Spatiotemporal big data analysis based on social sensing

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1. Concept
2. Sensors for Social Sensing
3. Applications
   - Social media
   - Smartphone
   - Navigation Device
   - Video Surveillance
   - Wearable Device
4. Conclusions
The report outline

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1. Social Sensing—Concept

The ternary world (physical world, human society and cyber world) is a dynamic and open network society.
Remote Sensing vs Social Sensing

- **Remote Sensing**: based on different types of platform to obtain remote sensing signals, mainly used to obtain the information from the natural landscape.
- **Social Sensing**: based on the human as sensors to obtain the behavior patterns, revealing socio-economic factors.

Better understand geographical space
1. Social Sensing—Concept

**Macro Groups**

To study the spatio-temporal behavior of human group, and reveal the human activities and socio-economic environments by using various means of social sensing.

**Micro Individual**

To take people as the perceptual unit, and extract the spatio-temporal behavior patterns and relationship of human beings based on social sensing data.
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3. Data and Applications
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2. Social Sensing—Techniques

1) Internet (Web 2.0) social media

- Facebook breaks through 1.28 billion for a month
- The total number of Google+ users reached 1.6 billion
- Everyday, there are about 500 million "tweets"
- About 20 billion photos being shared on Instagram everyday

Massive social media and unstructured web
Social Sensing—Data

1) Social Media Data

- More Time Dimension
- Rich Text Semantics
- Social Network
2. Social Sensing—Techniques

2) Smartphone

Sensors:
- Camera
- GPS
- INS

Perception
- Position
- Gesture
- Behavior
- Identity
- Physiology
- Emotion
- Social Relations

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2. Social Sensing—Techniques

3) Navigation Device

The user activity data (personal trajectory, group trajectory, vehicle trajectory) can be used to reflect the user's position and social preference by GNSS device.
4) Video Monitoring

China has installed more than 30 million surveillance cameras, producing thousands of PB (PetaByte) data each year. The number of video surveillance devices is growing at a rapid rate of more than 30%.
5) **Wearable Device**

The interactive form of wearable devices and human body is mainly based on the ability of human body and the built-in equipment, with the concept of "people-oriented".
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Social Sensing—Applications

Data
- Social media data
- GNSS data
- Smartphone data
- Video data
- …..

Spatio-temporal data

Research Field
- Resident Behavior
- Urban Structure
- Transportation
- Ecosystem
- Disaster Emergency

Analysis Method

- $600 billion—a disk drive that can store all of the world’s books.
- 5 billion mobile phones in use in 2009.
- 30 billion smartphone data collected by the U.S. Library of Congress by April 2011.
- 40% of global internet traffic can be traced to a single domain name.
- 5% of global IT spending.
- 15 out of 17 sectors in the United States have more jobs today than in 2000.
Applications—Social media

Using Sina Weibo to detect urban function areas

Sina-Weibo daily (24 hours) temporal patterns of different clusters using K-means cluster algorithm

Residential areas (cluster 6)

Commercial areas and work areas (cluster 5)
Applications—Smartphone

1) Urban Multi-center structure

- Multi-Center classification results of Shenzhen are consistent with that of human traffic generation.
- $\frac{2}{3}$ crowd movement appears on the planned development belt.
- The multi-center boundary is consistent with 70\% of the community boundary detected by population movement.
Applications—Smartphone

2) Human activity Space

Distribution patterns of number of activity points and daily activity range

Temporal variation of average movement distance

The geographic disparity of people’s travel range in Shenzhen and Shanghai is significant

Geographic distributions of individuals with daily activity range < 2 km
2) Human activity Space
Behavior and activity pattern mining for large-scale group based on social sensing data
3) An inversion method based on spatio-temporal behavior distribution pattern

The quantitative solution of the land use type and the degree of mixed land use is realized, which solves the problem of geo-spatial differentiation pattern inversion and provides scientific basis for urban and regional planning.

Dynamic change of activity distribution based on social sensing data
1) Urban Functional Network Extraction

Applications—Video Surveillance

1) Population density can be detected based on video data

For video real-time, dynamic and local characteristics, as well as the static and macro features of the geographical scene, combined with road network constraints, the population density of the blind area is deduced.
1) Personality and organizational behavior Analysis

By using the wearable social measurement sensor (Sociometric Badge), the data of individual movement, speech and proximity were sensed to analyzes the personality and organizational behavior of employees.

Wearable sociometric badge

- Amount of face-to-face interaction
- Conversational time
- Physical proximity to other people
- Physical activity levels

Capture individual and collective patterns of behavior
Evaluate employees’ self-assessments of job satisfaction

Olguín et al. Sensible organizations: Technology and methodology for automatically measuring organizational behavior
2) **Enhance social networking**

To build and maintain social networks using wearable computing devices to enhance face-to-face social interaction in the real world.

Augmenting social space with wearable computers.

A wearable community system

Kortuem G, Segall Z. Wearable communities: augmenting social networks with wearable computers
4. Conclusions

Social sensing

Social sensing has brought us a big data related to human.

The big data spatiotemporal analysis is working for human’s life, such as environment, emergency, economy, urban planning.

Big Data: The next frontier for innovation, competition and productivity.
International Geocomputation Center for Social Sciences

Participants:

University of Chicago
Wuhan University

You are welcome to join us!
Thank you!