Modeling of human movement behavior: from data to applications

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Data revolution
From data to knowledge
Urbanization

- 1950: 30% of the population lives in cities
- 2014: 54% of the population lives in cities

Source: UN World Urbanization Prospects: 2011 Revision
Smart city: Application of IoT

**Challenges**
- Climate change
- Energy consumption and pollution
- Increased traffic and congestion

**Solution**
- Data availability
- Networked technologies
From data to application

Examples

- Congestion and pedestrian movements
- Reconstructing actual itineraries
Congestion and pedestrian movements
Congestion

Research challenges

- Understand, describe and predict
- Optimization of current infrastructure and operations
- Efficient planning and management of future pedestrian facilities
Data sources

Survey

Counts

Wireless technologies

Automated detection and tracking
Models and applications

- Departure time choice
- Activity pattern choice
- Activity scheduling
- Route choice
- Walking behavior
- Level of service
- Design and planning
- Guidance
- Control
Example: Lausanne train station
Data sources

- Pedestrian trajectories
- Timetables
- Infrastructure data

**Pedestrian type**
- Arriving
- Departing
- Transferring
- Non-passengers

**Period**
- Peak
- Off-peak

**Walking pattern**
- Group
- Alone

**Time to departure**

**OD distance**
Data-driven models for pedestrian movements

Models

Application domains

[Diagram showing speed (m/s) vs. density (ped/m²)]
Reconstructing actual itineraries
Traditional data sources: Travel surveys

Drawbacks:
- Biased response
- No response
- Erroneous reporting
Modern data sources: Smartphones

Smartphones, mobile PCs, tablets and mobile routers with cellular connection

5.6 BILLION smartphone subscriptions by the end of 2019

Mobile PCs, tablets and mobile router subscriptions
Smartphone subscriptions
Applications

- Environmental studies
- Urban planning
- Customized advertisements
- Context aware smartphones
- Travel demand estimation
- PT companies
- Real-time traffic state estimation
- Intelligent travel assistants
Example: Telecommunication traces
Telecommunication traces and path inference

Issues

- Low frequency in some areas
- Inaccuracy due to technological constraints
- Weaker signal in some areas
- Map matching algorithms do not work with this data
Conclusions

Strengths

- Pervasive & non intrusive

Opportunities

- From data to applications

Weaknesses

- Data ≠ information ≠ decisions
- Big data ≠ useful data

Threats

- Privacy & biases
Thank you

4th Advances in Destination Management
Visitor Data and Decision Making: Challenges and Opportunities

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