Y. Honma LAB.

[Design of Future Social Systems]

Center for Social Complex Systems

Urban Environmental Mathematical Engineering

Department of Architecture

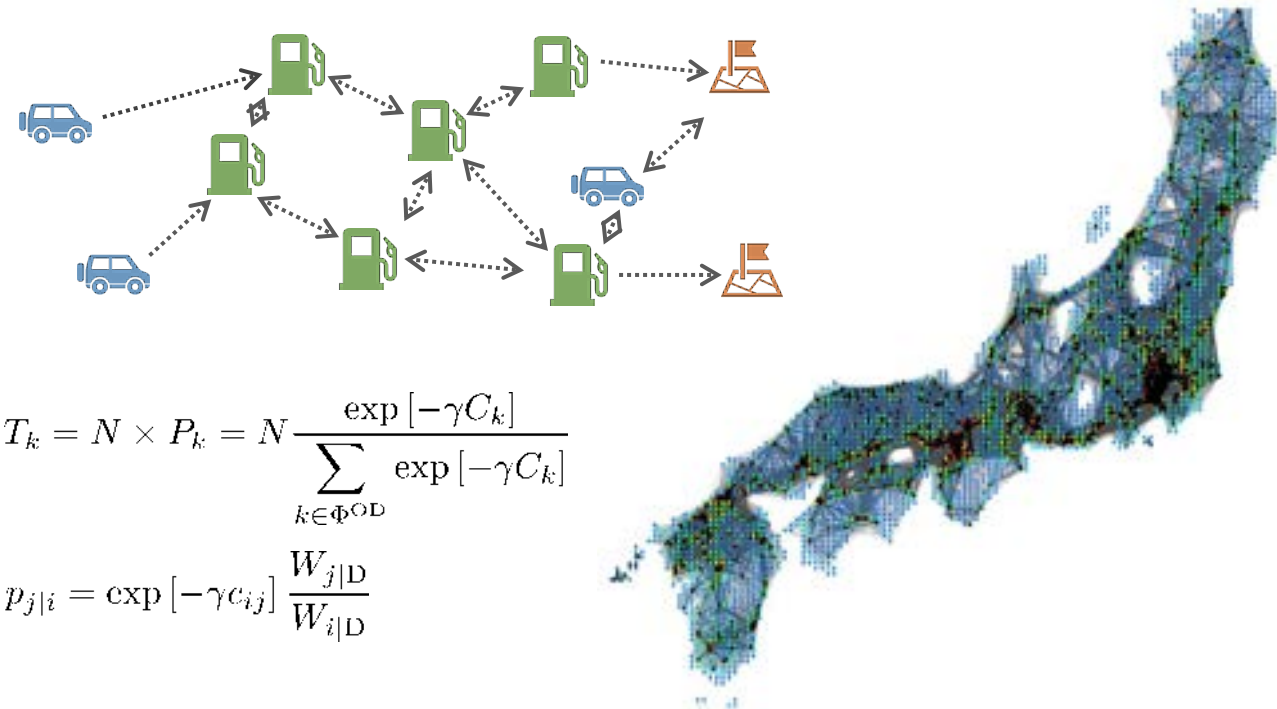https://www.honma-lab.iis.u-tokyo.ac.jp/

Design of Future Social Systems

Mathematical Engineering for Sustainable Society

Due to globalization in recent years, the cities in which we live and work have become more complex. In this laboratory, we are developing "visualization of essential features" using mathematical models and "mathematical techniques for designing social systems" based on them, so that rapidly changing social systems can develop sustainably.

Infrastructure Vision for Alternative Fuel Society

Infrastructure for Alternative fuel vehicles, such as electric vehicles, is essential for their widespread adoption. In this study, we propose a spatio-temporal strategy based on the best mix of multiple infrastructures, using GIS data.

$T_k = N \times P_k = N \dfrac{\exp[-\gamma C_k]}{\sum_{k \in \Phi^{(u)}} \exp[-\gamma C_k]}$

$p_{jji} = \exp[-\gamma c_{ij}] \dfrac{W_{j|\mathrm{D}}}{W_{i|\mathrm{D}}}$

Large-scale, High-precision Composite Shadow Analysis

4km   150m

The shadows cast by high-rise buildings, can sometimes be over 1 km long and affect a wide area. In this study, a system with more than 4,000 building data and 160,000 candidate points is implemented to analyze composite shadows.

Optimal Location of Roadside Stations for Various Users

$\min \sum_{i \in I} \sum_{k \in K} w_i l_{ik} x_{ik}^2$

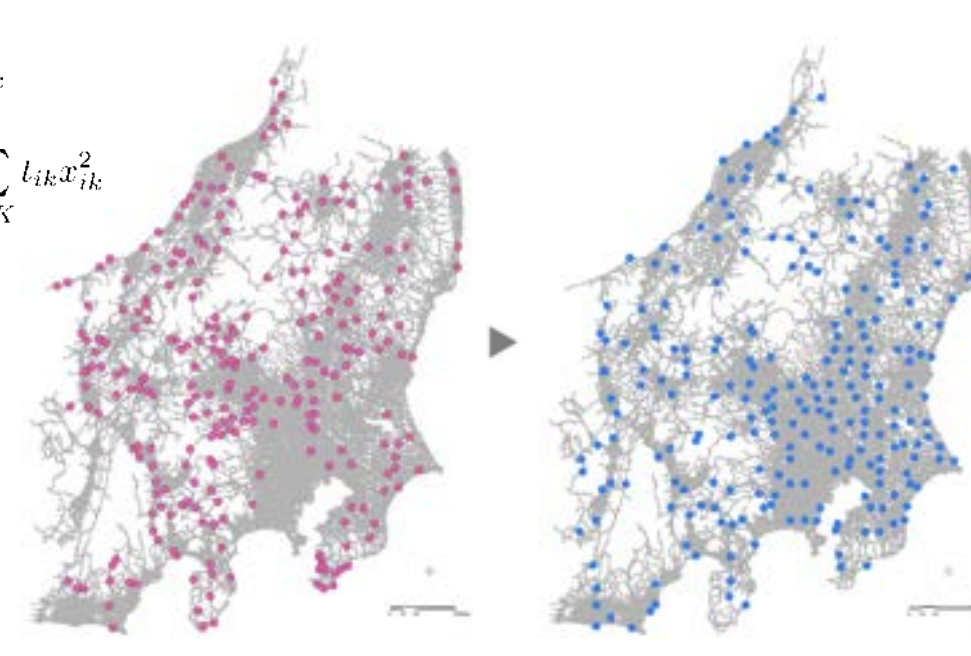s.t. $\sum_{k \in K} t_{ik} x_{ik}^1 \leq \sum_{k \in K} l_{ik} x_{ik}^2$

$\sum_{i \in I} x_{ik}^1 = 1$
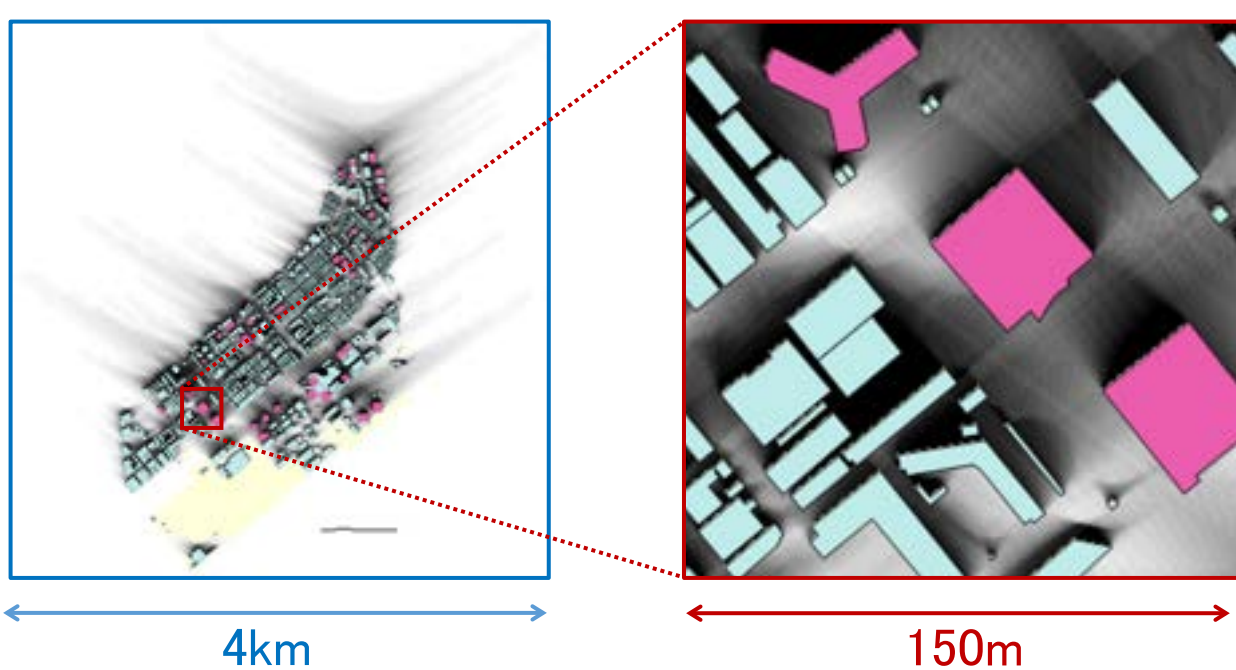
$\sum_{i \in I} x_{ik}^2 = 1$

$z_k \geq x_{ik}^1$

$z_k \geq x_{ik}^2$

$\sum_{k \in K} z_k = p$

Roadside Stations are expected to serve as hubs for wide-area transportation, local residents, and disaster prevention. This study analyzes the optimal locations of such facilities based on a multi-objective optimization method.
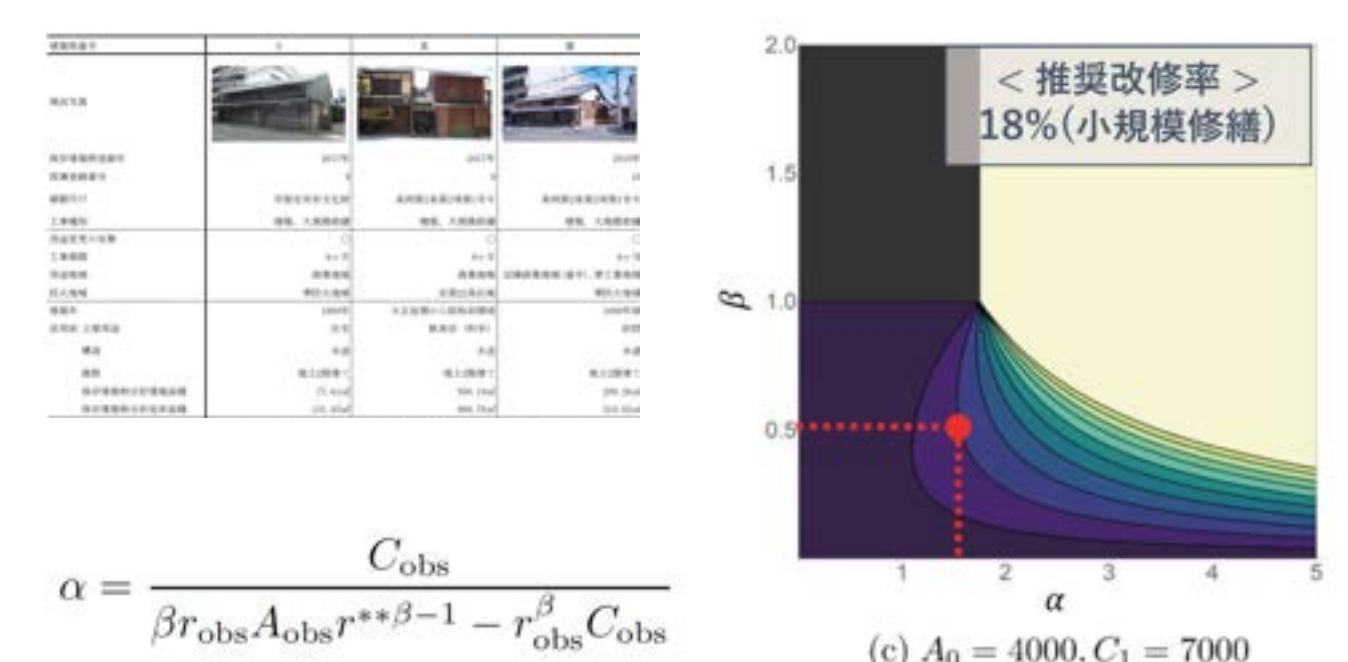
Rational Scheme for Historic Building Preservation

In order for historic buildings to be preserved sustainably, their economic rationale is important. In this study, we combine detailed interviews with mathematical technique to identify their common parameters and design preservation schemes.
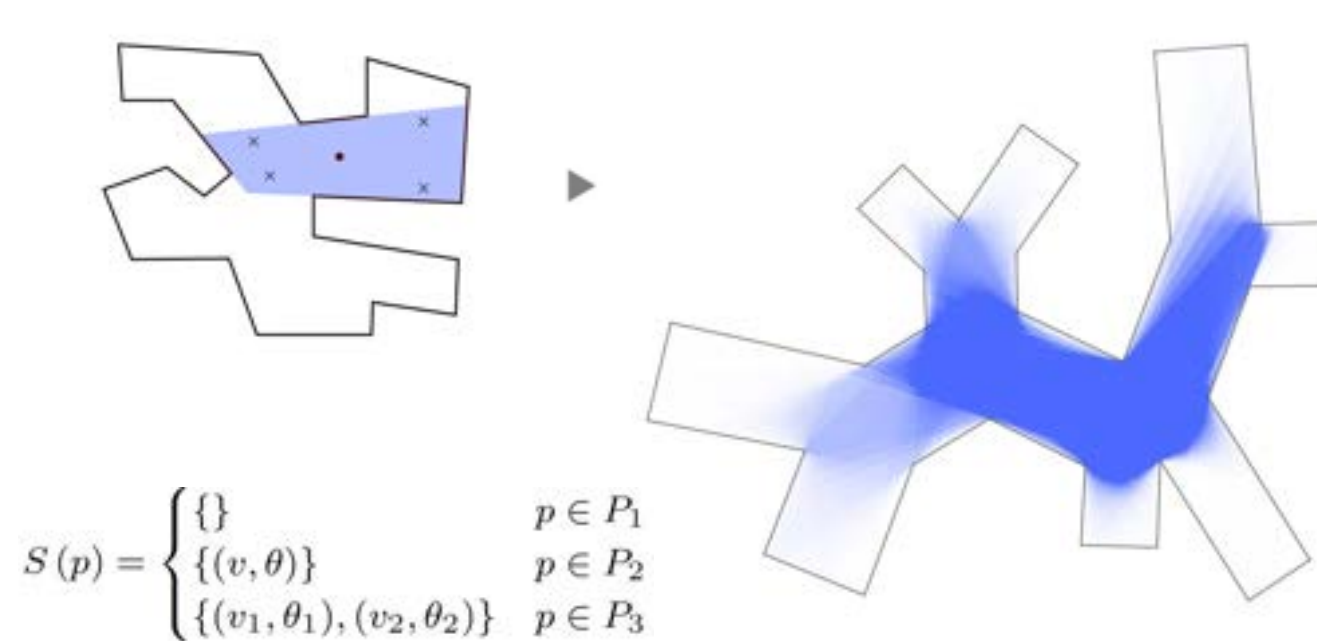
$\alpha = \dfrac{C_{\mathrm{obs}}}{\beta r_{\mathrm{obs}} A_{\mathrm{obs}} r^{**\beta-1} - r_{\mathrm{obs}}^\beta C_{\mathrm{obs}}}$

< 推奨改修率 > 18%(小規模修繕)

(c) $A_0 = 4000, C_1 = 7000$

Urban

◄ Simulation

Mathematical Modelling

Optimization ►

Human

Visualization of Public Space by Enumerating Convex Space

$S(p) = \begin{cases} \{\} & p \in P_1 \\ \{(v, \theta)\} & p \in P_2 \\ \{(v_1, \theta_1), (v_2, \theta_2)\} & p \in P_3 \end{cases}$

A sense of unity is an important element in public space. In this research, we have developed a mathematical technique to enumerate convex spaces and visualize the gradation of public vs. private spaces.

Appreciator's Positions in Architectural Space

In architectural spaces such as museums, people stand at a good distance from each other. In this research, based on the visibility relationship between people and people, the optimal positions are analyzed to evaluate spaces.

not recognized

recognized

$\max \ N(\{x_i\}) = \sum_{i \in I} x_i$

s.t. $D(\{x_i\}) = \sum_{i \in I} \sum_{j \in I} r_{ij} \cdot x_i x_j = 0$

$x_i \in \{0,1\} \quad \forall i \in I$
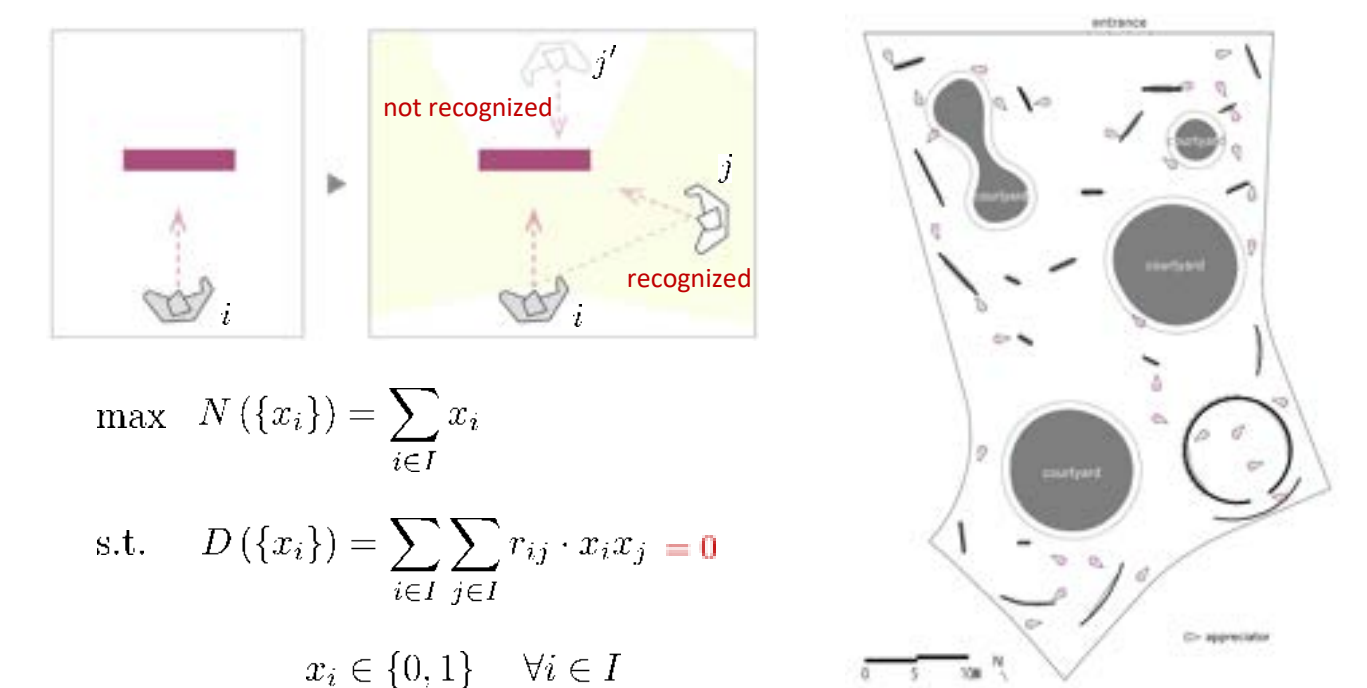
Learning Video Materials Produced with Japan Airlines

In a social system that involves many people, it is important to strike a balance. To tell such importance, we have released learning video materials for high school students on the theme of "Air Route Design" in cooperation with JAL and ONG.

ベストな航空路線を
作ってみよう！
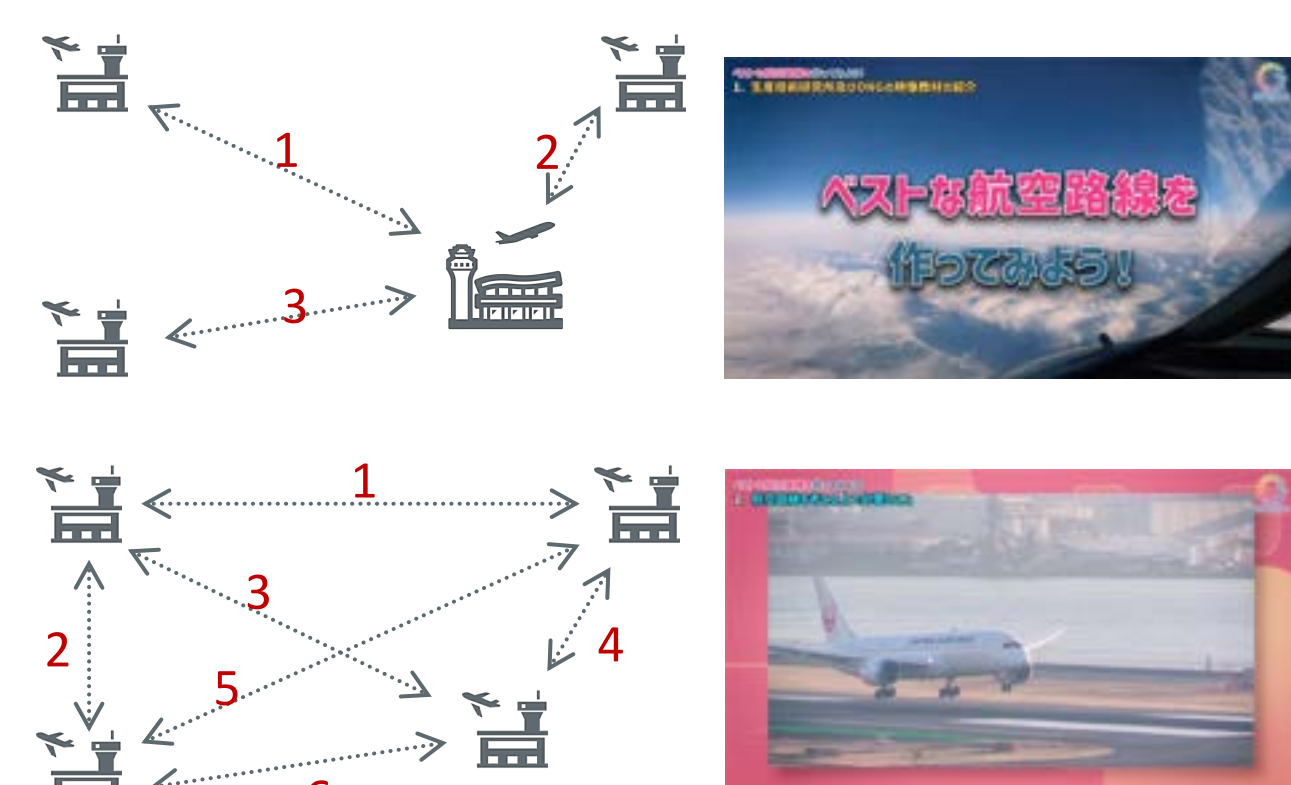
Trend Analysis Using Collection Photo Data

Tops
:sleeveless
:brilliant-red

Items
:hand bag
:leather

Collections presented by famous brands are important information to know the latest trends. we are analyzing the trends from a vast amount of collection photos in collaboration with Fashion Press, one of the most popular web sites in Japan.