L1B). MOD14 gives us a Fire-Mask raster that has the coordinates of the thermal anomalies called hotspots (Giglio, 2003). Each hotspot represents a 1 Km squared polygon that, with nearly 0.9 probability, has a uniformly distributed fire. The system automatically publishes information of county level locality name, area slope, ecosystem type and closeness to the nearest "Natural Protected Area". The system also has a WMS service provided by GeoServer that stores thematic map layers of Fire Propagation Index, a NDVI time-series analysis model that measures vegetation anomalies, and Moisture Percentage Map, based on dead vegetation fuel and rainfall duration raster products. Every 24 hrs we process a mean of 6 satellite passes during day and night. Over time, the amount of data has surpass the original capacity of the system. Although the first generation software has been upgraded to accomplish the needs of users, specially fire fighters, researches and decision-making people, the urgent need of a platform capable of forecasting, performing complex analysis and integrating it with next generation data sources has turned the use and administration of the old system an awkward task. A next-generation system is being developed at the moment and the release date is expected by the end of this year. The system lies on a Postgres9.1-Postgis2.0 with raster support engine that decreases dramatically the processing time. The design of a software based on a spatially-enable database has opened a new world of opportunities. This system will be based purely on Open Source Software.

Fire Alert System homepage:
http://www.conabio.gob.mx/incendios/

Transport and Dispersion Simulation in Downtown Oklahoma City and New York City

Fernando Camelli, Jyh-Ming Lien, David Wong

In this video, we showcase two atmospheric dispersion simulations in an Oklahoma City dataset and a New York City (NYC) dataset. These simulations are created using a robust and efficient framework that generates seamless 3D architectural models from overlapping 2D footprints. These footprints with elevation and height information are commonly used to depict various components of buildings in GIS software such as ESRI ArcGIS and urban model synthesis methods, and usually contain small, sharp, and various (nearly) degenerate artifacts due to machine and human errors. In the first part of the video showing a simulation in Oklahoma City, the location is south of the public library in an area where there is a building currently. Two iso-surfaces of 10-4 and 10-5 ppm are shown in green and the brown clouds. The inflow is a westerly wind with a wind speed of 5 m/s at 10 meters above ground level. In the second part of the video showing a simulation in NYC, the location is the Financial District, Manhattan. The simulation assumed a boundary condition for the inflow of a logarithmic profile of 2 m/s with a velocity at 10 meters from the ground. An iso-surface of 10-5 ppm is shown. The final volume mesh produce contains 333 million tetrahedra, and 59 million points. The total time of the NYC simulation, including the initialization time and dispersion, took approximately two days on a high performance computing system running 2048 cores in a CRAY XK6 nodes. In both simulations, the release is continuous.

Collaborate.org - A Worldwide Collaboration Geospatial Infrastructure

Kevin Montgomery

We, as humans, are facing several challenges. Some are imposed, some self-inflicted. Global climate change, pandemic disease, disaster management, humanitarian assistance, land and water conservation only to name a few. To thrive and survive as a species, and as caretakers of our planet, we must work together to address these challenges. No one group, organization, agency, or even country comprises all the resources or abilities to overcome these challenges - we must work together. Today we release Collaborate.org -a site to empower that collaboration. A worldwide, online community of people working together, infused with data, empowered with advanced technology, linked together for the common good of all mankind. The site combines collaborative tools, all of the world's geospatial data, in an open, free, inclusive platform of shared resources, abilities, and enthusiasm, to empower people all over the world to work together to accomplish Big Things.

Cloud to Host Legacy Airport Layout Plans and Orthoimages
Shyam Parhi

U.S. DOT FAA Airports GIS is a web portal which hosts a few application modules. It allows authorized Airports GIS users to submit changes to airport data. One module in this portal is electronic Airport Layout Plan (eALP). This application when deployed will help create digital Airport Layout Plans. The layout view capability in this module is provided by ESRI's ArcGIS server. We are using GIS data available for a few airports which were included in our pilot program study for electronic ALP development. We expect this application will go to production sometimes next year. It will take several years before most or all airports in USA have their digital Airport Layout Plans. During this transition period we would store legacy Airport Layout Plans in Cloud. These Layout Plans are basically in pdf form. Plan to catalogue these Layout Plans and provide access to users are currently being discussed.

As part of Airports GIS survey module requirement we get airport imagery for every submitted airport to Airports GIS. We plan to archive these orthoimages in Cloud and then give the ability to users to take advantage of ESRI's ArcGIS to analyze and manage these imageries. These orthoimages are large in size. In future we will receive many orthoimages because the number of airports who submit this data is growing and the size of each orthoimage is also growing. Hence it needs special care to organize and access these imageries. Once completed this will have siginificant impact on airport planning and budgeting.

The FAA Tech Talk will be presented at Emerging Tech Panel III on July 3.

Emerging Tech Panels+

Emerging Tech Panel+ I

Monday, July 2 3:00 PM - 4:30 PM

Regency Ballroom

Realizing the Geospatial Potential of Mobile, Internet of Things, and Big Data

What happens when you have connected sensors in everyone's pockets, homes, vehicles, workspaces, street corners, shopping areas, and more? With the convergence of Mobile Computing, the Internet of Things (IoT), and the ability to gather and analyze this Big Data, the availability of massive amounts of information will continue to be gathered and you can expect the unexpected to happen.

The themes of this panel are driving development in information technology, but what is the intersection with geospatial? Location determination and use of location for context are core capabilities of Mobile and IoT. Knowing your location along with nearby Points of Interest (PoIs) and Indoor maps provide a new level of spatial awareness and decision making. This information will be used and viewed in new ways including Augmented Reality (AR). Social computing with geospatial checkins provides a rich picture of the social environment. With embedded computing becoming even more ubiquitous, Sensor Webs will provide opportunistic sensing of the physical environment. Geospatial filtering is one of the most effective methods to extracting information from these big data streams. These streams will continue to grow, e.g., mobile 3D video at incredibly high resolution. Data Fusion to combine multiple data sources will create new capabilities many based on geospatial processing.

How can we realize the full potential of these technological capabilities in regards to geospatial? We can envision a lot of upside with the technology, but at what cost to privacy and rights? How should policy, privacy and rights be included in the conversations and deployments of these technologies and the resultant data? What role will ambient and participatory crowdsourcing play? A goal of our technology development must be to reduce the apparent tradeoff between surveillance for public safety vs. interests and rights of people. Technology development will continue to be a social activity based on geospatial APIs and standards for mobile platforms from organizations like W3C, OGC, IETF, and OMA. Development of these technologies are a basis for the critical outcomes, e.g, in creating Smart Cities including Smart Energy. Crowdsourcing from mobile platforms and M2M-based sensors webs will provide a basis for humanity to better understand our world and make critical decisions about the livability of our future.

Moderator

George Percivall
Chief Architect & Executive Director - Interoperability Program
OGC

Panelists

Xavier Lopez
Director, Spatial and Semantic Technologies
Oracle

Kipp Jones
Chief Architect
Skyhook Wireless

Paul Wilson
Market Segment Leader
GE Energy / MapFrame Mobile Solutions

Joel Reyes
Senior Developer Evangelist for Mobile Computing
Microsoft

Kevin Montgomery
CEO
Intelesense Technologies

Emerging Tech Panel+ II

Monday, July 2 3:00 PM - 4:30 PM

Robert E. Simon Boardroom

Big Data Computing for Transportation

Moderator

Dr. Phil W. Yen
Principal Bridge Engineer & Program Manager
Member of NSTC's Subcommittee on Disaster Reduction for the White House Office
U.S. DOT - FHWA

Panelists

Gregory I. Snyder
Manager, LIDAR Program Development, Land Remote Sensing Program
USGS

Dr. Olli-Pekka Tossavainen
Researcher
Nokia

Dr. Peter C. Chang
Professor
University of Maryland

Emerging Tech Panels+

Emerging Tech Panel+ III

Tuesday, July 3 10:25AM - 11:25 AM

Regency Ballroom

Cloud Computing & Big Data Computing

The amount of data each organization deals with today has been rapidly growing. However, analyzing large datasets commonly referred to as "big data" has been a huge challenge due to lack of suitable tools and adequate computing resources. Why are organizations, both in public sector and private sector, so keen on unlocking business insights from all structured and unstructured data? What is the current state of big data solutions and service providers? How effective are some of the solutions that have been put into real world practices? What is the current state of cloud computing technologies? What impacts have cloud computing technologies available in public clouds and private clouds had on the way organizations addressing big data challenges? How to secure big data in the clouds? What are the future roadmaps for cloud-based big data solutions, especially for geospatial related applications?

This panel discussion will include a short presentation or discussion related to big data and cloud computing by each panelist, followed by questions and questions from the audience and the panel.

Moderator

Dr. Zhiming Xue
Senior Architect Evangelist for Windows Azure Cloud Computing
Microsoft

Panelists

Dr. Simon Y. Berkovich
Professor, ***George Washington University***
Senior Advisor, ***COM.Geo***

Dr. Larry Feldman
Lead Associate
Booz Allen Hamilton

Dr. Olli-Pekka Tossavainen
Researcher
Nokia

Dr. Shyam Parhi
Computer Scientist for Airport GIS
U.S. DOT – FAA

Kevin Montgomery
CEO
Intelesense Technologies

Emerging Tech Panel+ IV

Tuesday, July 3 11:15 AM - 12:15 AM

Regency Ballroom

Cloud / Big Data Computing for Defense

The ever growing necessity for Big Data processing within the industry, government, and specially within defense applications causes the need and requirement for the fast development of new technologies. In addition, the protection of Big Data can be a serious problem because security is commonly an afterthought during technology development, and the exponentially increasing rate at which new data is generated presents many challenges. Although conventional Turing computation has been remarkably successful, it does not scale well and is failing to adapt to novel application domains in cyberspace. Fortunately, Turing formalism for computation represents only a subset of all possible computational possibilities. Unconventional computing - the quest for new algorithms and physical implementations of novel computing paradigms based on and inspired by principles of information processing in physical and biological systems - may help to solve some of the information overflow problems facing the Defense community. These and other topics will be covered by our diverse panel of experts.

Moderator

Dr. Robinson Pino
Senior Scientist
ICF International

Panelists

Dr. Douglas Kelly
Branch Chief, Network Security Branch
Army Research Laboratory

Dr. Arthur H. Edwards
Senior Research Physicist, Space Vehicles Directorate
Air Force Research Laboratory

Mr. Michael Shevenell
Project Manager, ***ICF International***

Dr. Bryant Wysocki
Ret Maj USAF, Senior Electronics Engineer, Information Directorate
Air Force Research Laboratory

Dr. Larry Feldman
Lead Associate, ***Booz Allen Hamilton***

Dr. Alexander DavyDov
Senior Scientist, ***COM.Geo*** *(ever worked for DOD)*

Kevin Montgomery
CEO, ***Intelesense Technologies***

Workshops & Boot Camps

Tuesday July 3 1:30 PM - 5:00 PM
Regency Ballroom A

Microsoft
Windows 8 Moblie and Cloud Computing Workshop

Frank La Vigne, Joel Reyes, Dr. Zhiming Xue

The workshop provide toturials and dicussions for how to create Windows 8 Metro Style applications. We will also discuss how to create Windows Phone and Windows Azure cloud computing applications.

Microsoft, COM.Geo
Boot Camp for Microsoft Mobile American Contest
Frank La Vigne, Joel Reyes, Dr. Zhiming Xue

MOBILE AMERICA
the people hackathon
windows phone cloud

For attendees who are interested to participate in the Mobile America contest (more detail at http://aka.ms/mobileamerica), we will provide a Q/A session at the end of the workshop.

Courses

Tuesday July 3 1:30 PM - 5:00 PM
Regency Ballroom B

ORNL
Modeling Spatial Dependencies and Semantic Concepts in Data Mining
Dr. Ranga Raju Vatsavai

Course Description

Data mining is the process of discovering new patterns and relationships in large datasets. However, several studies have shown that general data mining techniques often fail to extract meaningful patterns and relationships from the spatial data owing to the violation of fundamental geospatial principles. In this tutorial, we introduce basic principles behind explicit modeling of spatial and semantic concepts in data mining. In particular, we focus on modeling these concepts in the widely used classification, clustering, and prediction algorithms. Classification is the process of learning a structure or model (from user given inputs) and applying the known model to the new data. Clustering is the process of discovering groups and structures in the data that are “similar," without applying any known structures in the data. Prediction is the process of finding a function that models (explains) the data with least error. One common assumption among all these methods is that the data is independent and identically distributed. Such assumptions do not hold well in spatial data, where spatial dependency and spatial heterogeneity are a norm. In addition, spatial semantics are often ignored by the data mining algorithms. In this tutorial we cover recent advances in explicitly modeling of spatial dependencies and semantic concepts in data mining.

Relevance to COM.Geo

Data mining is not new to Computational Geoinformatics community. Recognizing the need for applying data mining to the spatial data, several extensions and new methodologies have been proposed, collectively known as spatial and spatiotemporal data mining [14]. Modeling spatial concepts in classification, clustering, and prediction has received considerable research interest, both in computer science and Geoinformatics community [16, 1, 6, 8]. Semantics are playing an important role in developing interoperable geospatial data and services for a long time. In this tutorial is designed to introduce recent advances in modeling spatial dependencies and semantic concepts in data mining to the Geoinformatics researchers. We believe it would benefit all researchers who want to model spatial dependencies and semantics in analyzing spatial and spatiotemporal datasets using data mining techniques.

Tutorial Organizers

Dr. Ranga Raju Vatsavai is currently a senior research scientist in the Computational Sciences and Engineering Division at the Oak Ridge National Laboratory. He received his masters and doctoral degree in computer science from the University of Minnesota. He has been conducting research in the area of remote sensing, spatial databases, and data mining for the past 20 years. Before joining ORNL, he worked at IBM-Research, Remote Sensing Lab at the U of Minnesota, AT&T Labs. He has published over fifty peer reviewed articles and served on program committees of several international conferences including ACM SIGKDD and ACM SIGSPATIAL GIS. He co-organized several workshops on Spatial and Spatiotemporal Data Mining with (IEEE ICDM) and Knowledge Discovery from Sensor Data (with ACM KDD) and co-edited two books. He also contributed to several highly successful software systems in various capacities (UMN-MapServer a world leading open source WebGIS, *Miner a spatiotemporal data mining workbench, EASI/PACE Parallel Fly!, Parallel SAR, and the first parallel softcopy photogrammetry system for IRS-1C/1D satellites). His research interests include remote sensing, data mining, machine learning, parallel computing, and computational geoinformatics.

Tutorial Outline and Objectives

The primary objective of this tutorial is to bring recent advances in modeling spatial dependencies and semantics in data mining, specifically in classification, clustering, and prediction. Through this tutorial we would like to disseminate the basic principles, algorithmic extensions and practical applications in the earth and climate change studies.

Outline

The following topics will be covered in depth along with demonstration using open source data mining and machine learning tools.

1. Statistical Framework: We first introduce basic concepts, such as, maximum likelihood parameter estimation, Bayesian classification framework, Gaussian Mixture Models, Expectation Maximization, Covariance structure and robust estimation techniques. Reading materials [24, 4, 18].

2. Modeling Spatial Dependencies: We will introduce several spatial concepts, such as, indicators of spatial association [3], cliques [13], spatial weight matrix [1].

3. Classification: We will introduce several spatial Classification schemes and also allude the participants to the basic diffierences with respect to the conventional Classification schemes based on i.i.d assumptions. Special emphasis will be given to Markov Random Fields and efficient solutions like graph min-cuts. We will also introduce recent advances in spatial Classification (especially modeling spatial heterogeneity) using Gaussian Process Learning. Reading materials [17, 10, 23, 16, 9, 22, 13, 15, 11].

4. Clustering: We will start with basic clustering using Gaussian Mixture Models including techniques for selecting optimal number of clusters. Main emphasis will be on modeling spatial constraints and neighborhood relationships. Reading materials [19, 2].

5. Prediction: We will introduce spatial autoregressive (SAR) model, exact and approximate solutions, and applications. Reading materials [7, 12].

6. Semantic Clustering and Classification: We will introduce Latent Dirchlet Allocation (LDA) algorithm and show how it can be used in semantic clustering and Classification. Reading materials [5, 21, 20].

Courses

Audience

This is an advanced tutorial. Though basic principles will be covered, we assume the attendees are familiar with basic data mining schemes. A familiarity of commercial systems such as Erdas Imagine or PCI Geomatica or ESRI ArcGIS is assumed for doing basic spatial analysis. We expect this tutorial to benefit researchers who have basic knowledge of classification, clustering, and prediction, and are keen to learn on how to model spatial dependencies and semantics in data mining tasks.

Materials

A set of papers and presentation materials will be distributed to the participants. We also encourage users to bring their laptop computers (with latest Java environment installed) to get hands on experience with open source machine learning tools.

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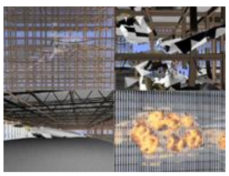
Demo Videos

Monday July 2 10:15 AM - 10:30 AM
2:45 PM - 3:00 PM
Tuesday July 3 10:05 AM - 10:15 AM
Regency Ballroom

Purdue University
9/11 Attacks Simulation
Prof. Christoph M. Hoffmann

Professor Hoffmann at Purdue University has received national media attention for his work simulating the 9/11 attacks on the Pentagon and the World Trade Center.



BMW Research and Technology GmbH
Temporally Coherent Real-Time Labeling of Dynamic Scenes
Mikael Vaaraniemi, Marc Treib, Rüdiger Westermann

The augmentation of objects by textual annotations provides a powerful means for visual data exploration. Especially in interactive scenarios, where the view on the objects and, thus, the preferred placement of annotations changes continually, efficient labeling procedures are required. As identified by a preliminary study for this paper, these procedures have to consider a number of requirements for achieving an optimal readability, e.g. cartographic principles, visual association and temporal coherence. In this paper, we present a force-based labeling algorithm for 2D and 3D scenes, which can compute the placements of annotations at very high speed and fulfills the identified requirements. The efficient labeling of several hundred annotations is achieved by computing their layout in parallel on the GPU. This allows for a real-time and collision-free arrangement of both dynamically changing and static information. We demonstrate that our method supports a large variety of applications, e.g. geographical information systems, automotive navigation systems, and scientific or information visualization systems. We conclude the paper with an expert study which confirms the enhancements brought by our algorithm with respect to visual association and readability.

George Mason University
Transport and Dispersion Simulation in Downtown Oklahoma City and New York City
Fernando Camelli, Jyh-Ming Lien, David Wong

The augmentation of objects by textual annotations provides a powerful means for visual data exploration. Especially in interactive scenarios, where the view on the objects and, thus, the preferred placement of annotations changes continually, efficient labeling procedures are required. As identified by a preliminary study for this paper, these procedures have to consider a number of requirements for achieving an optimal readability, e.g. cartographic principles, visual association and temporal coherence. In this paper, we present a force-based labeling algorithm for 2D and 3D scenes, which can compute the placements of annotations at very high speed and fulfills the identified requirements. The efficient labeling of several hundred annotations is achieved by computing their layout in parallel on the GPU. This allows for a real-time and collision-free arrangement of both dynamically changing and static information. We demonstrate that our method supports a large variety of applications, e.g. geographical information systems, automotive navigation systems, and scientific or information visualization systems. We conclude the paper with an expert study which confirms the enhancements brought by our algorithm with respect to visual association and readability.

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