03 Recover urban people flow from population data

- People flow estimation from spatiotemporal population data -

Abstract

Real-time spatiotemporal population data is attracting a great deal of attention for understanding crowd movements in cities. The data is the aggregation of personal location information and consists of just areas and the number of people in each area at certain time instants. Accordingly, it does not explicitly represent crowd movement.
We propose a probabilistic collective graphical models that can estimate crowd movement from spatiotemporal population data. There are two technical challenges: (i) poor estimation accuracy as the traditional approach means the model would have too many degrees of freedom, (ii) excessive computation cost. Our key idea is to model the transition probability between areas by using three factors: departure probability of areas, gathering score of areas, and geographical distance between areas. These advances enable us to reduce the degrees of freedom of the model appropriately and derive an efficient estimation algorithm.

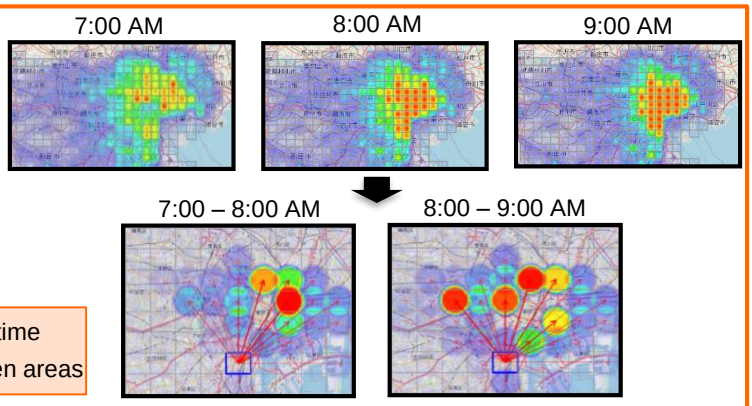
What we are working on?

- ✓ It is difficult to utilize people movement data across various services and enterprises because of privacy issues.
- ✓ In many practical situations, only aggregate information is available.

Our technology

Input: population of each area at each time

Output: # of people who moved between areas



Technical points

Estimation reflects nature of human movements

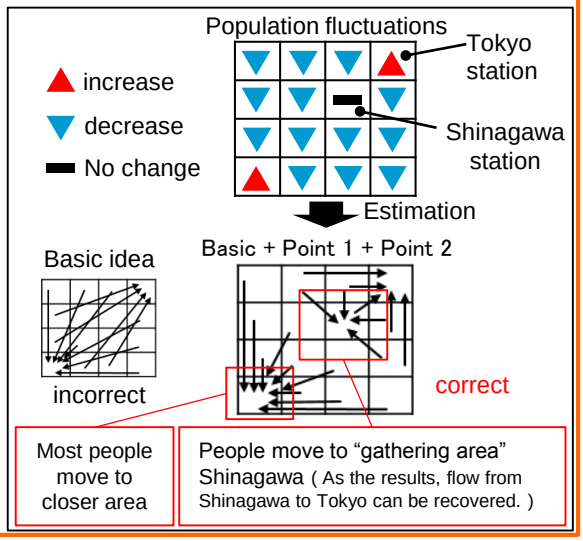
- **Basic idea**: Allocate people flow from decreasing area to increasing area
- **Point 1:** Consider **area characteristics**
  - **Gathering** area (areas where people are likely to gather)
  - **Emissive** area (areas where people are likely to leave)
- **Point 2:** Consider **distance** between areas

Transition probability from area i to j

$$\theta_{ij} \propto \pi_i \times s_j \times \exp(-\beta \cdot dist(i,j))$$

Point 1 Point 2

- Departure probability π_i determines whether the person leaves area i or stay
- If the person is deemed to leave i, (probability of next area j to be chosen) $\propto$ (gathering factor of j) × (distance between i and j)



References

[1] Y. Akagi, T. Nishimura, T. Kurashima, H. Toda, "A fast and accurate method for estimating people flow from spatiotemporal population data," in Proc. *the 27th International Joint Conference on Artificial Intelligence and the 23rd European Conference on Artificial Intelligence (IJCAI-ECAI-18)*, pp. 3293-3300, 2018.

Contact

Yasunori Akagi Email: cs-liaison-ml at hco.ntt.co.jp
Proactive Navigation Project, NTT Service Evolution Laboratories

Innovative R&D by NTT
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