CSIS

# SEZAKI LAB.

## [Urban Sensing and Mobility Analysis]

**Center for Spatial Information Science**

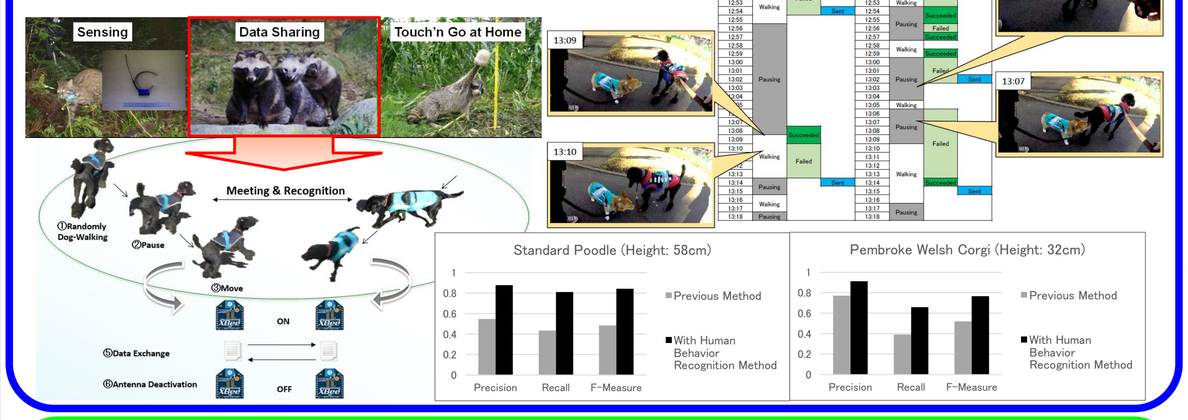
http://www.mcl.iis.u-tokyo.ac.jp

**Information and Communication Engineering**

Information & Communication Engineering
Socio-cultural Environmental Studies

## Animal-Computer Interface Design for Data Sharing

- For the efficient and safe field surveys, we research the efficient inter-animal communication.
- By using the habits of wild animals, we develop the power-saving data-sharing system.
- With the method of human behavior recognition, the accuracy of the system was improved.




## Digital Archiving Project of the Tianjin Settlement in China

- Aiming to archive historical architectures with mobile sensing technology
- Collaboration with Prof. Aoki in the School of Architecture, Tianjin University
- Development of a smartphone app to survey architectures and streets
- Collection of various types of data with smartphone sensors

## Mitigation of ISI in Diffusion-based Molecular Communication

- **Objective:** To mitigate the intersymbol interference (ISI) in diffusion-based Molecular Communication (MC)
- **Analysis:** ISI in MC is influenced by code width (In Fig.2 waves on the left have more interference)
- *Step1:* Using received signal strength to estimate distance between Rx and Tx
- *Step2:* Determine a suitable code width (Above the dashed line in Fig. 1) according to the distance

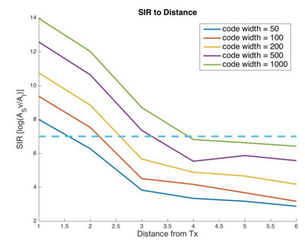



**Fig. 1 SIR to distance with different code width**

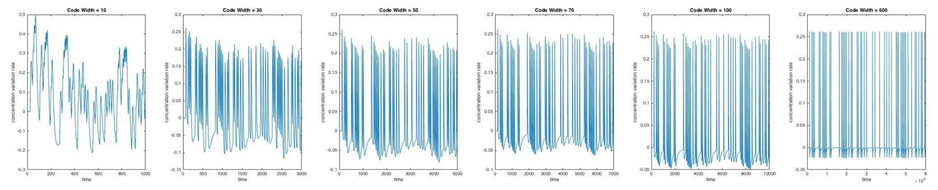



**Fig. 2 Signal waveform with different code width**

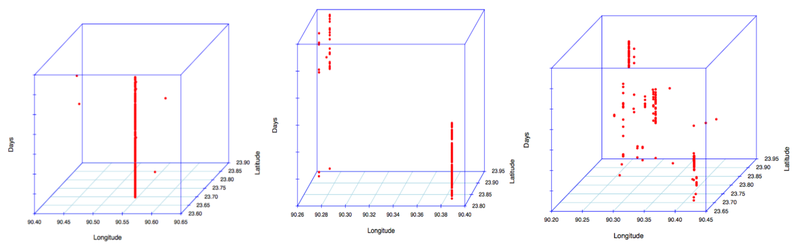
## Mining Long Term Mobility from Mobile Phone Data

**Objective:** Given mobile phone data in the form of call detailed records(CDR), our objective is to automatically discover users who change place of residence (home).

**Significance:** infer internal migration-useful for urban planning and business intelligence.

**Approach:** Spatio-temporal sequential clustering.

**Experiments with large scale CDR data**



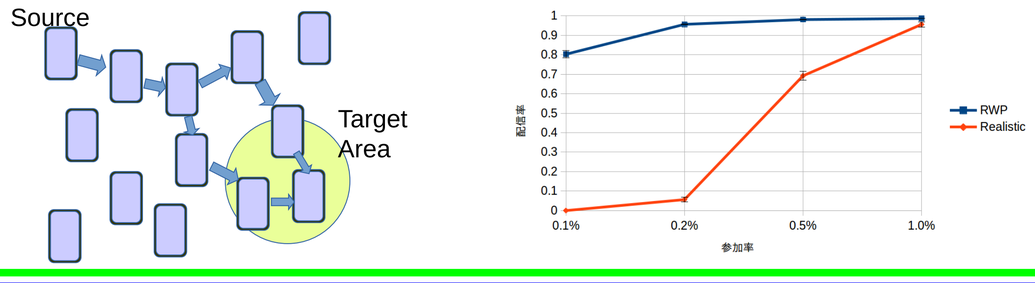

**Sample user trajectories based on 4-months CDRs depicting three typical mobility patterns: suggestive of no change of residence(left), suggestive of residence change (middle) and non-suggestive - irregular pattern (right).**

**Perfomance Indicators averaged over ε parameter**

| Category | Detection rate(%) | False Positive rate(%) |
|---|---|---|
| Case 1 | 70.8 | 19 |
| Case 2 | 67.9 | 14.2 |
| Case 3 | 71.7 | 14.6 |

## Geocast on Mobile Ad-hoc Networks

- Geocast on Mobile Ad-hoc Netwoks using smartphones is one way to send information when infrastructures are broken (e.g. big earthquakes).
- By simulations, delivery ratios are decrease when realistc mobility model is applied compared to artificial mobility model such as Random WayPoint.
- On the mobility model, required paticipants for enough delivery ratio is about 1%.



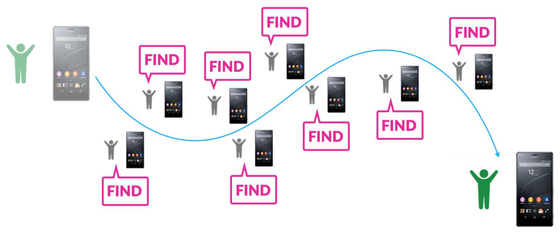

## Sensing of People Flow
## Using Short-Range Wireless Communication

We detect pedestrian flow by using Bluetooth inquiry in order to analyze people density of wide-range outdoor environment of urban city.
The subject walks around all roads of target area multiple times and records detected devices and the number of people passing by with his GPS data. We assume the model representing the correlation between the number of detected devices and people.

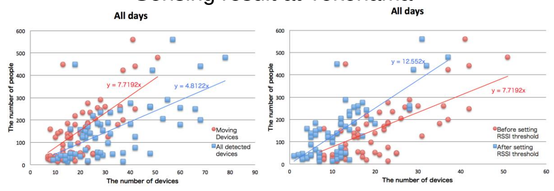
**The achievement of this study** is assuming the precise model which is used to know people density from the number of detected devices.

- Distinguishing pedestrians' devices from stationary devices
- Considering density of surrounding people by setting dynamic RSSI threshold

} improve the accuracy of the model




Sensing result at Yokohama




Before and after removing stationary devices

Before and after setting RSSI threshold

## Location Privacy Considering Time Variation of Population Density

Goal

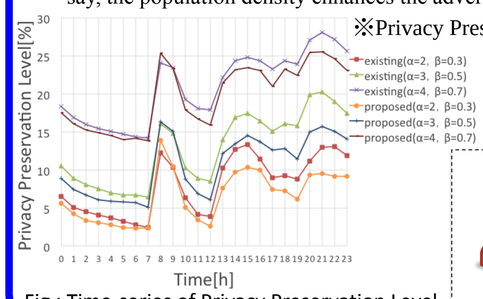
- We evaluate the effectiveness of the prior information derived from population density as an adversary's knowledge to the existing location privacy preservation methods.

Approach

- We use the existing framework to quantify the performance of location privacy preservation methods.
- We integrate a prior probability derived from population density into a probability distribution which the adversary uses to estimate user location.

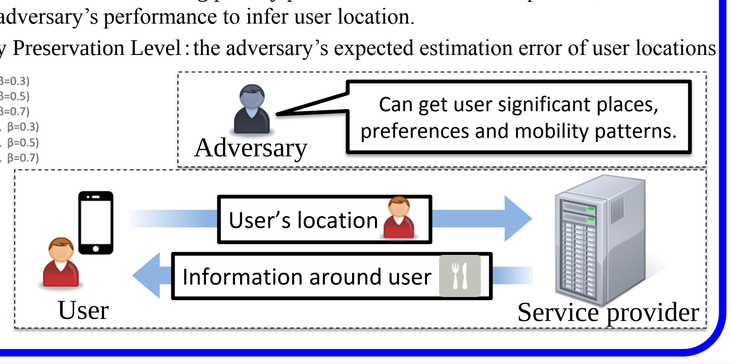
Evaluation

- We use distortion-metric which quantifies location privacy as the adversary's expected estimation error.
- We confirmed the location privacy preservation level of existing privacy preservation methods is depressed, that is to say, the population density enhances the adversary's performance to infer user location.




※Privacy Preservation Level : the adversary's expected estimation error of user locations

Fig : Time-series of Privacy Preservation Level




## Reconstruction Accuracy of Data Perturbation in Mobile Environmental Sensing

**Perturbation and Problem**

- Modifying data on a user side while allowing a server to reconstruct statistical information of original data.
- A server cannot calculate reconstruction accuracy.

**Proposal and Evaluation**

- Estimating reconstruction accuracy utilizing a spatiotemporal model of environmental variables (e.g., air quality).
- We evaluated our proposal assuming a sensing scenario where users sense carbon monoxide and apply negative surveys to sensor readings