

Surveillance Geoinformatics of Hotspot Detection and Prioritization for Monitoring, Etiology, Early Warning and Sustainable Management

by G.P. Patil

Short Courses and Case Studies Workshops Around the World

1. Parma, Italy (March 30-31, 2006: October 1, 2006)
2. San Diego, USA (May 21-24, 2006)
3. Jalgaon, India (December 11-22, 2006)
4. New Delhi, India (December 26, 2006)
5. Bogor, Indonesia (December 27-30, 2006)
6. McCau, China (January 10-11, 2007)
7. Hiroshima, Japan (January 15, 2007)
8. University Park, PA, USA (May 14-18, 2007)
9. Jalgaon, India (November 13-23, 2007)
10. Macao, China (December 10-13, 2007)
11. Jalgaon, India (December 16-30, 2007)
12. Bangkok, Thailand (January 14-16, 2008)
13. Bogor, Indonesia (January 18-25, 2008)
14. Parma, Italy (May 12-18, 2008)
15. Milan, Italy (May 19, 2008)
16. Jalgaon, India (December 15-26, 2008)
17. Bogor, Indonesia (December 28-30, 2008)
18. University Park, PA USA (May 14-18, 2009)
19. Jalgaon, India (December 15-30, 2009)



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Administrative Information and Registration

Registration fees will be reduced/waived for graduate research students, interested government scientists and acceptable case studies presenters.

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Technical and Scientific Interaction

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Motivation, Description, and Timeliness

Geoinformatic surveillance for spatial and temporal hotspot detection and prioritization is a critical need for the 21st Century. A declared need is around for statistical geoinformatics and software infrastructure for spatial and spatiotemporal hotspot detection, prioritization, early warning, and sustainable management. A hotspot can mean an unusual phenomenon, anomaly, aberration, outbreak, elevated cluster, critical area. The declared need may be for monitoring, etiology, early warning, or management. The responsible factors may be natural, accidental, or intentional. The five year NSF DGP project has been instrumental to conceptualize surveillance geoinformatics partnership among several interested cross-disciplinary scientists in academia, agencies, and private sector across the nations.

Our efforts are driven by a wide variety of case studies of interest to agencies, academia, and private sector involving critical societal issues, such as public health, ecosystem health, ecohealth, biodiversity and threats to biodiversity, emerging infectious disease, water management and conservation, carbon sources and sinks, persistent poverty, environmental justice, crop pathogens, invasive species management, biosurveillance, biosecurity, disease biogeoinformatics, social networks, sensor networks, hospital networks and syndromic surveillance, video mining, early warning, tsunami inundation, and disaster management. Also space-time disease, poverty, pollution, object identification and tracking, early detection, early warning, hotspot trajectories and trends with examples of West Nile Virus, urban poverty patch dynamics, etc. The project emphasis is on development of geoinformatic hotspot surveillance system. The system has two methodological components: hotspot detection and prioritization.

Our methodology involves an innovation of the popular circle-based spatial scan statistic methodology. In particular, it employs the notion of an upper level set and is accordingly called the *upper level set scan statistic system*, pointing to the next generation of a sophisticated analytical and computational system, effective for the detection of arbitrarily shaped hotspots along spatio-temporal dimensions. We also propose a novel prioritization scheme based on multiple indicator and stakeholder criteria without having to integrate indicators into an index, using Hasse diagrams and partially ordered sets. It is accordingly called *poset prioritization and ranking system*.

We propose a cross-disciplinary collaboration to design and build the prototype system for surveillance infrastructure of hotspot detection and prioritization. The methodological toolbox and the software toolkit developed will support and leverage core missions of several agencies as well as their interactive counterparts in the society. The research advances in the allied sciences and technologies necessary to make such a system work are the thrust of this five year project.

The project will have a dual disciplinary and cross-disciplinary thrust. Dialogues and discussions will be particularly welcome, leading potentially to well considered synergistic case studies. The collaborative case studies are expected to be conceptual, structural, methodological, computational, applicational, developmental, refinental, validational, and/or visualizational in their individual thrust.

The proposed short courses will provide up-to-date instruction with live examples and illustrations. The proposed workshops will emphasize presentations of case studies from within the region of the workshops, using preferably the methodology and software of the short courses. The participants will be

encouraged to be in contact with the course instructor before and after the course and the workshop to help formulate and finalize their case studies for presentation and publication.

Best case studies will be invited for presentation at an annual digital government research conference symposium on surveillance geoinformatics of hotspot detection and prioritization to be held in USA. Publications are planned for special issues of subject area journals and edited monographs.

Technical, Scientific, Picturesque Reference Material

1. Overview PowerPoint
http://www.stat.psu.edu/%7Egpp/ppts/Atlanta_Overview.pdf
2. Poster PowerPoint
<http://www.stat.psu.edu/%7Egpp/ppts/AtlantaPoster.pdf>
3. Poster Two Pager
http://diggov.org/library/library/dgo2005/demosb/patil_upper.pdf
4. Demo Two Pager
http://diggov.org/library/library/dgo2005/postersb/patil_geoinformatic.pdf
5. Project Highlights Two Pager
http://diggov.org/library/library/dgo2005/alert/geoinformatic_patil.pdf
6. Center for Statistical Ecology and Environmental Statistics
<http://www.stat.psu.edu/~gpp>
7. Hotspots Project Initiatives
<http://www.stat.psu.edu/hotspots>
8. NSF Digital Government Research Program Online News
[DGOnline News 2004 and 2006](http://www.stat.psu.edu/dgonline)
9. Networks and Infrastructure
http://www.stat.psu.edu/%7Egpp/current_events.htm
10. Raster Map Analysis
http://www.stat.psu.edu/%7Egpp/raster_map_analysis.htm
11. Landscape Pattern Analysis for Assessing Ecosystem Condition (Johnson and Patil)
<http://www.springer.com/west/home/generic/search/results?SGWID=4-40109-22-173673812-0>
12. Pattern Based Compression of Multi Band Image Data for Landscape Analysis (Myers and Patil)
<http://www.springer.com/west/home/generic/search/results?SGWID=4-40109-22-173677709-0>
13. Article on the workshop program on hotspot geoinformatics
<http://www.dgrc.org/dgo2006/papers/workshops.jsp#hotspot>
14. Freeware for circular spatial scan program and information.)
<http://www.satscan.org>
15. Freeware for academia for Hasse program for Windows
<http://www.getsynapsed.de/>

The following web links are of some informative papers.

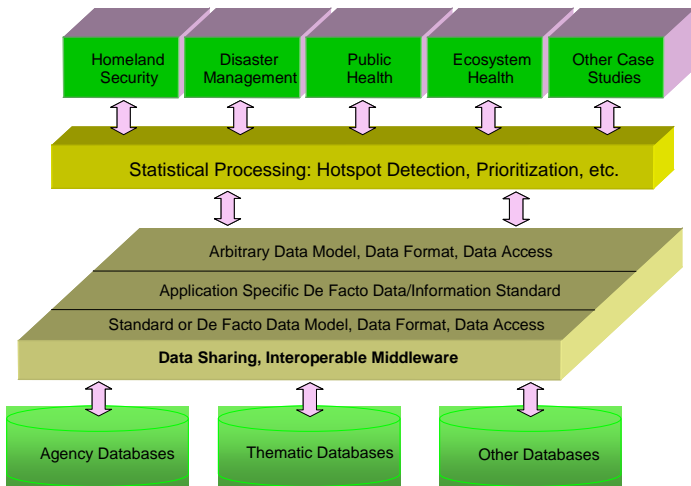
16. [G. P. Patil and C. Taillie \(2003\). Geographic and network surveillance via scan statistics for critical area detection. *Statistical Science*, 18 \(4\), 457-465.](#)
17. [G. P. Patil and C. Taillie. \(2004a\). Upper level set scan statistic for detecting arbitrarily shaped hotspots. *Environmental and Ecological Statistics*, 11 \(2\), 183-198.](#)
18. [G. P. Patil and C. Taillie \(2004b\). Multiple indicators, partially ordered sets, and linear extensions: Multi-criterion ranking and prioritization. *Environmental and Ecological Statistics*, 11 \(2\), 199-228.](#)

19. [G.P. Patil, Raj Acharya, Amy Glasmeier, Wayne Myers, Shashi Phoha, and Stephen Rathbun \(2006d\). Hotspot Detection and Prioritization – Geoinformatics for Digital Governance, In: Digital Government: Advanced Research and Case Studies. Springer Publ., H. Chen. L. Brandt, V. Gregg, R. Traunmüller, S. Dawes, E. Hovy, A. Macintosh, C. Larson \(Editors\).](#)
20. [G.P. Patil, Raj Acharya, Wayne Myers, Shashi Phoha, and Rajan Zambre, Hotspot Geoinformatics for Detection, Prioritization, and Security \(2006g\). In: Encyclopedia of Geographical Information Science, Shashi Shekhar and Hui Xiong \(Editors\).](#)

The following links are of some relevant methods and tools.

21. TeeraSeer Space-Time Intelligence System
<http://www.terraser.com/>
22. Salford Systems
<http://www.salford-systems.com/>
23. CrimeStat
<http://www.icpsr.umich.edu/crimestat>
24. Hierarchical Modeling and Analysis for Spatial Data by Banerjee, Carlin, and Gelfand, CRC Press, 2003.
http://www.crcpress.com/shopping_cart/products/product_detail.asp?sku=C410X&parent_id=&pc
25. Applied Spatial Analysis of Public Health Data by Waller and Gotway, Crawford, Wiley, 2004
<http://www.wiley.com/WileyCDA/WileyTitle/productCd-0471387711.html>

NSF Digital Government Surveillance Geoinformatics Project, Federal Agency Partnership and National Applications for Digital Governance.



Surveillance Geoinformatics of Hotspot Detection, Prioritization and Early Warning
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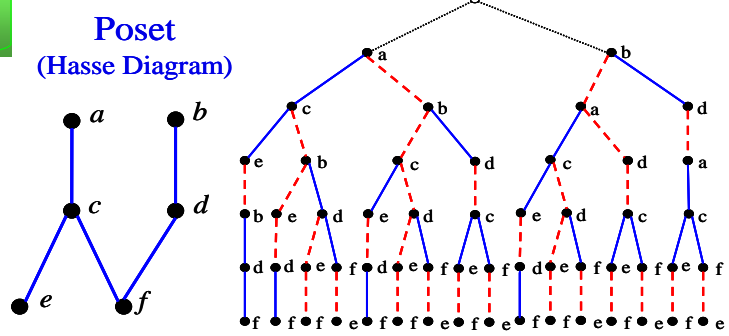
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Federal Agency Partnership
CDC DOD EPA
NASA NIH
NOAA USFS USGS

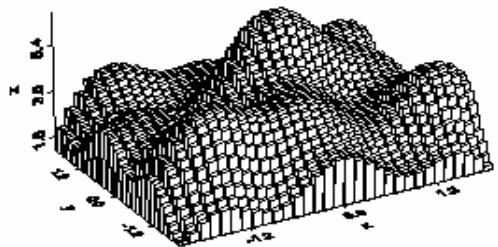
National and International Applications

- Biosurveillance
- Carbon Management
- Coastal Management
- Community Infrastructure
- Crop Surveillance
- Disaster Management
- Disease Surveillance
- Ecosystem Health
- Environmental Justice
- Environmental Management
- Environmental Policy
- Homeland Security
- Invasive Species
- Poverty Policy
- Public Health
- Public Health and Environment
- Robotic Networks
- Sensor Networks
- Social Networks
- Syndromic Surveillance
- Tsunami Inundation
- Urban Crime
- Water Management

Linear extension decision tree



Cellular Surface



Websites:
<http://www.stat.psu.edu/~gpp/>
<http://www.stat.psu.edu/hotspots/>
<http://www.stat.psu.edu/~gpp/DGOnlineNews2006.mht>

