Geo-Immersion: A Killer-App for Cloud Computing, Social-Networks and Mobile Computing

http://imsc.usc.edu/

Cyrus Shahabi
Professor, Computer Science Department
Director, IMSC
Viterbi School of Engineering
University of Southern California
Los Angeles, CA 900890781
shahabi@usc.edu

OUTLINE

- Vision: Geo-Immersion
- Example Application: iCampus
- Research Challenge: Geo-Social (Mobile -> SN)
- Generalization (Mobile+SN+Cloud)

Geo-Immersion Overview

(shameless advertising!)

http://www.nsf.gov/news/special_reports/science_nation/geoimmersion.jsp

Vision: Geo-Immersion

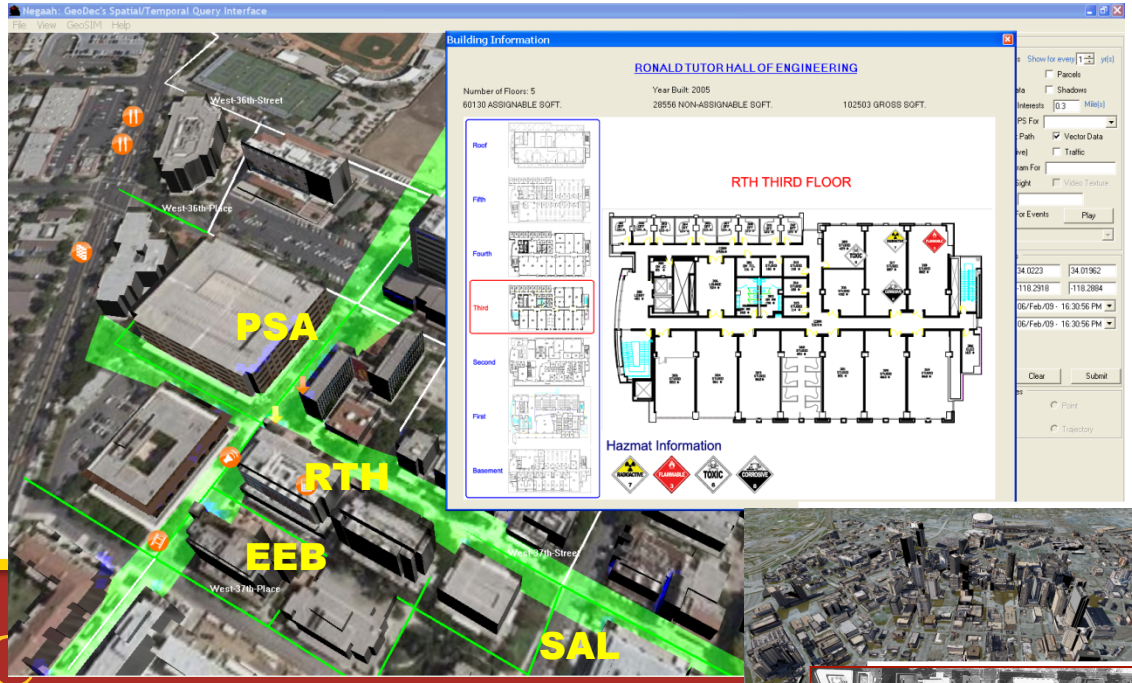
- *Blending the real and virtual worlds:*
  - Beyond augmented-reality, virtual-reality and such
  - Beyond integrating data and information
  - Towards fusion of human behaviors in both worlds

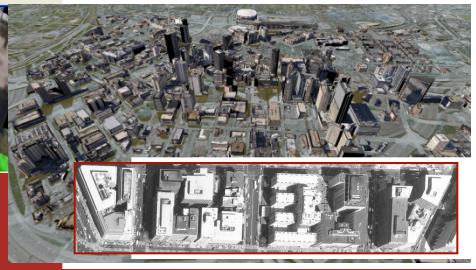
- ***W⁴:*** What, Where, When, Who
  - Alleviating information overload
    - Search, filter, customize, personalize
  - Enabling a natural integration information

Geo-Immersion Broader Impact

- Urban Security
- Disaster management
- Military intelligence
- Urban planning and real-estate

- Intelligent transportation
- Simulation and training
- Public health in urban areas
- Sustainable Design



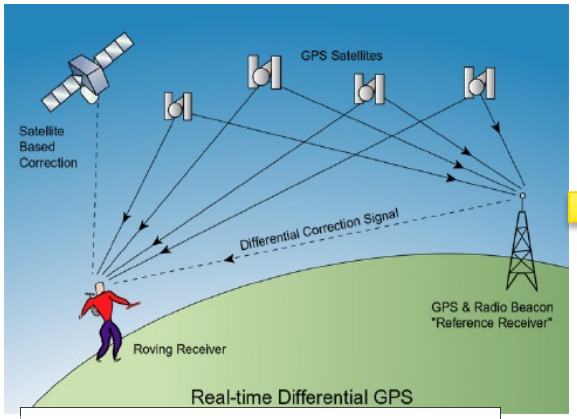


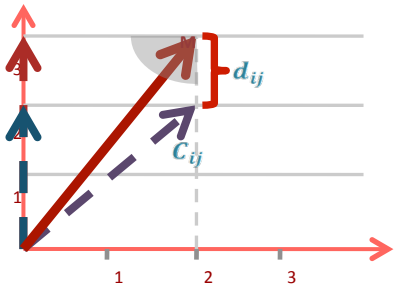
Research Challenges

- Spatiotemporal data analysis
- Cloud Computing
- Participatory Sensing
- Social Networks
- Privacy & Trust
- Sensor Networks
- Event Detection
- Video Fusion
- Face Detection
- Mobile Applications
- Geo-Social Models

http://imsc.usc.edu/research.php

Geo-Social: From Mobile to Social





Inferring friendship network structure by using mobile phone data *(PNAS'09)*

N. Eagle, A. Pentland, D. Lazer

- Study traces of 94 subjects using mobile phones
  - Subjects also reported their data: proximity and friendships
  - Analyzes proximity and friendships (inferred from recorded data) vs. ones that were self-reported by users
  - Conc-1: Two data sources is overlapping but distinct
  - Conc-2: Accurately infer 95% of friend- ships based on the observational data alone, where friend dyads demonstrate distinctive temporal and spatial patterns in their physical proximity and calling patterns.

Inferring social ties from geographic coincidences (in PNAS'10)

David J. Crandalla, Lars Backstromb, Dan Cosleyc, Siddharth Surib, Daniel Huttenlocher, and Jon Kleinberg

- Probabilistic Model
  - Infer the probability of two people being friends given their co-occurrences in space and time
  - Does not consider the frequency of co-visit
  - Simplifies the social network: one connection for each person

Bridging the Gap between Physical Location and Online Social Network (Ubicomp '10)

J. Cranshaw, E. Toch, J. Hong, A. Kittur, N. Sadeh

- Introduces a novel set of location based features for analyzing the social context of a geographical region
- **Location Entropy**: analyzes the context of the social interactions at that location: crowdedness and diversity
- **Regularity (Schedule_Entropy)**: High value reflects irregular movements, which produce high chance of making new friends
- Establishes a model of friendship in an online social network based on contextual features of co-locations

Towards Integrating Real-World Spatiotemporal Data with Social Networks (ACM-GIS'11)

Huy Pham, Ling Hu, Cyrus Shahabi

- Developed a distance measure (GEOSO) to compute spatiotemporal similarity of two subjects by counting co-occurrences
- Definitions:
  - Commitment: Two people co-visited the same place over and over again
  - Compatibility: Two people co-visited several different places
- Observations:
  1. Compatibility calculated by GEOSO has more impact on social distance than commitment
  2. Commitment needs to grow faster than compatibility to reach the same level of social distance
  3. The contribution to social distance of commitment gets saturated, which limits/avoids coincidences in case of high commitment

OUTLINE

- Vision: Geo-Immersion
- Example Application: iCampus
- Research Challenge: Geo-Social (Mobile -> SN)
- Generalization (Mobile+SN+Cloud) – *Uncomfortable zone!*

System Architecture of Past

Client

Network

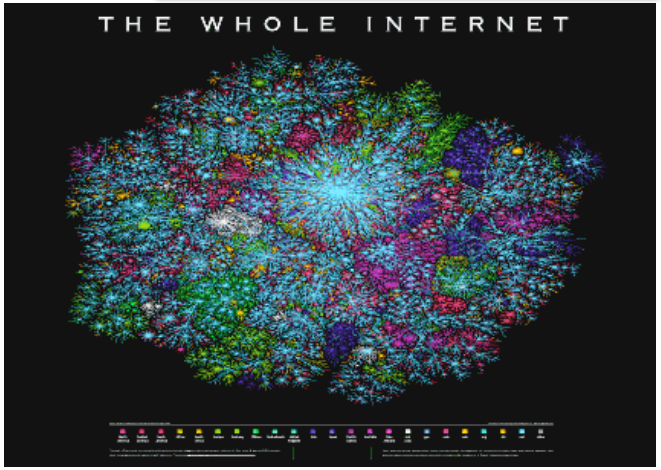
Server

Focused Application: ***Computation***

System Architecture of

Present

Client

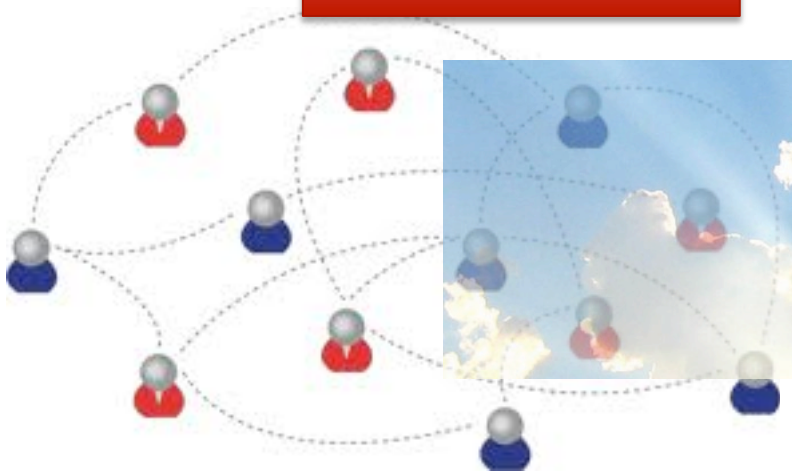


Network

Server

Focused Application: ***Information Access***

System Architecture of Future



Client ***Network*** ***Serve***

Focused Application:

Blending real & virtual worlds

➔ ***R2V:*** Crowd-Sourcing (**privacy** in participatory sensing)

➔ ***V2R:*** News, hyperlocal (Yatown)

Thanks!

Vision: Geo-Immersion

Unfolding of two phenomena:

1. **Major environmental, socioeconomic & man-made crises**
   - **global warming, earthquakes, fires, hurricanes, excessive energy consumption and terrorist attacks**
2. **Drop in the cost of sensor and IT → Increase in Geo-data**
   - **aerial/ground imagery, distributed/mobile climate and pollutant data, traffic and video data, and data from mobile devices**

Opportunity:

Exploiting the common coordinates of time and space to fuse these geo-data into actionable knowledge in order to deal with various natural, man-made and socioeconomic crises more effectively.