



# Spatiotemporal big data analysis based on social sensing

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# The report outline

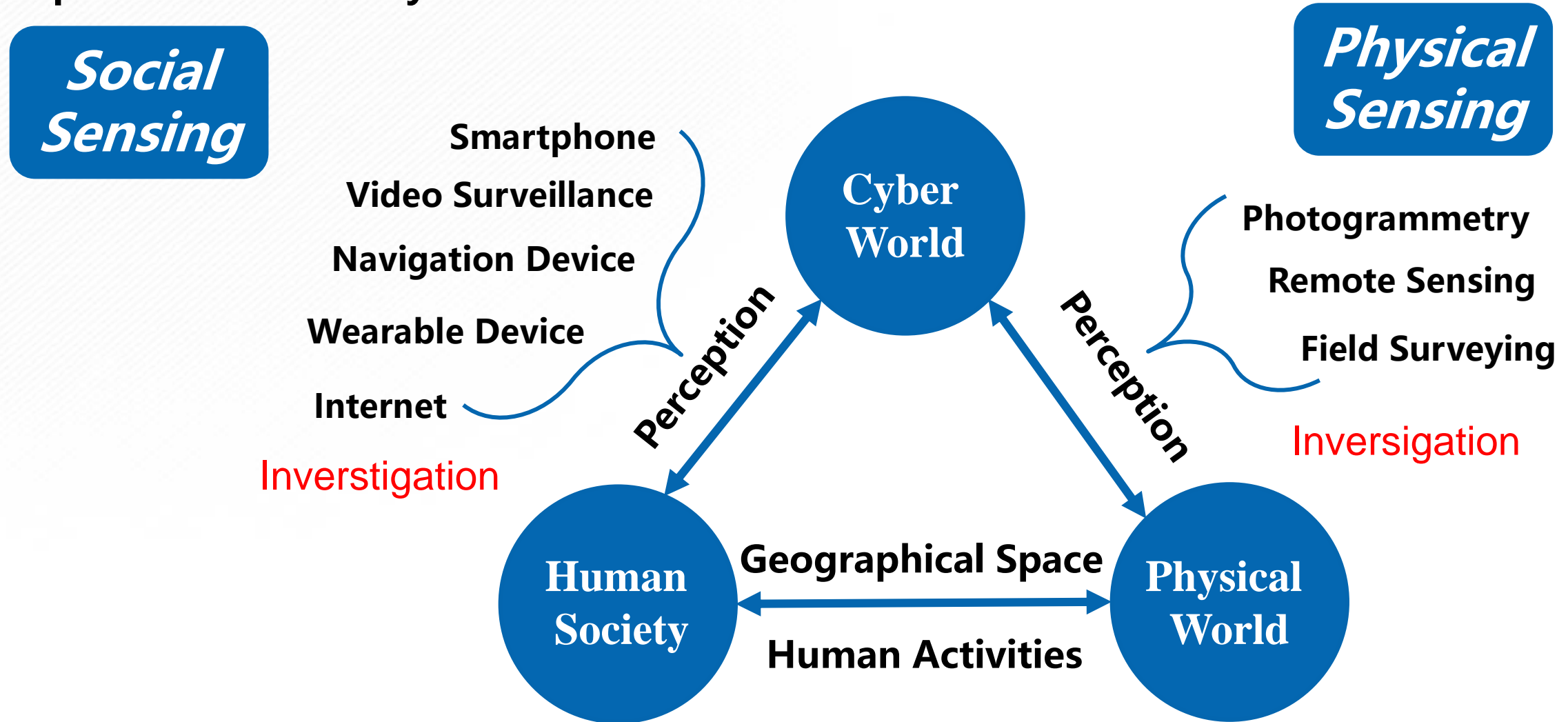
- 1. Concept**
- 2. Sensors for Social Sensing**
- 3. Applications**
  - Social media**
  - Smartphone**
  - Navigation Device**
  - Video Surveillance**
  - Wearable Device**
- 4. Conclusions**

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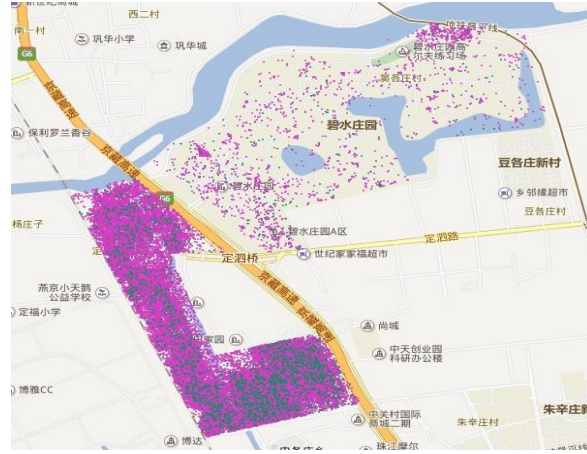
# 1. Social Sensing—Concept

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.



Remote Sensing

+

Social Sensing

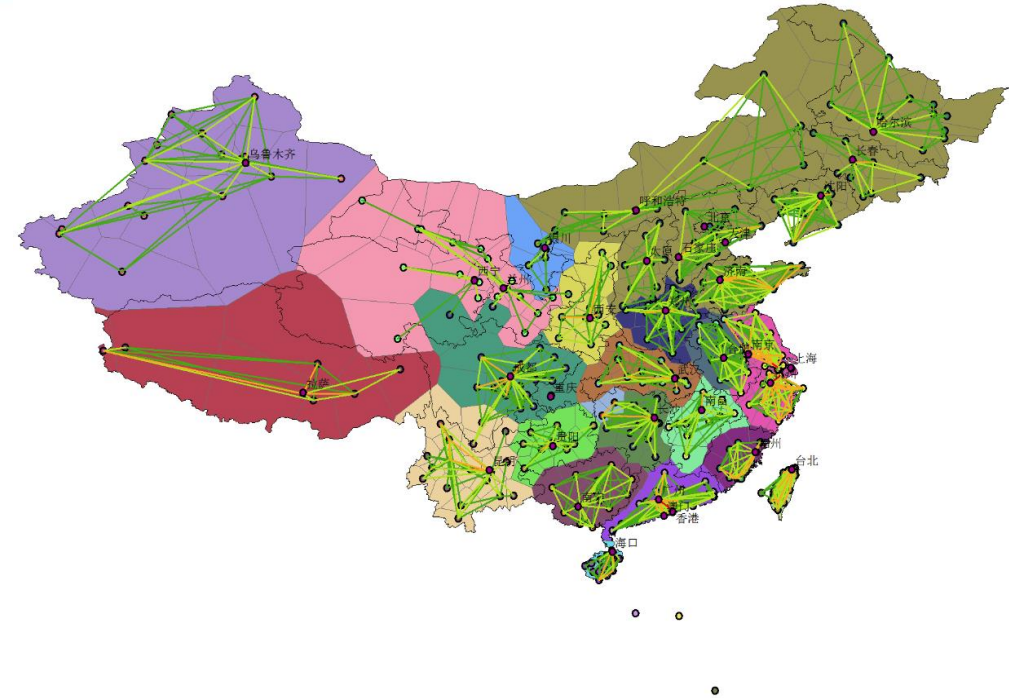
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Better understand geographical space

# 1. Social Sensing—Concept

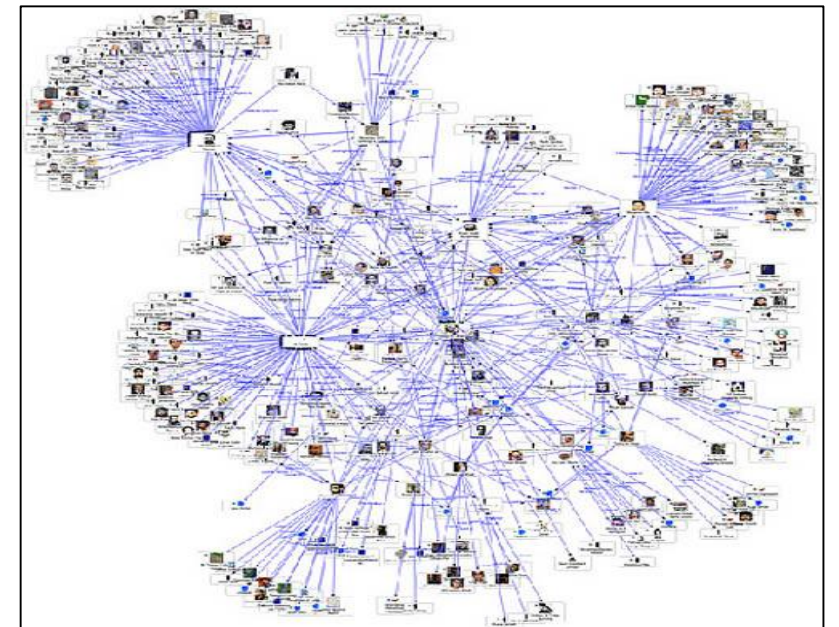
## Macro Groups

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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1. Concept
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3. Data and Applications
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  - Smartphone
  - Navigation Device
  - Video Surveillance
  - Wearable Device
4. Conclusions

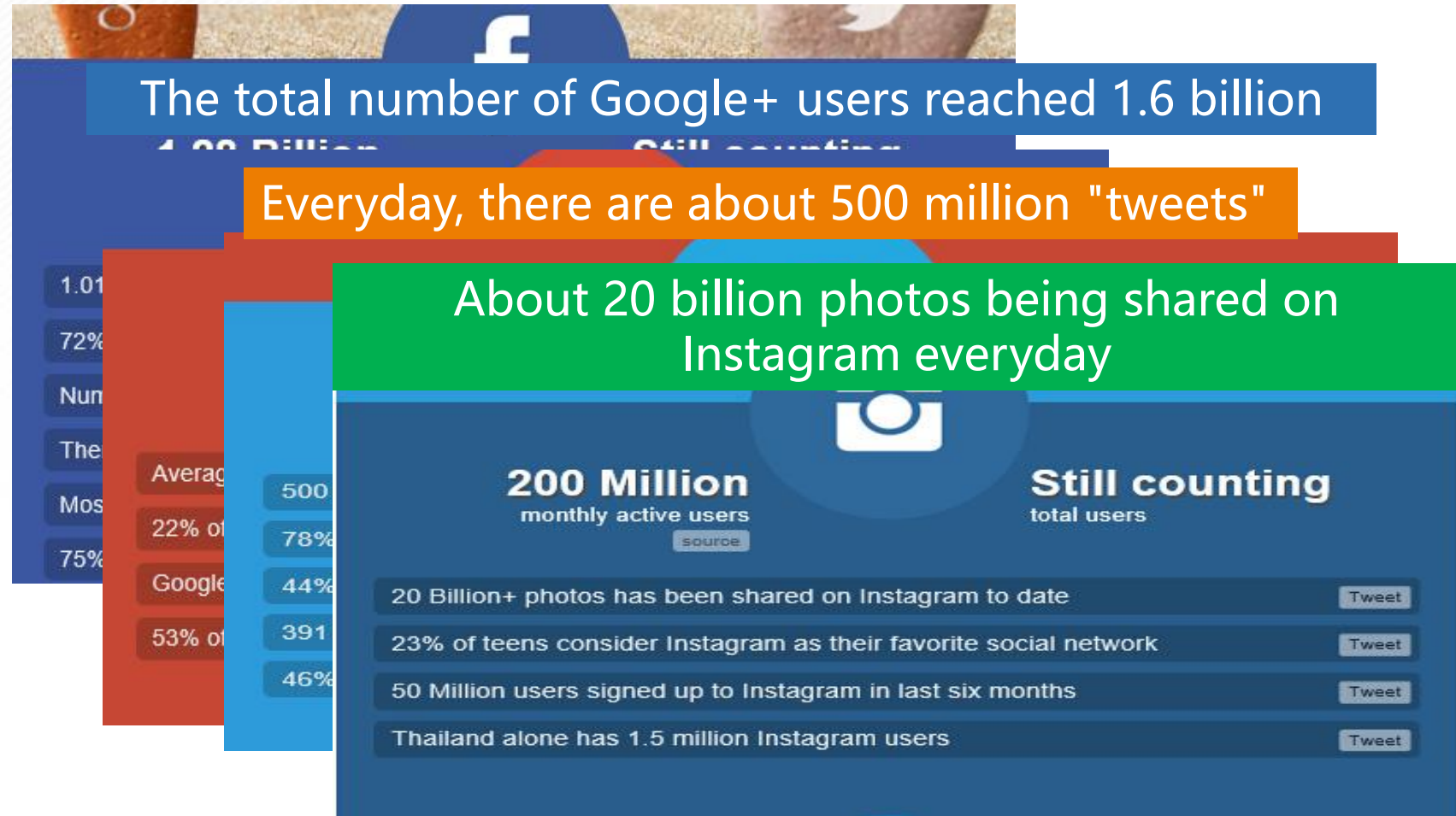
# 2. Social Sensing—Techniques

## 1) Internet(Web 2.0) social media

Facebook breaks through 1.28 billion for a month



Massive social media  
and unstructured web





# Social Sensing—Data

## 1) Social Media Data

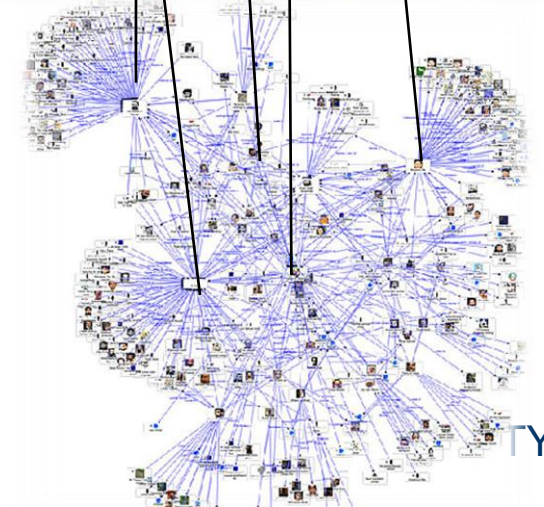
More Time Dimension



Rich Text Semantics



Social Network



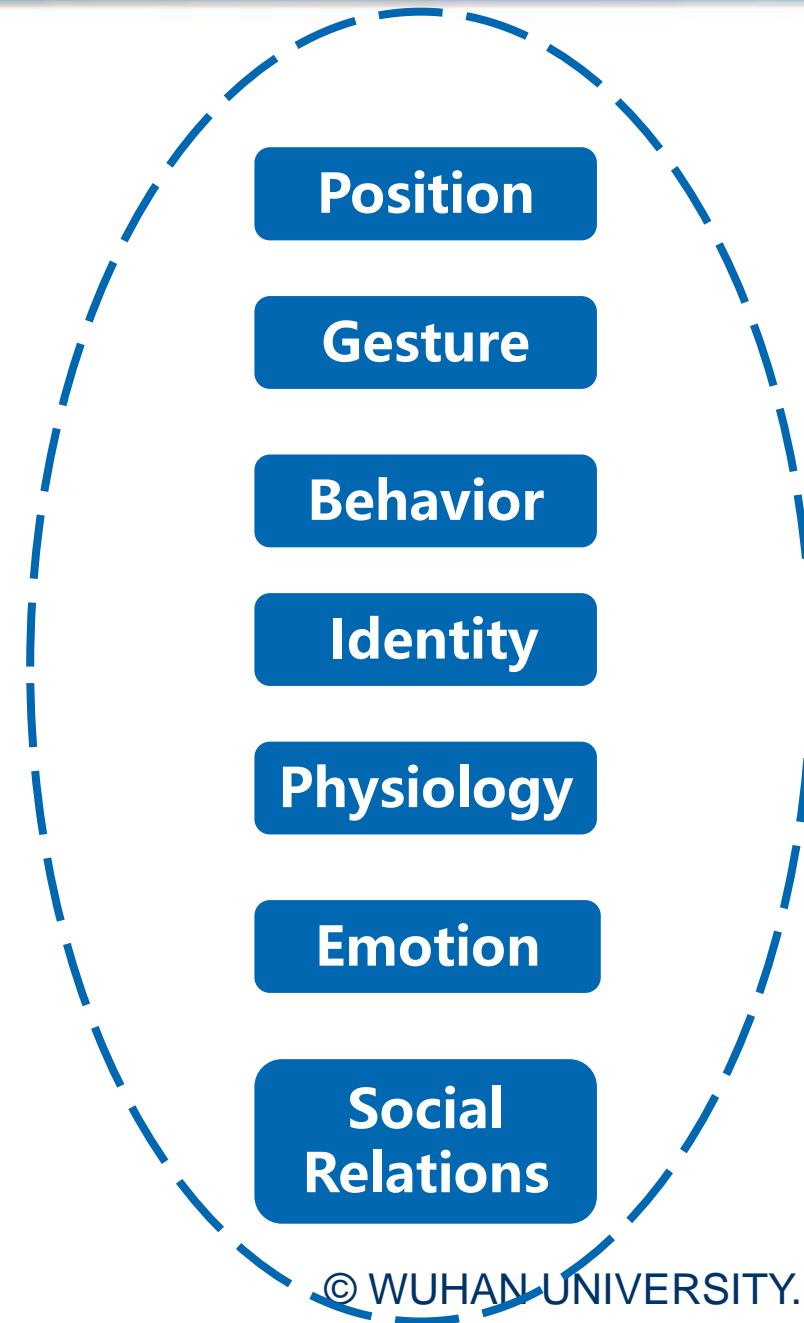
# 2. Social Sensing—Techniques

## 2) Smartphone



Sensors:  
Camera  
GPS  
INS  
.....

Perception  
→



# 2. Social Sensing—Techniques

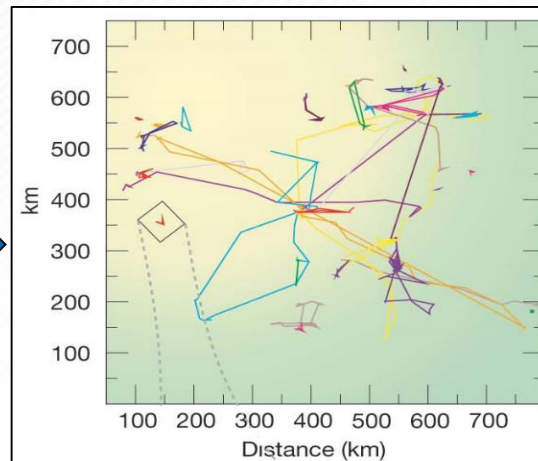
## 3) Navigation Device

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.

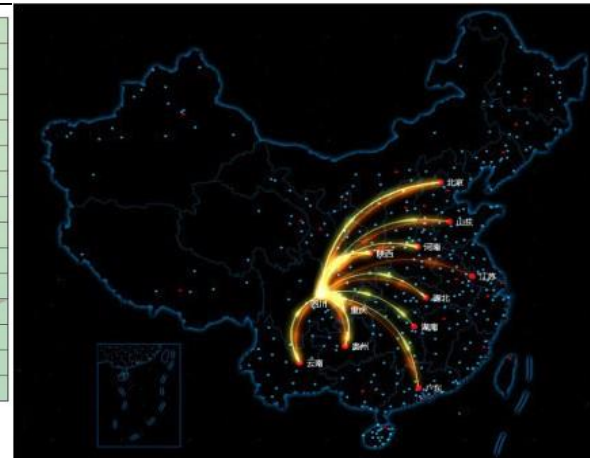


Trajectory

Perception  
→



Individual activities



Community events



Vehicle state

Mining  
↓

Moving objects

Activities

Location

Behavioral

Hobbies

Convention

# 2. Social Sensing—Techniques

## 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%.

### People Flow



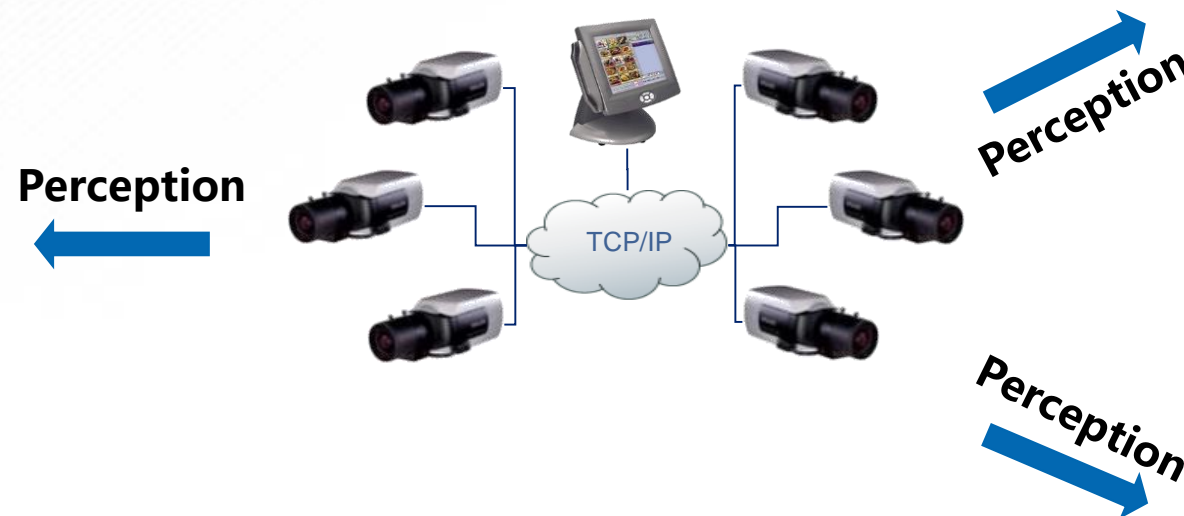
### Emergency



### Traffic Flow



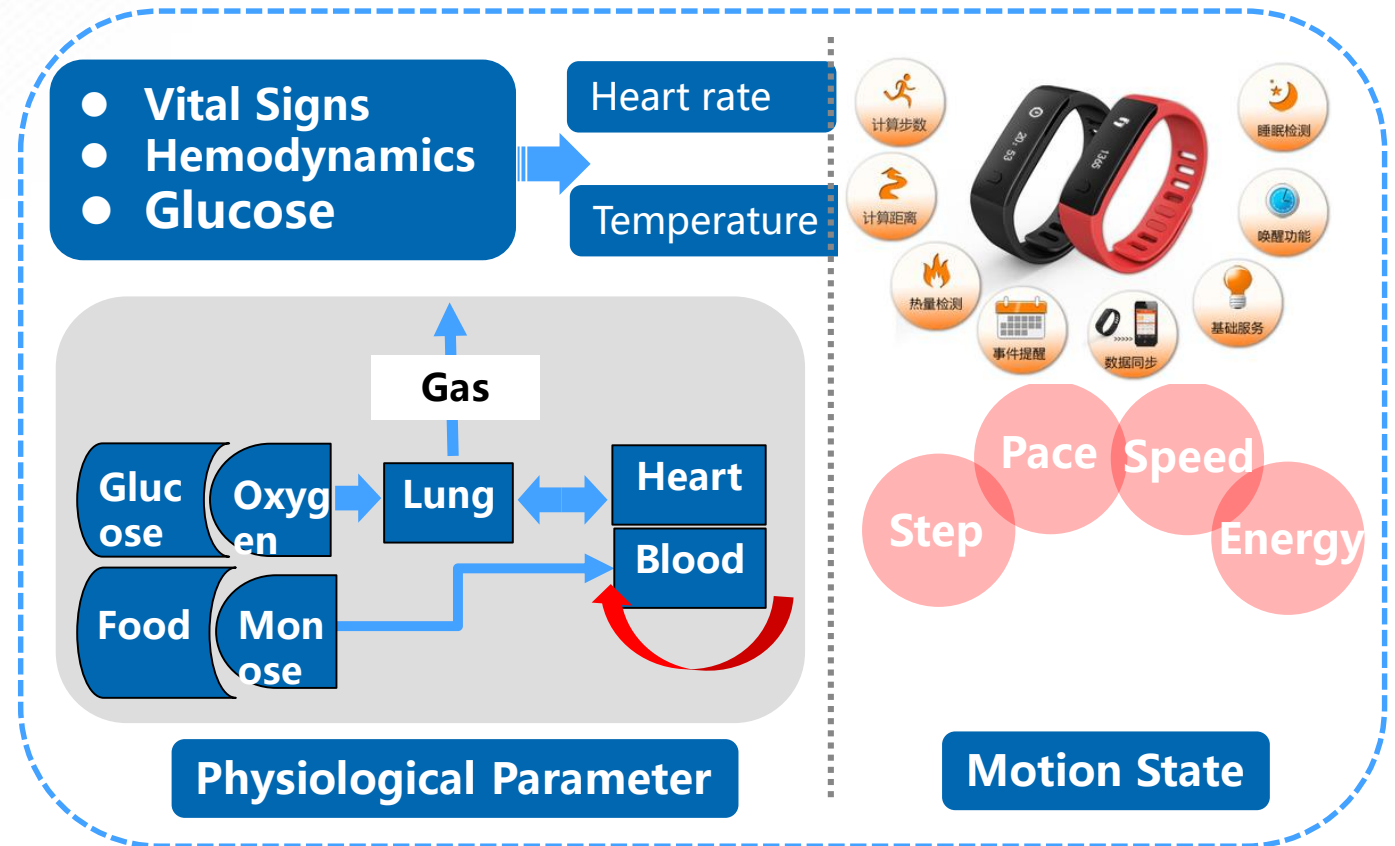
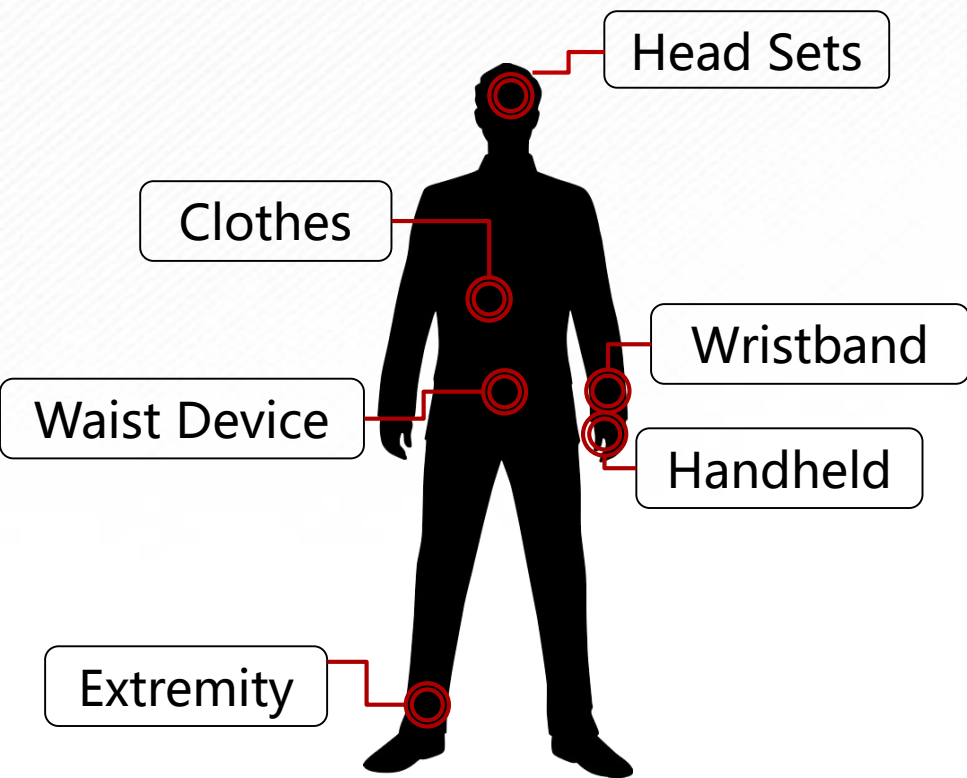
### Intelligent Monitoring



# 2. Social Sensing—Techniques

## 5) Wearable Device

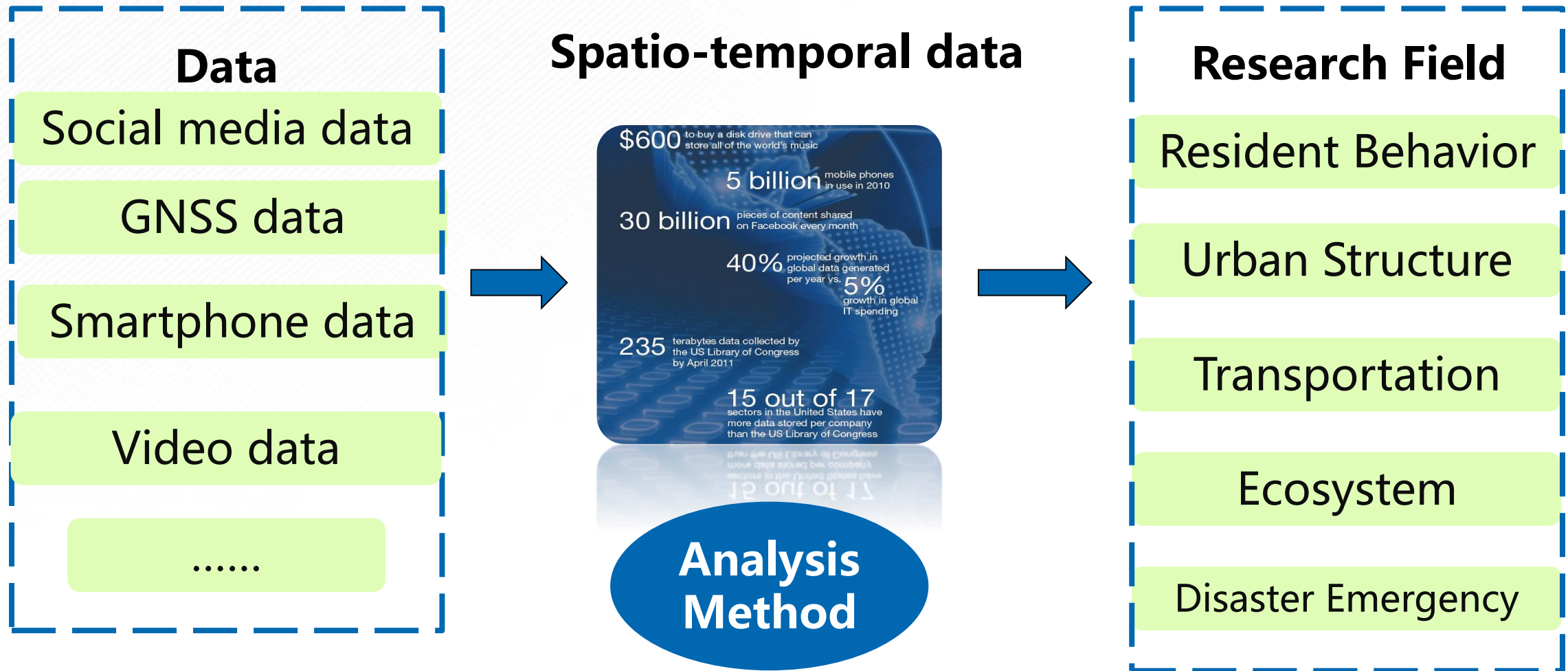
The interactive form of wearable devices and human body is mainly based on the ability of human body and the built-in equipment, with the concept of "people-oriented".



# The report outline

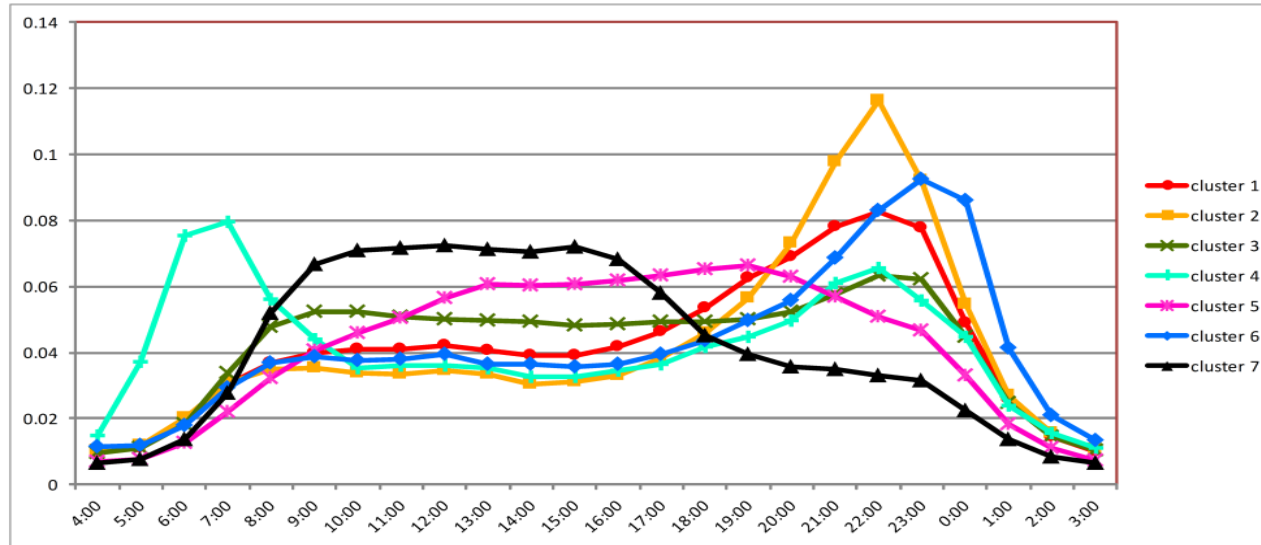
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# Social Sensing—Applications

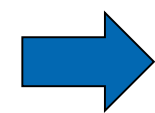


# Applications—Social media

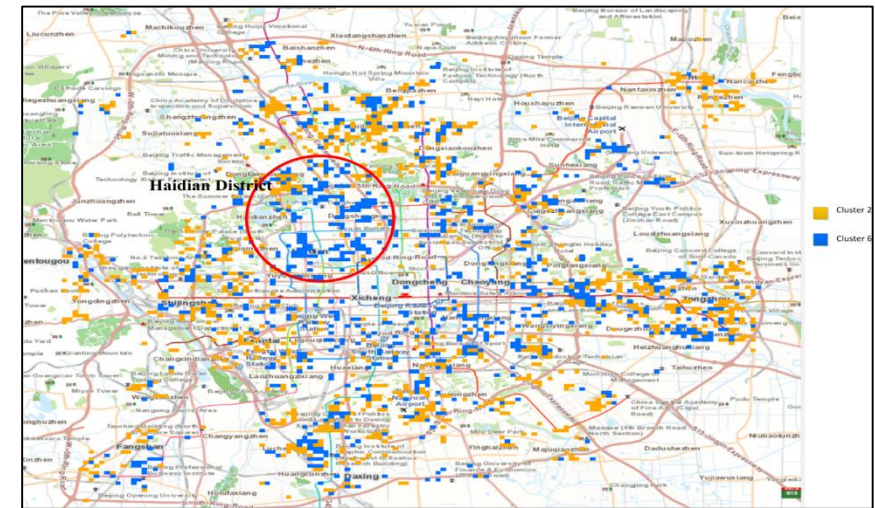
## Using Sina Weibo to detect urban function areas



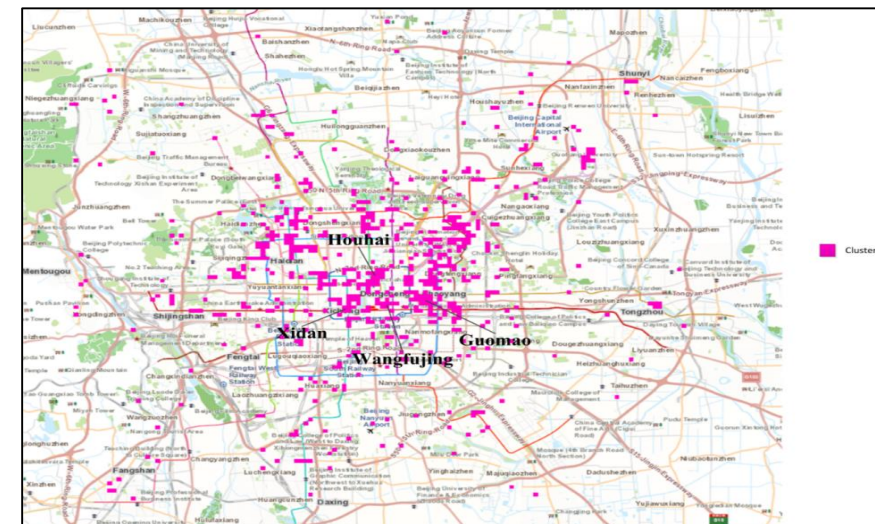
Sina-Weibo daily (24 hours) temporal patterns of different clusters using K-means cluster algorithm



Residential areas(cluster 6)



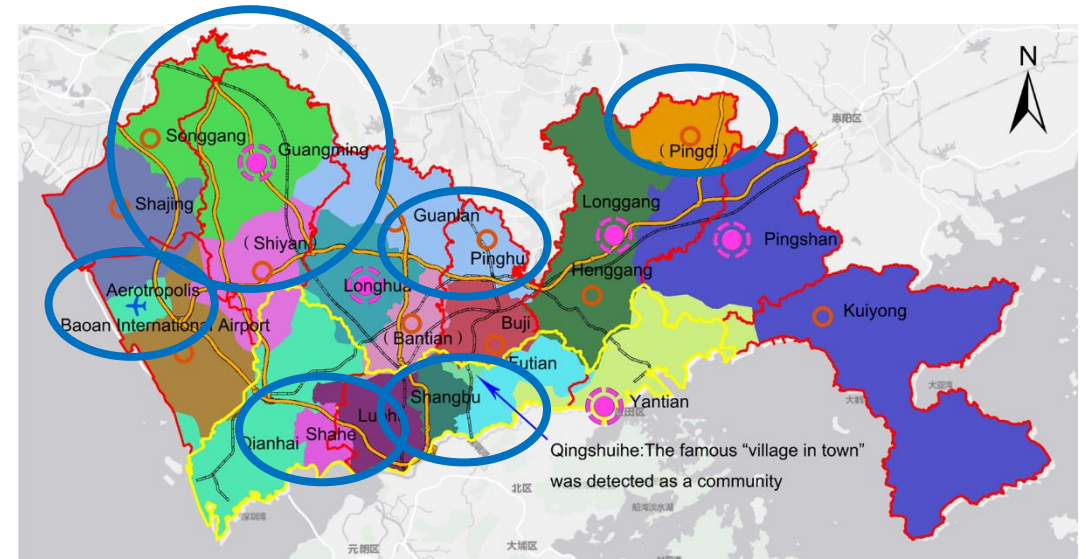
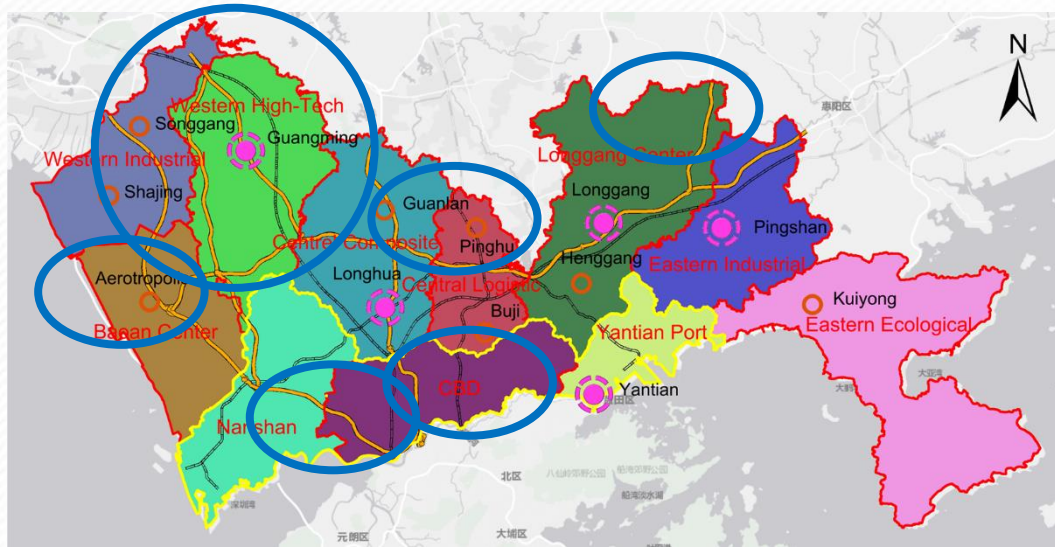
Commercial areas and work areas(cluster 5)





# Applications—Smartphone

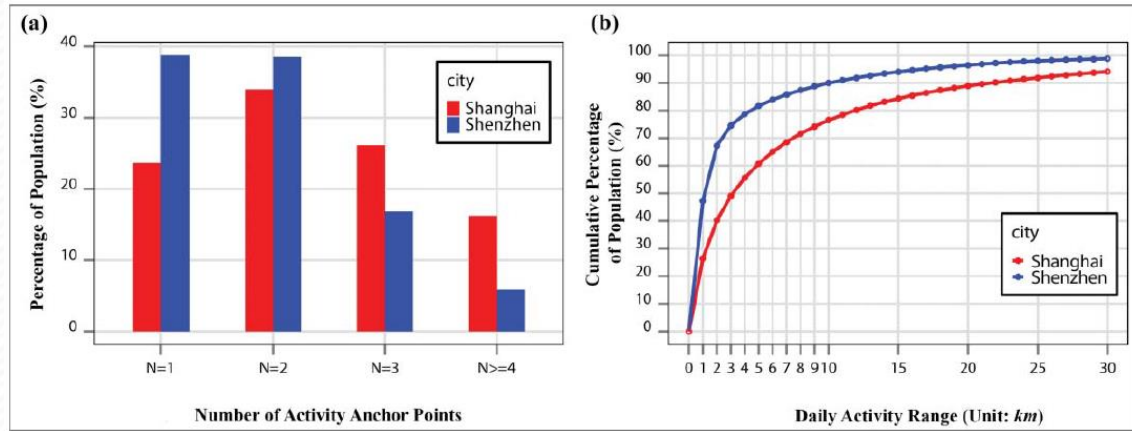
## 1) Urban Multi-center structure



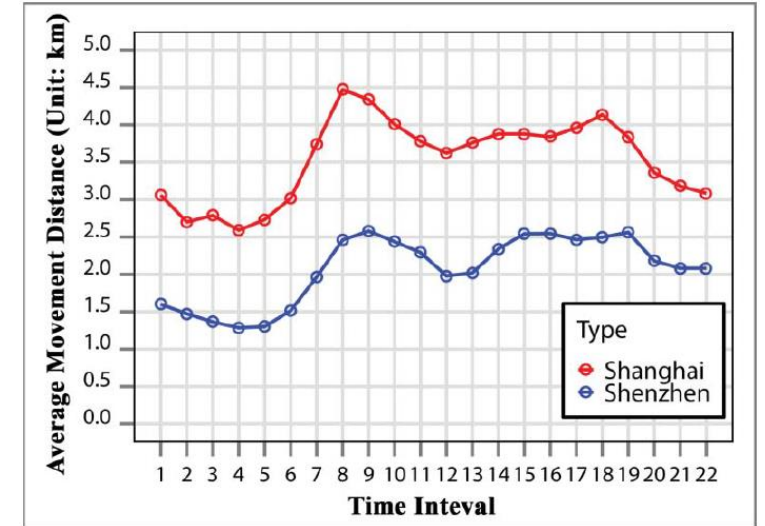
- Multi-Center classification results of Shenzhen are consistent with that of human traffic generation.
- **2/3** crowd movement appears on the planned development belt
- The multi-center boundary is consistent with **70%** of the community boundary detected by population movement

# Applications—Smartphone

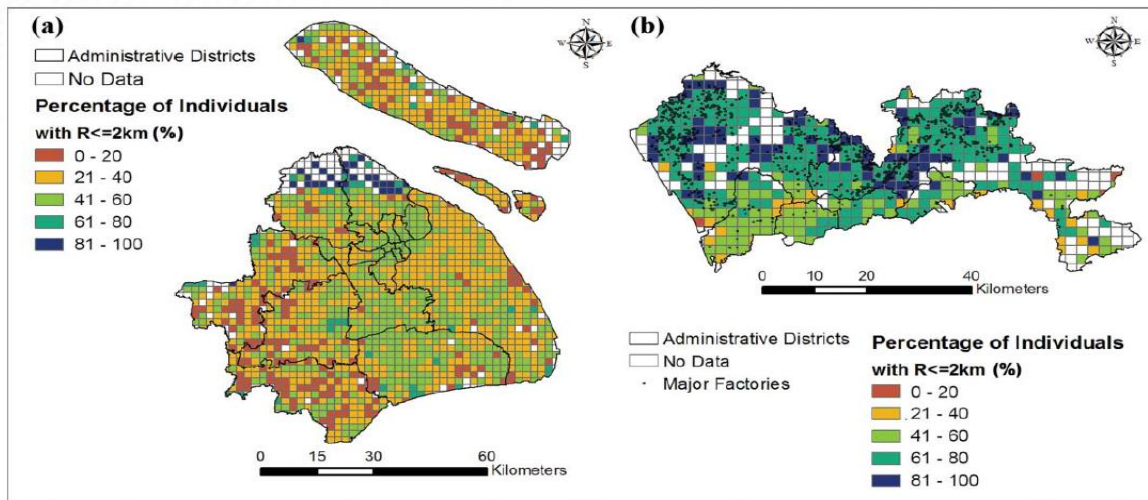
## 2) Human activity Space



Distribution patterns of number of activity points and daily activity range



Temporal variation of average movement distance



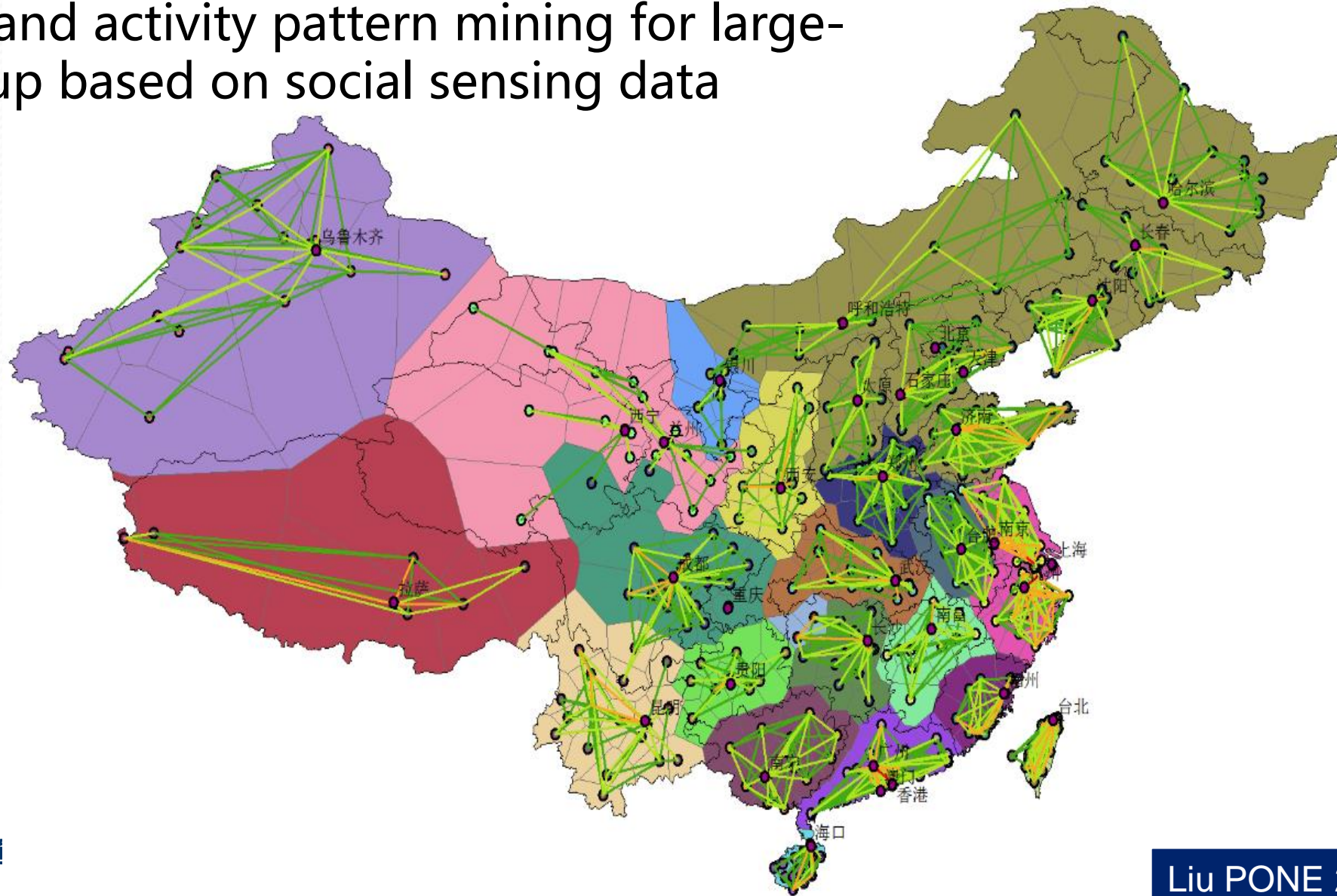
Geographic distributions of individuals with daily activity range  $\leq 2$  km

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

# Applications—Smartphone

## 2) Human activity Space

Behavior and activity pattern mining for large-scale group based on social sensing data

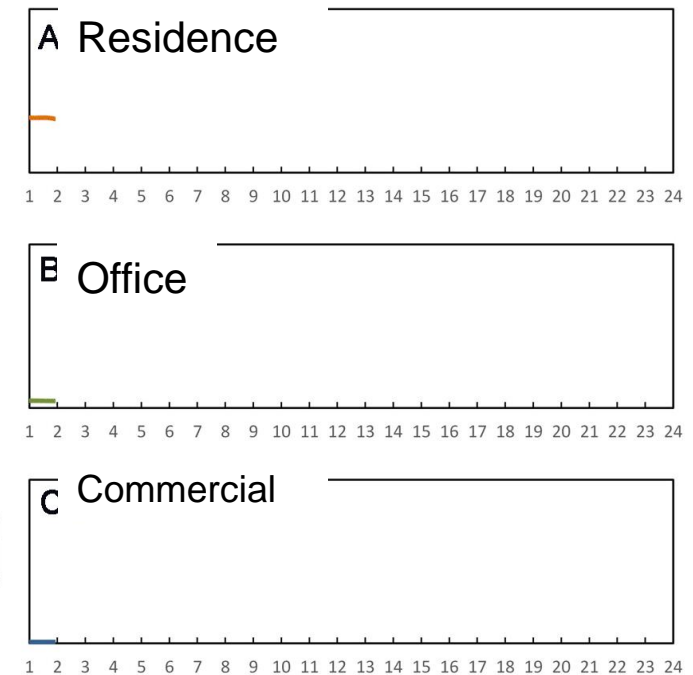
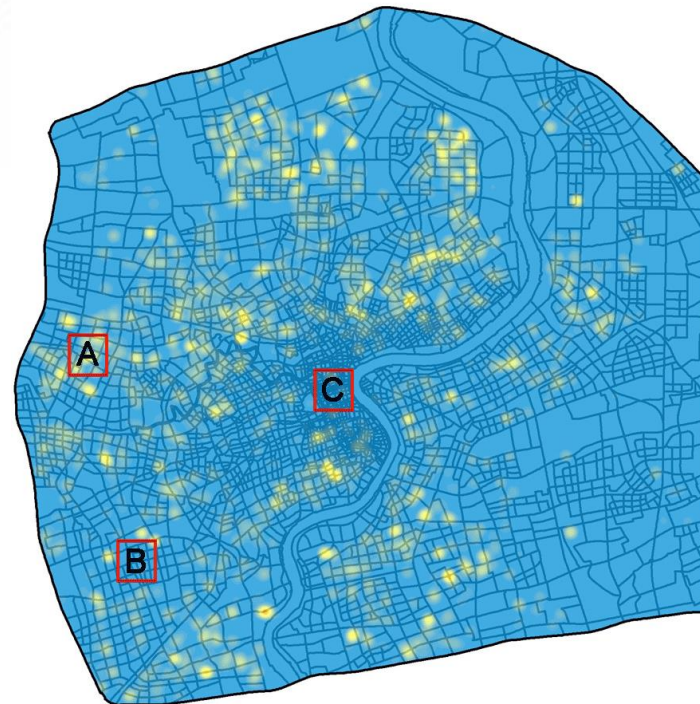


# Applications—Smartphone

## 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



# Applications—Navigation Device

## 1) Urban Functional Network Extraction

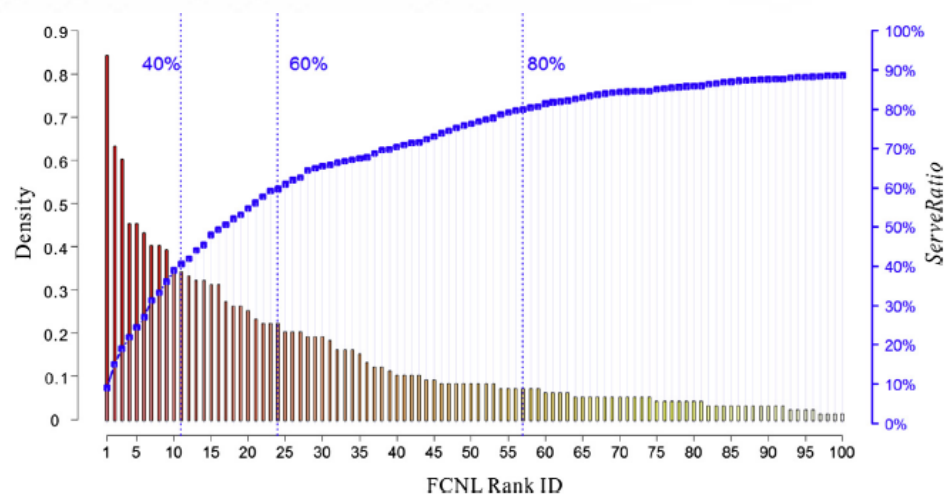
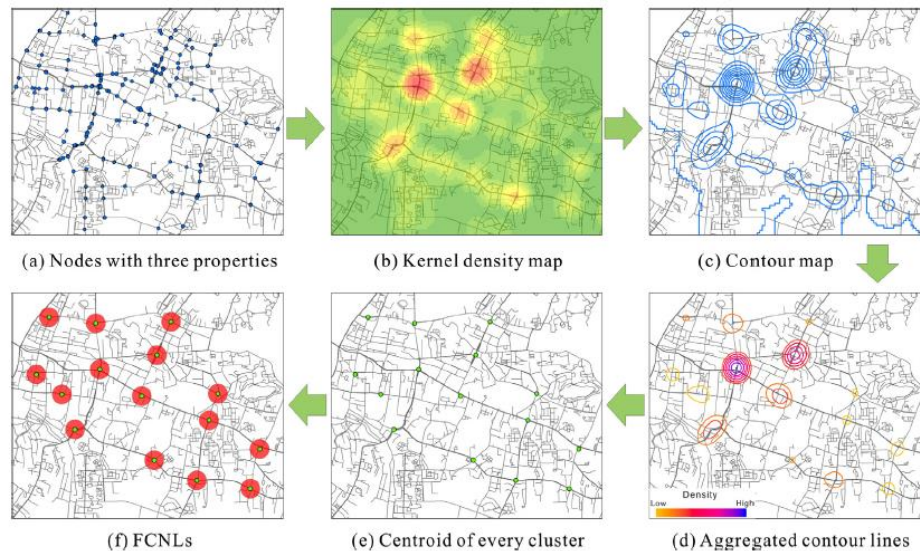


Fig. 6. Node density (bars) and *ServeRatio* (diamonds) as a function of FCNL rank order  $i$  in  $t_{18}$ .

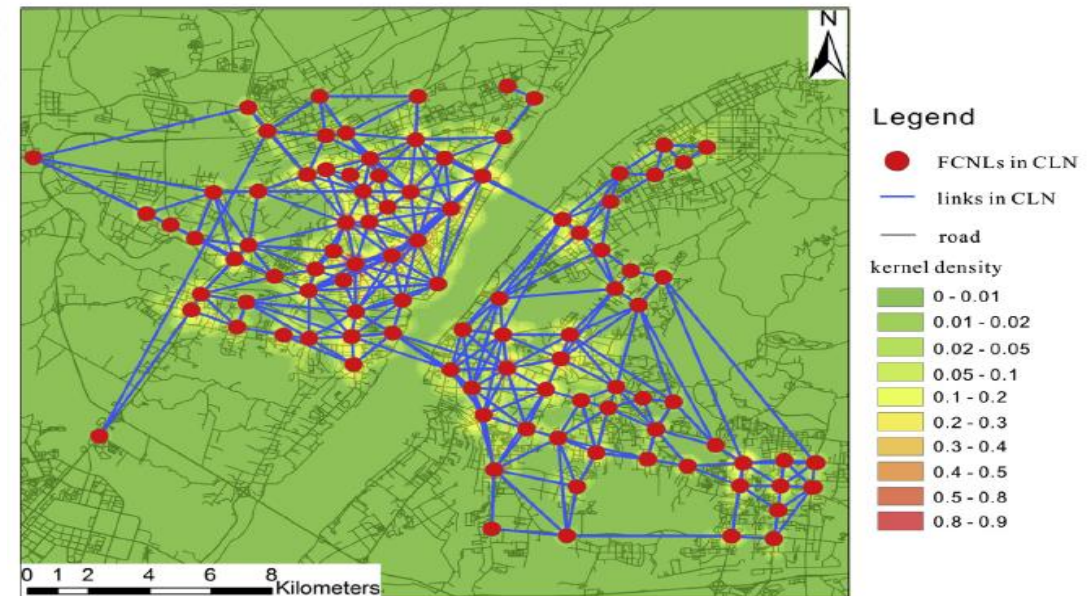


Fig. 5. The top 100 FCNLs in Wuhan at  $t_{18}$ .

Yang ZHOU, Zhixiang Fang\*, Jean-Claude Thill, Qingquan Li, Yuguang Li. Functionally critical locations in an urban transportation network: Identification and space-time analysis using taxi trajectories. *Computers, Environment and Urban Systems*, 2015, 52, 34–47.

# 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.



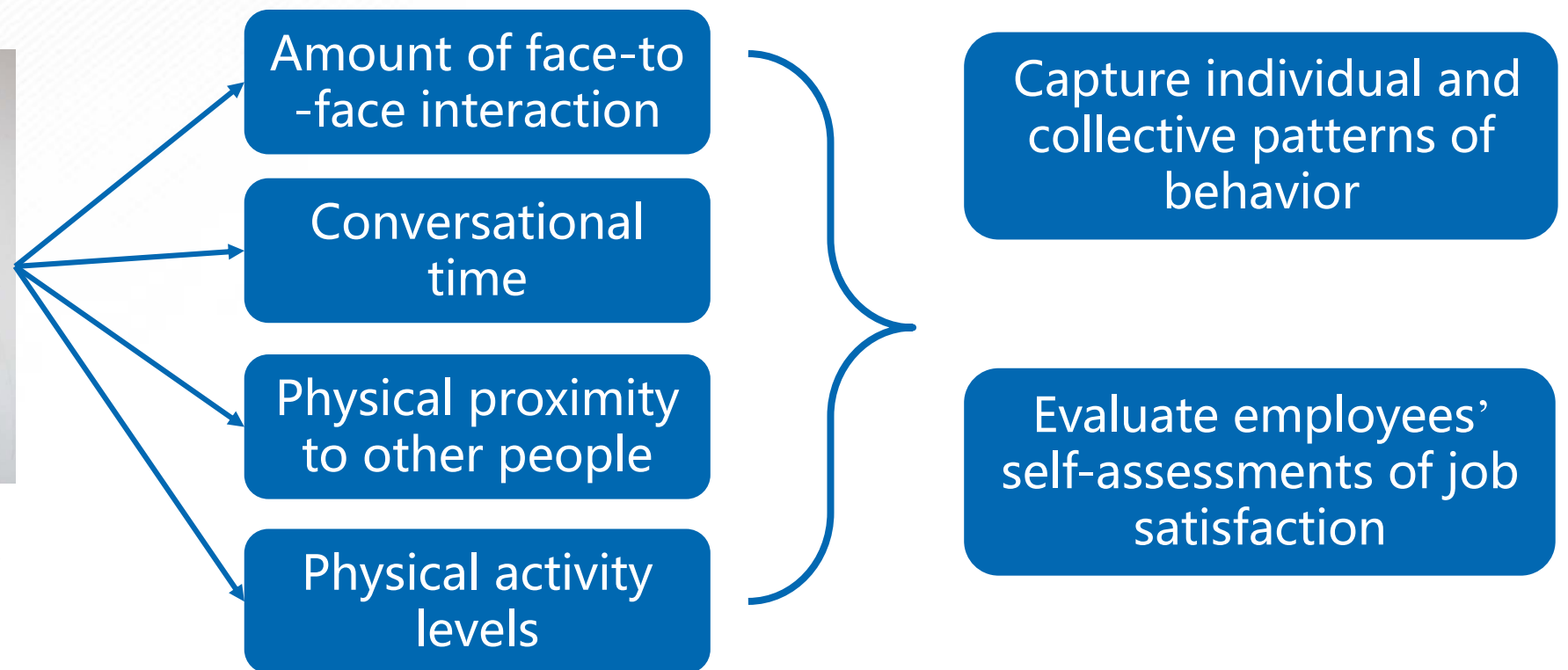
# Applications—Wearable Device

## 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



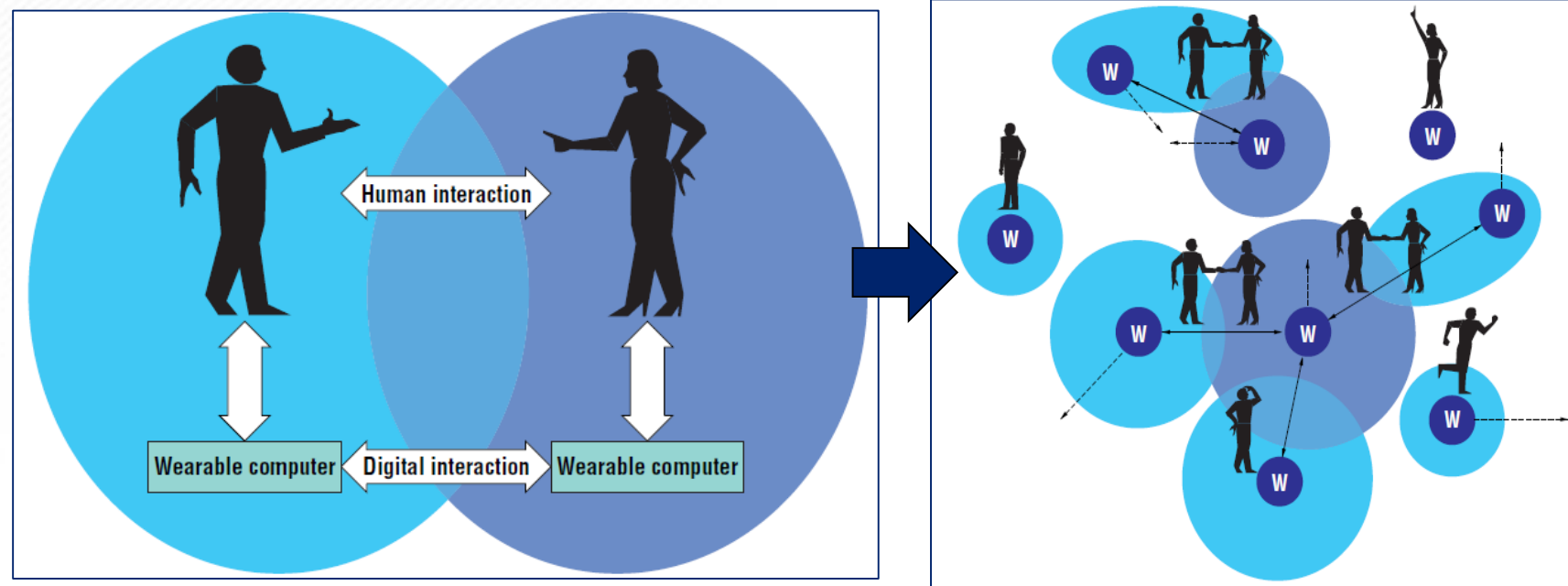
Wearable sociometric badge



# Applications—Wearable Device

## 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**





# International Geocomputation Center for Social Sciences

**Participants:**

**University of Chicago**

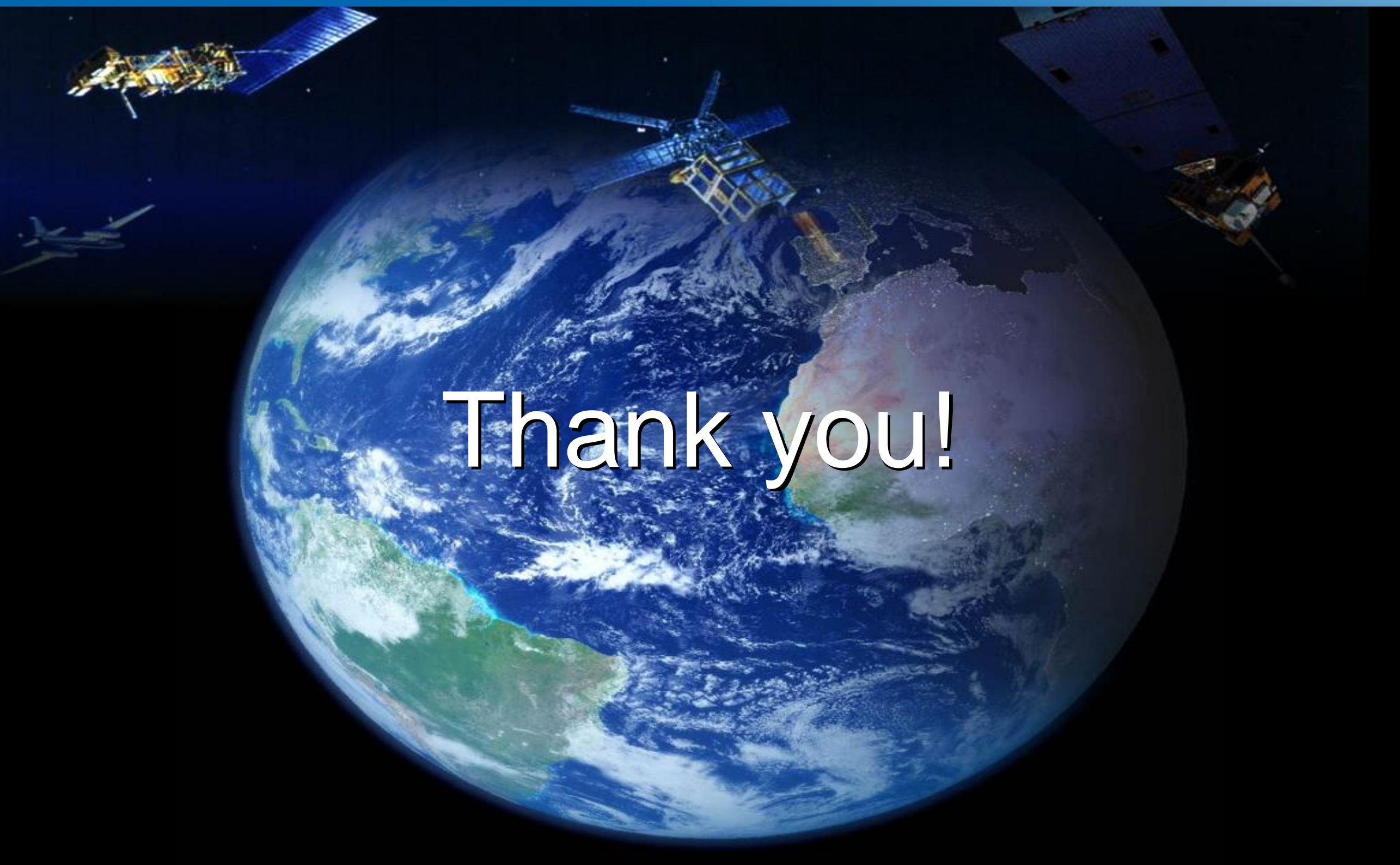
**Wuhan University**

**You are welcome to join us!**



LIESMARS

测绘遥感信息工程国家重点实验室



Thank you!