

Hotspot Detection and Early Warning for Synoptic and Network-Based Syndromic Surveillance

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The poster presents the following: (1) a new version of the spatial scan statistic that allows for detection of clusters of arbitrary shapes; (2) a space-time version for the early detection of outbreaks; (3) generalization of the method for detection and evaluation of hotspots on networks, such as subway systems, water distribution systems, and river systems; (4) assignment of a hotspot rating to each network node using hotspot confidence regions on the network.

Watersheds and river systems provide relevant contexts for syndromic surveillance of both human health and ecosystem health. At the watershed level, synoptic scan statistic techniques can be utilized effectively. The hierarchical nature of watershed delineations allows one to assess the effect of aggregation on hotspot determination. Hotspots within hotspots can be explored with multi-scale scanning.

Treatment of a stream and river system as a formal network serves to reframe the hydrologically-based surveillance information into a network topology. Scanning protocols for networks constitute a subject of substantial research opportunity in hotspot detection. Strategies for linking potential explanatory variables to critical subnetworks (hotspots) await exploration for purposes of etiological analysis.

The following concept papers and proof-of-concept papers given with their websites will be used to illustrate the methods and tools proposed for syndromic surveillance, accomplishing cross-disciplinary cross-fertilization between geospatial ecosystem health and geospatial public health for hotspot detection and early warning.

1. Patil GP, Bishop J, Myers WL, Taillie C, Vraney R, and Wardrop DH (2002). Detection and delineation of critical areas using echelons and spatial scan statistics with synoptic cellular data. Proof-of-Concept Paper 1. *Environmental and Ecological Statistics* (to appear).
Website: <http://www.stat.psu.edu/~gpp/PDFfiles/TR2002-0501.pdf>
2. Myers WL, Kurihara K, Patil GP, Vraney R (2002). Finding upper level sets in cellular surface data using echelons and SaTScan. Proof-of-Concept Paper 2. Invited paper, 2002 Joint Statistical Meetings, New York.
Website: <http://www.stat.psu.edu/~gpp/PDFfiles/TR2002-0801.pdf>
3. Patil GP, Kulldorff M, Heffernan RT, and Taillie C (2002). Spatial scan statistics for irregularly shaped clusters and early warning system. Concept Paper 8, Penn State Center for Statistical Ecology and Environmental Statistics. 34 pp.
Website: <http://www.stat.psu.edu/~gpp/PDFfiles/Prospectus-8.pdf>

4. Patil GP, Blackman P, Taillie C, and Tutwiler RL (2002). Development of remote sensing methods for crop bioterrorism. Concept Paper 9, Penn State Center for Statistical Ecology and Environmental Statistics. 14 pp.

Website: <http://www.stat.psu.edu/~gpp/PDFfiles/Prospectus-9.pdf>

5. Patil GP, Myers WL, Taillie C, and Wardrop DH (2002). Network-based analysis of biological integrity in freshwater systems. Concept Paper 11, Penn State Center for Statistical Ecology and Environmental Statistics. 22 pp.

Website: <http://www.stat.psu.edu/~gpp/PDFfiles/Prospectus-11.pdf>

6. Patil GP, Brooks RP, O'Connell TJ, and Taillie C (2002). Classifying and prioritizing watersheds for protection and restoration, Concept Paper 10, Penn State Center for Statistical Ecology and Environmental Statistics. 27 pp.

Website: <http://www.stat.psu.edu/~gpp/PDFfiles/Prospectus-10.pdf>