Workshop on GeoSpatial and GeoTemporal Informatics
National Science Foundation, January 8-9, 2009

PRELIMINARY SUMMARY OF FINDINGS

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1. WORKSHOP PROFILE

The workshop comprised three components: short presentations by thirty two invited participants, four birds-of-a-feather sessions on specific topics, and two panel discussions. The mix of invited participants included academics from several disciplines such as computer science, geoinformation science, engineering and geography, as well as representatives from industry, the government, and even K-12 educators.

The short presentations addressed the following questions about the field of geospatial and geotemporal informatics:
1. What is solved? Include expected and surprise successes.
2. What is almost solved? Include on-going hot areas.
3. What has failed? Include surprise failures.
4. What is missing? Discuss areas not currently on the radar.
5. What is next? Include both high risk and needed topics.

The topics of the birds-of-a feather sessions were:
1. Geovisual Analytics and Multimedia;
2. From Long-Term Monitoring to Persistent Surveillance and GeoSensor Networks;
3. The Effect of Google Earth and Similar Technologies; and
4. Context Areas Beyond the Traditional CS and GIS

The panel discussions, which concluded the two days of the workshop, addressed the following topics:
1. Academic Research in View of Latest Industry Developments and Actual Government and Society Needs; and
2. Emerging and Anticipated Future Trends and Needs: How Research Can Respond to Society Needs.

2.EMERGING TOPICS OF IMPORTANCE

Based on the presentations, discussions, and interaction between participants, which occurred during the workshop, the following topics emerged as the upcoming leading research topics in the field of *spatio-temporal informatics*:

I. New challenges on information extraction and modeling

- Spatiotemporal modeling, especially as it relates to fuzzy and abstract information
- Support for seamless navigation through space and time datasets:
    - Continuous updates of databases
    - Fully 3-D spaces
    - Space/time prediction (e.g. for event monitoring, resource allocation, alert issues)
    - Legacy and historical data integration
    - *Now and then* in Google Earth: continuously updating its content, accessing legacy and timely data and information, predicting emerging situations
- Event-driven approaches:
    - Event modeling
    - Automated attribute recognition
    - Event similarity assessment
    - Spatiotemporal event mining
    - Reasoning
    - Risk assessment, etc.
    - Integration in a spatiotemporal algebra
- Global monitoring: cross temporal- and spatial-scale analysis
- *Mobility, flow, and evolution*: from single to composite objects (e.g. cars, pollution front, groups of people, disease risk): modeling, analyzing, and communicating across space, time, and semantic hierarchies
- New representations through the integration of low- and high-level data (e.g. raw image data *and* interpreted GIS-data)
    - expert annotation
    - multiple theme-based representations of the same scene as intuitive context descriptions (a critical underpinning to knowledge discovery)
- GeoRealism: At the right space, time, resolution and quality
    - Point clouds vs. 3d models; video vs. events; trajectories vs. patterns
    - Vector with imagery; text (from wire news) with maps; verbal descriptions with 3d models
    - As fast as we need it, and nothing we don't.

II. Data collection revisited

- *Ambient spatial computing*: adaptive, multi-modal, sensor-based
- Towards geosensor networks:
    - P2P
    - Sensors running multiple, isolated services
    - In-network, on-the-fly data analysis, interpretation, integration & resource allocation
    - An opportunity to reduce the gap between ST Research and DBMSs

- Humans as sensors, text and speech as data: extending temporal and spatial linguistic analysis
- *GeoMedia*:
    - Narrative-to-video and video-to-narrative capabilities
    - Text-to-image and image-to-text
- Location-based services revisited: *in-situ analytics*. Moving visual-analytical power to everyday devices and tasks
- Collaborative use of diverse data sources to track objects and events
- *Mind the gap:* identifying redundancies and gaps in massive amounts of spatiotemporal datasets

III. Support for cross-discipline discovery using spatiotemporal information

- Decentralized geospatial computing
- Knowledge representation: within and cross-domain (e.g. temporal and event-based modeling for hazards, evacuation, and disaster recovery processes)
- Metadata: Visual/Hierarchical/Dynamic/Self-generated/Integrated/Composite
- Knowledge discovery tools to build empirical models for domain experts
    - Intuitive/visual spatiotemporal queries
    - Link between observation, field experiment, laboratory, and theory
    - Anomaly detection and causality
    - Scenario-based reasoning: support for what-if, counterfactual scenario generation and testing using spatiotemporal information
- Space and time scale harmonization: From atmospheric layers to molecular dynamics

IV. Support for non-expert interaction with spatiotemporal information

- *Ambient Spatial Intelligence*: Personalized, ubiquitous, location-based services:
    - scalability
    - privacy
    - context- and preference-awareness
- Link to social networks: geo-chatting, geo-twitter (location-aware social informatics – *geosocial informatics*)
- Ad-hoc, purpose-driven social networking: recognizing common spatiotemporal activities and linking users/carriers to exchange information
    - From the classic (transportation services with information shared among neighboring/meeting vehicles) to the more exotic (recognizing patterns of activities and preferences to identify different groups of individuals as they interact with their environment)
- Support for 3-D modeling and interaction of non-professionals with their environment through consumer products (e.g. cameras, cell phones, dashboard-mounted units)
    - Geolocating amateur static and video imagery using scene descriptors

    - Using amateur data to update databases
    - Quality management of volunteered information
    - Delivering specialized information to amateur users to aid their navigation in (and interaction with) urban environments
- Data and information delivery onto new modalities (i-pods, phones, cars etc.)
- Dynamic integration/interaction across scales and domains
- New cross-disciplinary paradigms: Rethinking and expanding the chain from society needs to scientific response
- Privacy