CSIS

S E Z A K I   L A B

[Urban Sensing and Mobility Analysis]

Center for Spatial Information Science

Information and Communication Engineering

Socio-cultural Environmental Studies

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

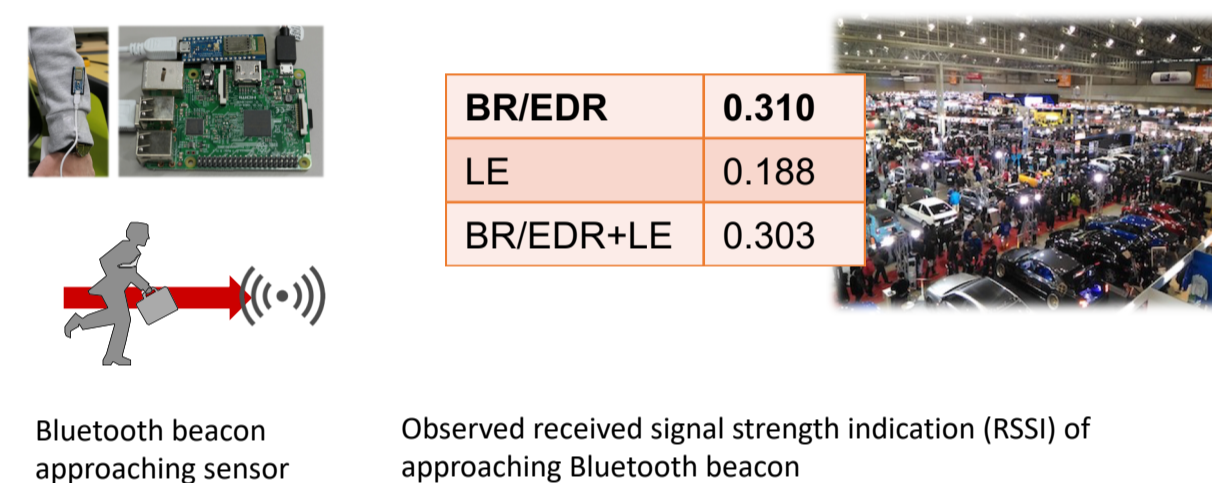## Capturing Human Mobility Using Bluetooth

Purpose
- Developing low-cost method to sense human mobility using Bluetooth

Technologies
- Congestion sensing by detecting Bluetooth devices
- Direction detection by observing transition of signal strength of Bluetooth Low Energy beacon

Applications
- Managing and reducing congestion of indoor facilities
- Understanding human mobility in disaster to support evacuation

Relationship between number of counted people and number of detected Bluetooth device at Makuhari Messe

BR/EDR	0.310
LE	0.188
BR/EDR+LE	0.303

Bluetooth beacon approaching sensor

Observed received signal strength indication (RSSI) of approaching Bluetooth beacon

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Diffusive-DNA-Based Molecular Communication

Tx   Modulating Signal   Propagation Carrier   Rx

Conventional Communication

Diffusion-based *Molecular Communication*

Diffusive-DNA-based Molecular Communication

To Nano Scale
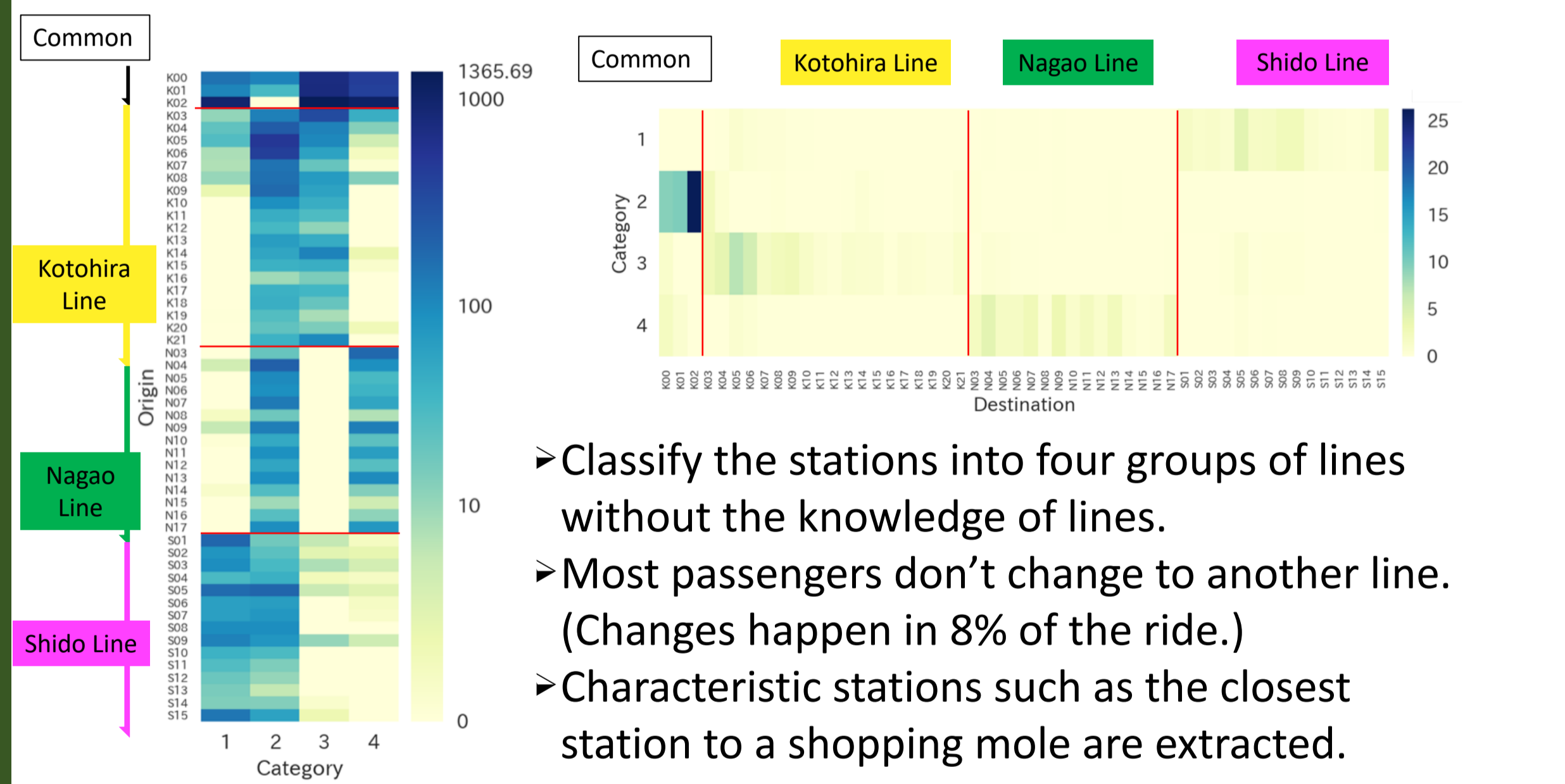
Higher Channel Capacity

DNA Diffusivity
$$D_l = 490 \mu m^2 / s \cdot [l(\text{bp})]^{-0.72}$$

Hit probability
$$f_{hit}(t) = \frac{r}{d_c} \frac{1}{\sqrt{4\pi D_l t}} \frac{d_c - r}{t} \exp\left[-\frac{(d_c - r)^2}{4 D_l t}\right]$$


Understanding Urban Mobility Using Smart Card Data

Grasp the patterns of passengers' movement in Kotoden by using Non-negative Matrix and Tensor Factorizations (NMF, NTF).

- Classify the stations into four groups of lines without the knowledge of lines.
- Most passengers don't change to another line. (Changes happen in 8% of the ride.)
- Characteristic stations such as the closest station to a shopping mole are extracted.

Nature Environment Monitor Research Using LPWAN

A study on the location information of a zone where it is difficult for people to step on continuously. Animals do sensing in place of people. Research on location information for natural environment monitoring
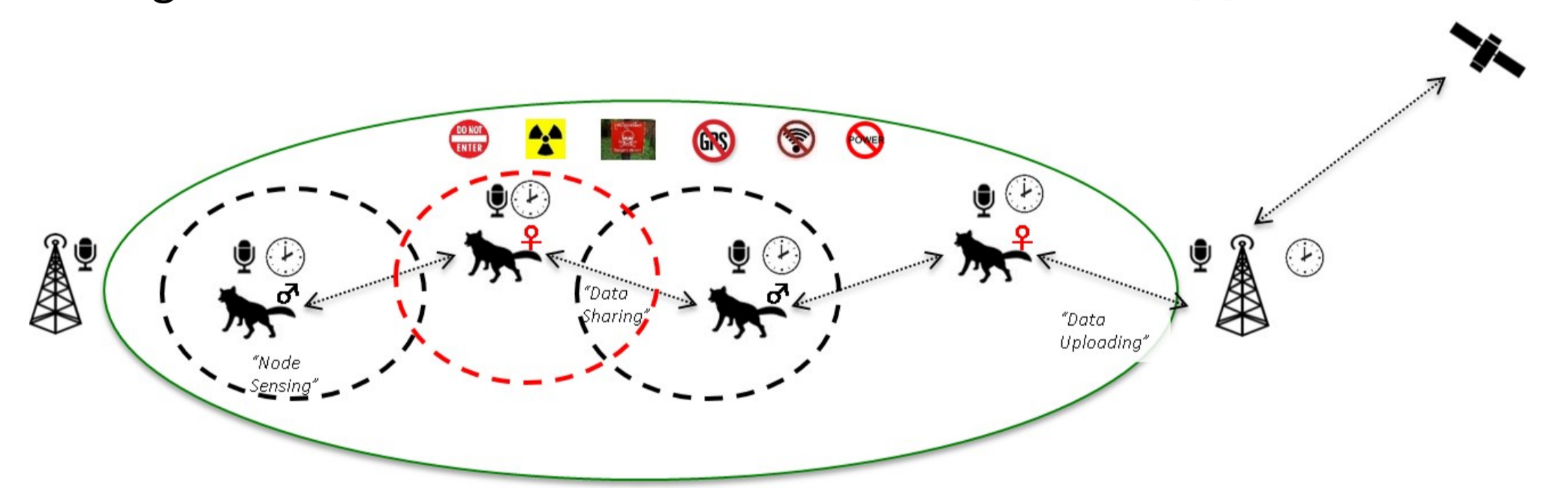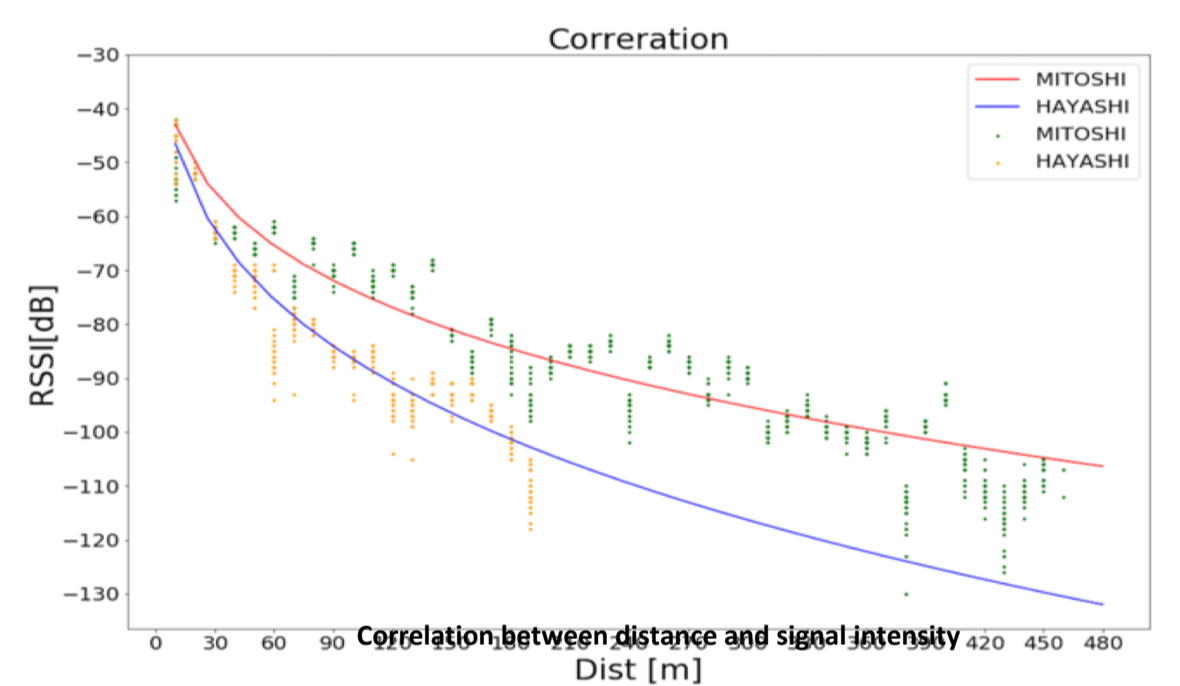

Estimating Reconstruction Accuracy of Data Perturbation in Mobile Sensing

Data Perturbation
- A technique to protect privacy by randomizing observed sensor values by each user before sending to a server. The server restore only statistical information from a collection of randomized sensor data.

Proposal and Experiment
- Estimate reconstruction accuracy assuming spatiotemporal correlation of the original data.
- Did an field experiment of mobile environmental sensing in Shibuya, and evaluated the proposal.
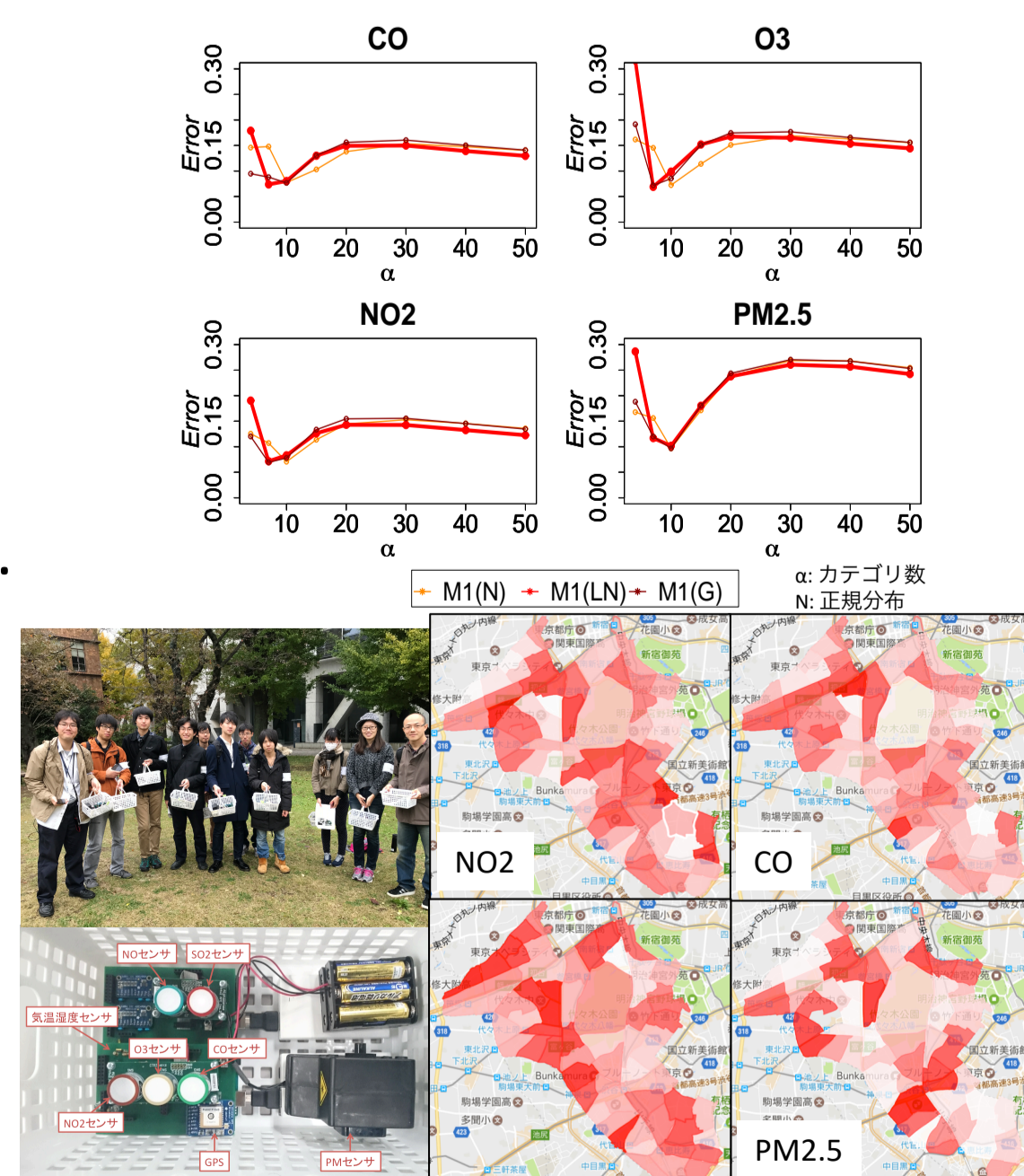
Relay Virtual Reality Networks

Users in virtual reality (VR) playgrounds wear wireless head mounted displays that use millimeter wave technology for communication. Reachability is significantly improved when these VR headsets are equipped with relaying capability. We proposed stable and fair algorithms for relaying between users and a single access point.

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