Urban Geo-Informatics

John W Z Shi

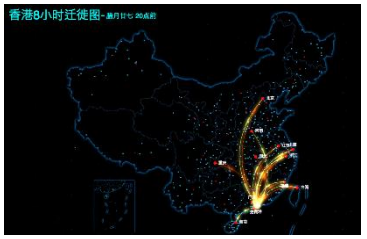
Urban Geo-Informatics studies the regularity, structure, behavior and interaction of natural and artificial systems in the urban context, aiming at improving the living standards of mankind.

Urban Geo-Informatics:
Building Spatial Infrastructure for Smart City

Geo-Informatics

Geo-Informatics: the science and technology dealing with the acquisition, storage, processing production, presentation and dissemination of geo-information (*Ehlers, 2008, IJDE*)

Smart city



Spatial dynamic analytics (Baidu)

Positioning and Navigation

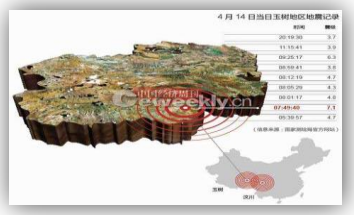
Geo-Informatics

Widely applied

Annual market value

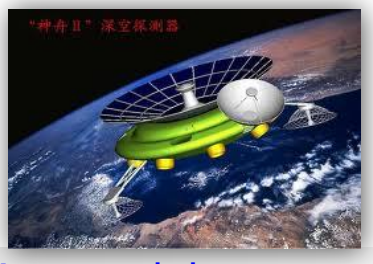
US$ 0.7 trillion in 2010

Environment



Disaster mitigation

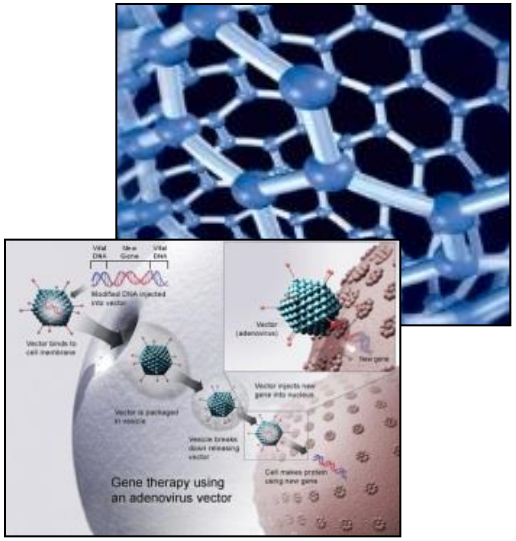
Resource management



Aero and deep space

Geo-Informatics

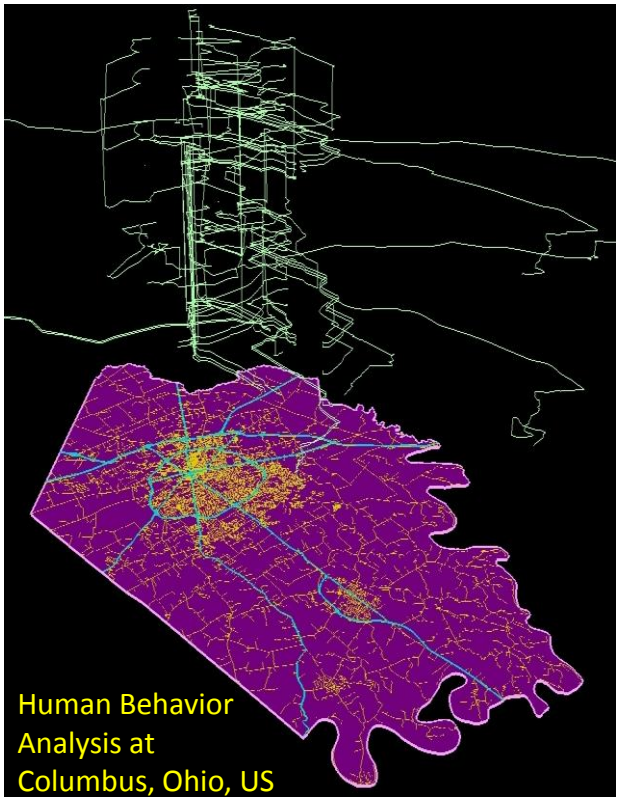
Geo-Informatics is “one of the three most important emerging and evolving fields, along with nanotechnology and biotechnology” (*Gewin, 2004. Mapping opportunities, Nature, 427, 376-377.*)



Challenges

Spatial discovery and prediction

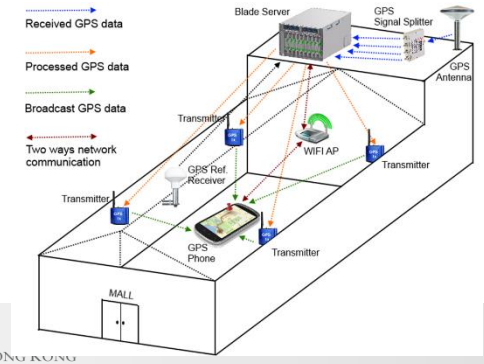
- Discover and explain human motion behavior and regularities in urban spatially and temporally
- Predict trend of human motion and social events
- Uncertainty-based spatial data mining and urban knowledge discovery



Challenges

Principles of dynamic spatial information extraction

- Dynamic objects recognition from multiple sensors
- Dynamic spatial data analytics from crowdsourcing data
- Change detection based on satellite images
- Seamless positioning and navigation based on satellite and ground sensors



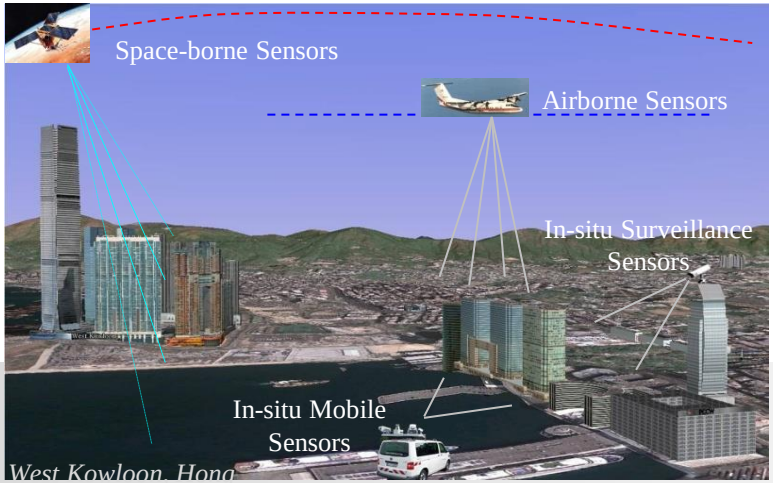
Dynamic aspects: people, traffic, goods, energy flow, disease spread etc.

Challenges

Three-dimensional spatial data infrastructure for smart city

- Complex 3D city modelling, including 3D indoor environment
- Data fusion for spatial data from multiple sensors: space borne high resolution satellite image, airborne LiDAR, UAV and ground-based mobile mapping system
- 3D spatial object recognition from images

3D spatial data infrastructure



Long Term Development and Well-being of Hong Kong

- Urban is facing to huge challenges, including housing, spatial infrastructure, environment and transportation, especially for megacities like Hong Kong, New York and Tokyo.
- With the research development in Urban Geo-Informatics, Hong Kong can be benefited by first using the innovations and high-tech related to geo-informatics, including satellite image processing, satellite positioning and geographic information science and technology.
- With the successful application of urban geo-informatics, Hong Kong can be provided with more solutions to the challenges it is facing to.

Creation, Application, and Transfer of Knowledge

- Characterization of urban dynamics
  - Observation, monitoring and simulation of urban dynamics
  - Analysis of urban dynamics spatio-temporally
  - Development of solutions for smart city applications
- Spatial analytics and urban knowledge discovery
  - To advance uncertainty-based spatial data mining methods
  - To develop massive data-oriented fast spatio-temporal data mining methods
  - To study people's activity patterns in space-time and their social implications
- Information on demand
  - Provides a flexible, reusable, and scalable mechanism to share and interoperate spatial data, information, and services
  - Improve the interaction of human, sensor, and information
- Hong Kong is an excellent urban laboratory.

Research Strength and Opportunities

Hong Kong's Existing Strengths	Institutions	Representative Researchers	Weakness (Opportunities)
GIScience	PolyU, CUHK	Wenzhong Shi (PolyU): Spatio-temporal analysis and mining Bo Huang: GIS for sustainable urban land use	• Well established in modelling static aspects of urban infrastructure, but very limited in dynamic aspects; • From spatio-temporal analysis to spatio-temporal intelligence • Data-orientated not information/ service-orientated • Spatial information aided human & social behavior research in urban area
Positioning and Navigation	PolyU	Wu Chen (PolyU): location-based service George Liu (PolyU): GNSS	
Remote Sensing	PolyU	Xiaoli Ding (PolyU): Measurement science Bo Wu (PolyU): Photogrammetry, remote sensing	
Computing	PolyU	Jiannong Cao (PolyU): Distributed and mobile computing	
Urban Studies	CUHK	Yee Leung (CUHK): Urban policy, urban geography	
Urban Planning	HKU	Anthony Ye (HKU): Urban planning	
Urban Environment	PolyU	Charles Wong (PolyU): Urban heat island, environmental monitoring	
Urban Logistics	PolyU, HKBU	Donggen Wang (HKBU): Urban & regional studies Lilian Pun (LSGI, PolyU): Traffic pattern	
Urban Social Science	PolyU	Daniel Shek (PolyU): Social issues in urban area	