

GEOSENSOR NETWORKS AND SPATIAL WEB

(Position Paper)

ANTHONY STEFANIDIS

Dept. of Spatial Information Science & Engineering
National Center for Geographic Information and Analysis
University of Maine
tony@spatial.maine.edu

GEOSENSOR NETWORKS (GSN)

A geosensor network (GSN) can be loosely defined as a sensor network that monitors phenomena in geographic space, and in which the geospatial content of the information collected, aggregated, analyzed, and monitored is of fundamental importance [Stefanidis & Nittel, 2004]. Analysis and aggregation may be performed locally in real-time by the sensor nodes or between sensor nodes, or off-line in several distributed, in-situ or centralized repositories. Regardless of where these processes take place, the spatial aspect is dominant in one or both of the following levels:

- *Content level*, as it may be the dominant content of the information collected by the sensors (e.g. sensors recording the movement or deformation of objects), or
- *Analysis level*, as the spatial distribution of sensors may provide the integrative layer to support the analysis of the collected information (e.g. analyzing the spatial distribution of chemical leak feeds to determine the extent and source of a contamination).

The geographic space covered by the sensor network, or analyzed through its measurements, may range in scale from the confined environment of a room to the highly complex dynamics of an ecosystem region.

The use of sensor networks for geospatial applications is not really new. Satellites and aerial cameras have been providing periodic coverage of the earth during the last few decades. However, the evolution of sensing devices [Hellerstein et al., 2003; Howard et al., 2003] is revolutionizing geospatial applications. The old paradigm of calibrated sensors collecting information in a highly-controlled deployment strategies is now substituted by wireless networks of diverse sensors. This evolution has a profound effect on the nature of collected datasets:

- Homogeneous collections of data (e.g. collections of imagery) are now substituted by heterogeneous feeds for an area of interest (e.g. video *and* temperature feeds).
- Regularly sampled datasets (e.g. coordinates of similar accuracy in a regular grid) are substituted by pieces of information that vary substantially in content, resolution, and accuracy (e.g. feeds from few distinct irregularly distributed locations with sensors of varying accuracy).
- Information becomes increasingly spatiotemporal instead of just spatial, as sensor feeds capture the evolution over time of the properties they monitor.

This evolution is bringing forward substantial challenges in terms of data management and analysis, but at the same time introduces up-to-date, unparalleled scene modeling

capabilities. Information can be collected in real-time, allowing the monitoring of phenomena and events, and enabling the continuous updating of geospatial databases.

GEOSENSOR NETWORKS AS SPATIAL MINIWEBS

Based on the above, GeoSensor Networks may be viewed as Spatial MiniWebs. They are spatially-focused information communities that actively share geospatial data over a limited area, with nodes collecting, forwarding, and even analyzing and aggregating information. Extending these capabilities is a major challenge facing GSNs, namely distributing analysis and aggregation capabilities across the network in order to optimize its functionality and performance. At the same time, an emerging challenge is to get multiple GSNs to collaborate, thus extending their spatial and thematic coverage.

These challenges put renewed focus to the typical issues addressed in spatial webs (e.g. interoperability, accuracy management), while imposing additional constraints like:

- the need to extend current modeling capabilities (e.g. Virtual Reality models) to handle the near real-time information flow of geosensor networks,
- the importance of distance in analysis, an underrepresented issue in today's spatial web, and
- computational cost, as network nodes typically have limited capabilities and/or energy resources.

REFERENCES

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