GRLによる駐車場を起終点とする歩行者回遊の分析

Analysis of Pedestrian Activity Starting and Ending at Parking Lots by GRL

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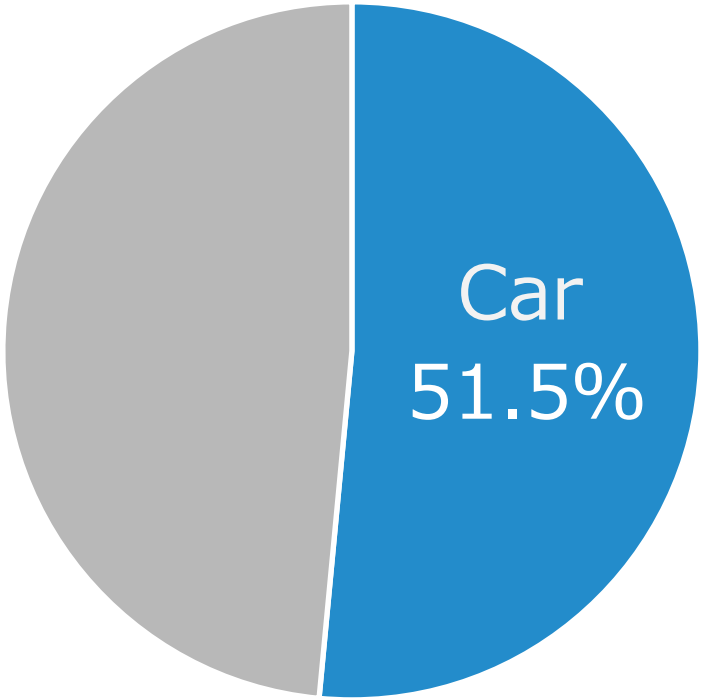
Introduction

地方での車の分担率の高さ
How large percentage of people in the countryside use their own car

Car share in **Matsuyama**
(2007 PP survey)



Car share in **Yokohama**
(2009 PP survey)

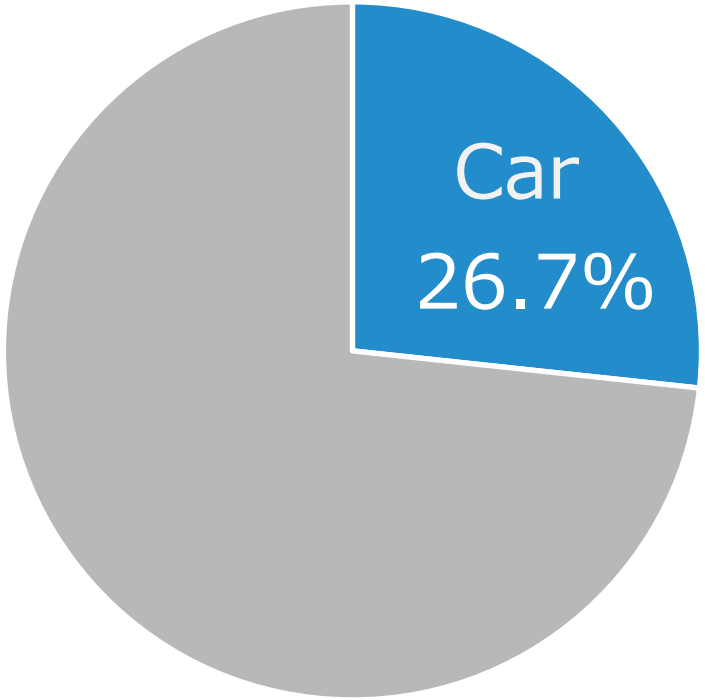


Fig.1:Car share among all the trips

Introduction

まちなかに散乱する駐車場
Parking Madness

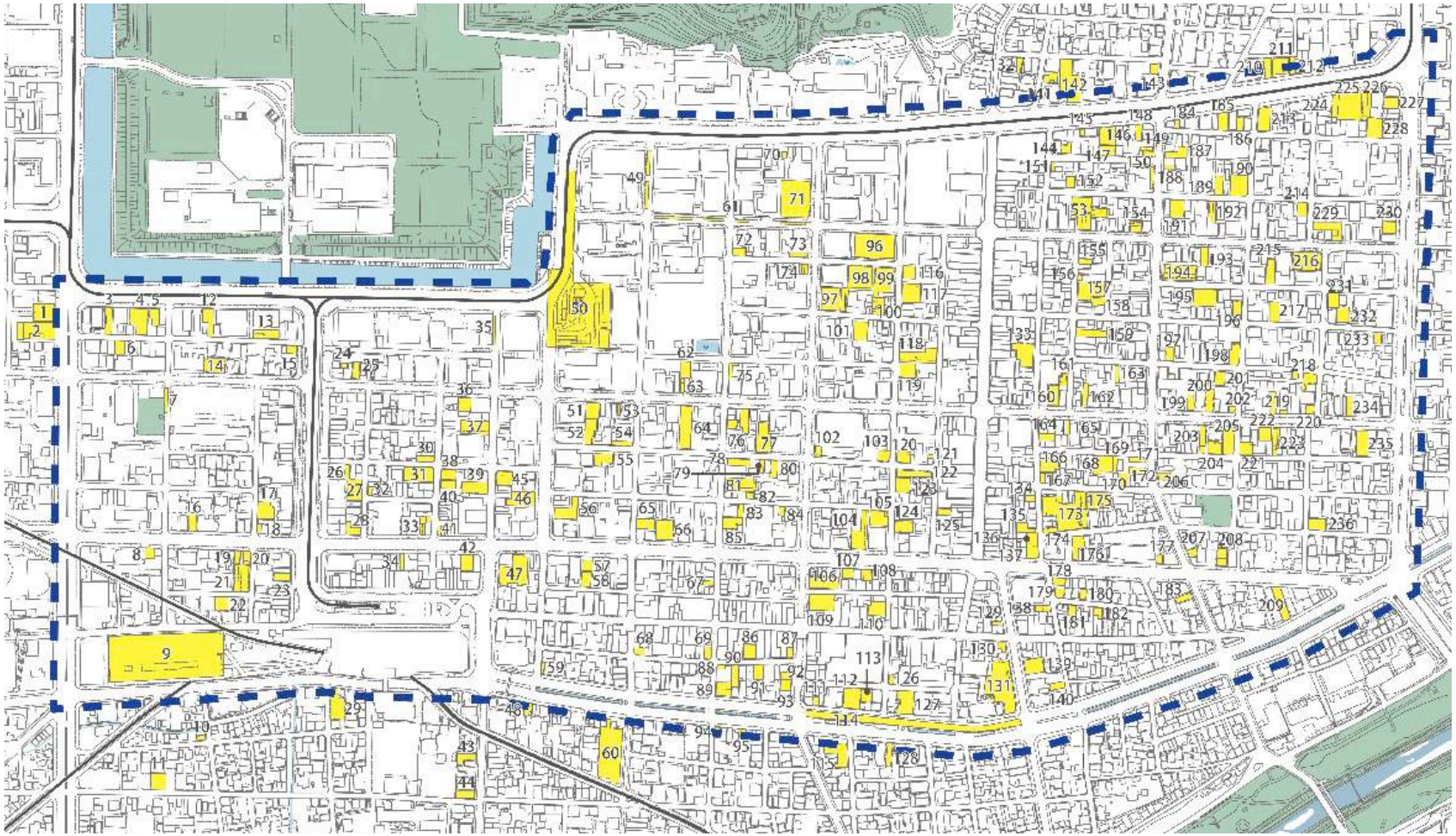
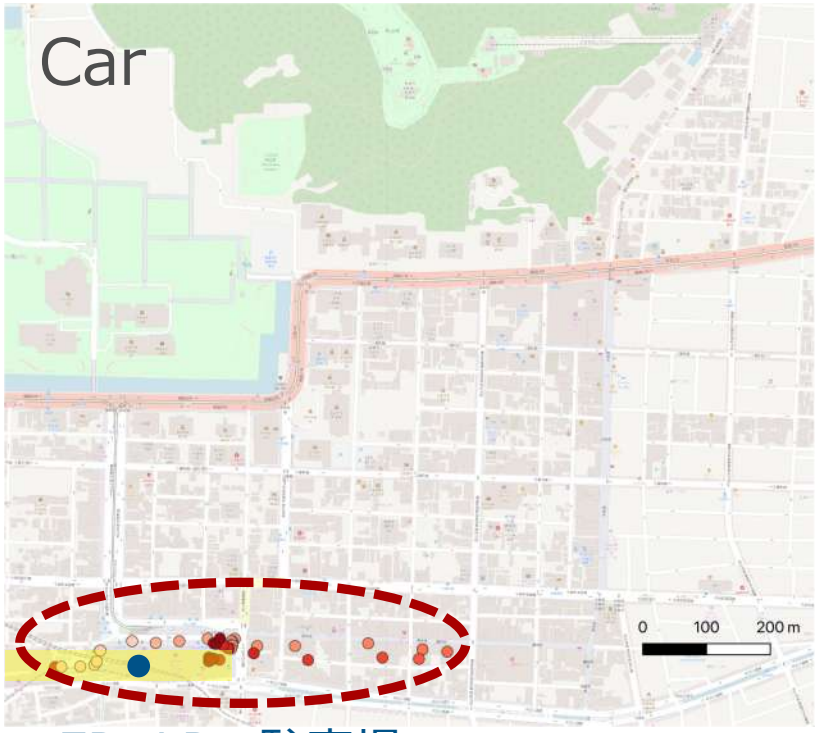


Fig.2: Location of parking lots around Matsuyama City Sta.

Introduction

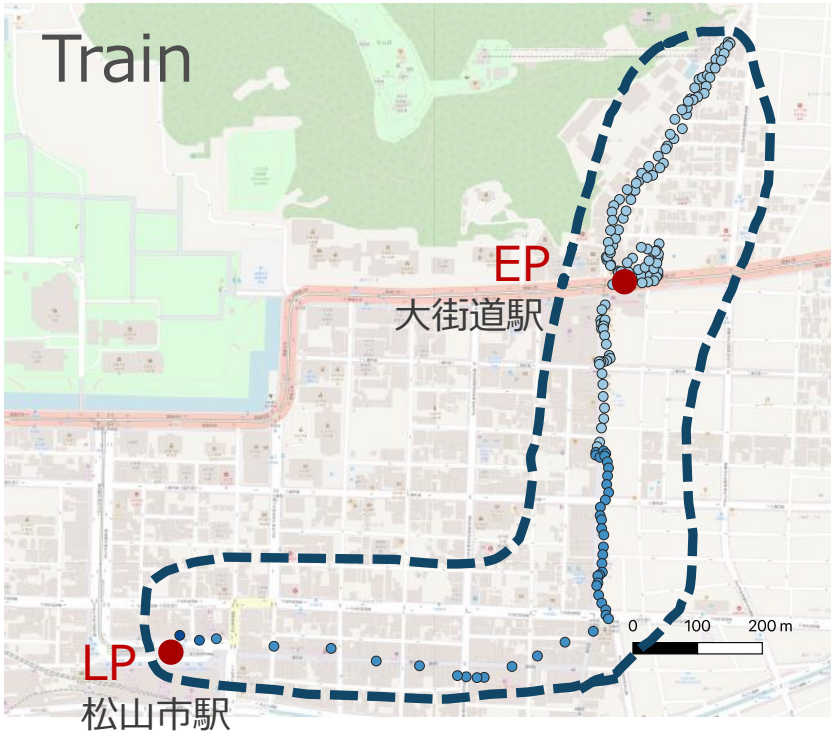
駐車場の位置が回遊範囲を狭める(**EP=LP問題**)

Location of parking lots restricts the area people walk around



車で訪れた人の回遊範囲

Area a person who came by car walk around



鉄道で訪れた人の回遊範囲

Area a person who came by train walk around

Fig.3: Illustrations of the walking area by different modal modes

Purpose

駐車場配置がまちなか回遊行動に与える影響の評価
Effect evaluation of parking lot arrangement on shop-around behaviors in city center

自動運転や乗り捨て型カーシェアリングの発展で
回遊の範囲はどう変わるか
How will the strolling area change due to the development of autonomous cars and one-way car-sharing?

Formulation

GRLモデル(Generalized Recursive Logit Model) Oyama, Hato (2016)

$$v(a_{j+1}|a_j) = \theta_{LD} \cdot LD + \theta_{NS} \cdot NS + \theta_{PD} \cdot PD$$

Link Distance　Number of Shops　Distance from Parking

$$V^d(a_j) = \mathrm{E}\left[\max_{a_{j+1} \in A(a_j)} \{v(a_{j+1}|a_j) + \beta V^d(a_{j+1}) + \mu\varepsilon(a_j)\}\right], \forall a_j \in A$$

$$P^d(a_{j+1}|a_j) = \frac{e^{\frac{1}{\mu}\{v(a_{j+1}|a_j)+\beta V^d(a_{j+1})\}}}{\sum_{a_{j+1} \in A(a_j)} e^{\frac{1}{\mu}\{v(a_{j+1}|a_j)+\beta V^d(a_{j+1})\}}}$$

$$V^d(a_j) = \begin{cases} \mu \log \sum_{a_{j+1} \in A} e^{\frac{1}{\mu}\{v(a_{j+1}|a_j)+\beta V^d(a_{j+1})\}} & (a_{j+1} \neq d) \\ 0 & (a_{j+1} = d) \end{cases}$$

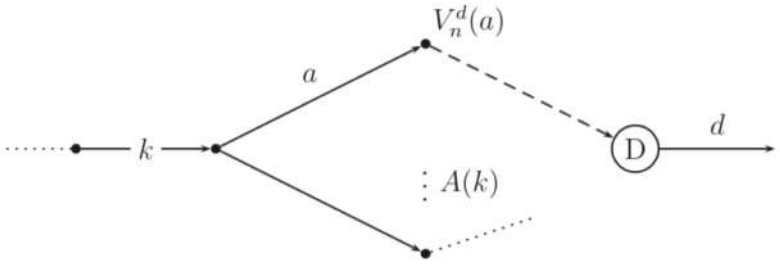


Fig. 1. Illustration of notation.

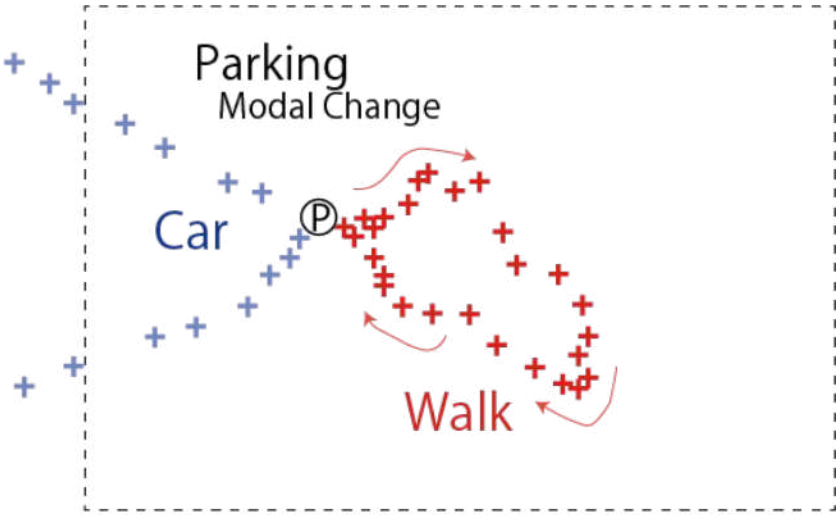
Fosgerau, M., Frejinger, E., Karlstrom, A. (2013).

Data

Network

Fig.4: 歩行者ネットワーク
Network for Walkers

Trip



City Center

Trip:84
Tour:31

▶ Map Matching to NW

Fig.5: 抽出したトリップ
Extracted Trips

Estimation Result

explanatory variables	Parameter	t-stat
link distance	-0.17	-0.88
number of shops	0.31	2.12 **
distance from parking	-0.61	-1.83 *
β -scale	8.7E-08	-0.012
L0	-95.6	
LL	-91.0	
Rho-square	0.048	
Adjusted Rho-square	0.0060	

*10% significant **5% significant

Fig.6 : Estimation Result

Assignment

Before: 現状の駐車場配置のとき(EP=LP)
When assigned to the network with current parking lots location

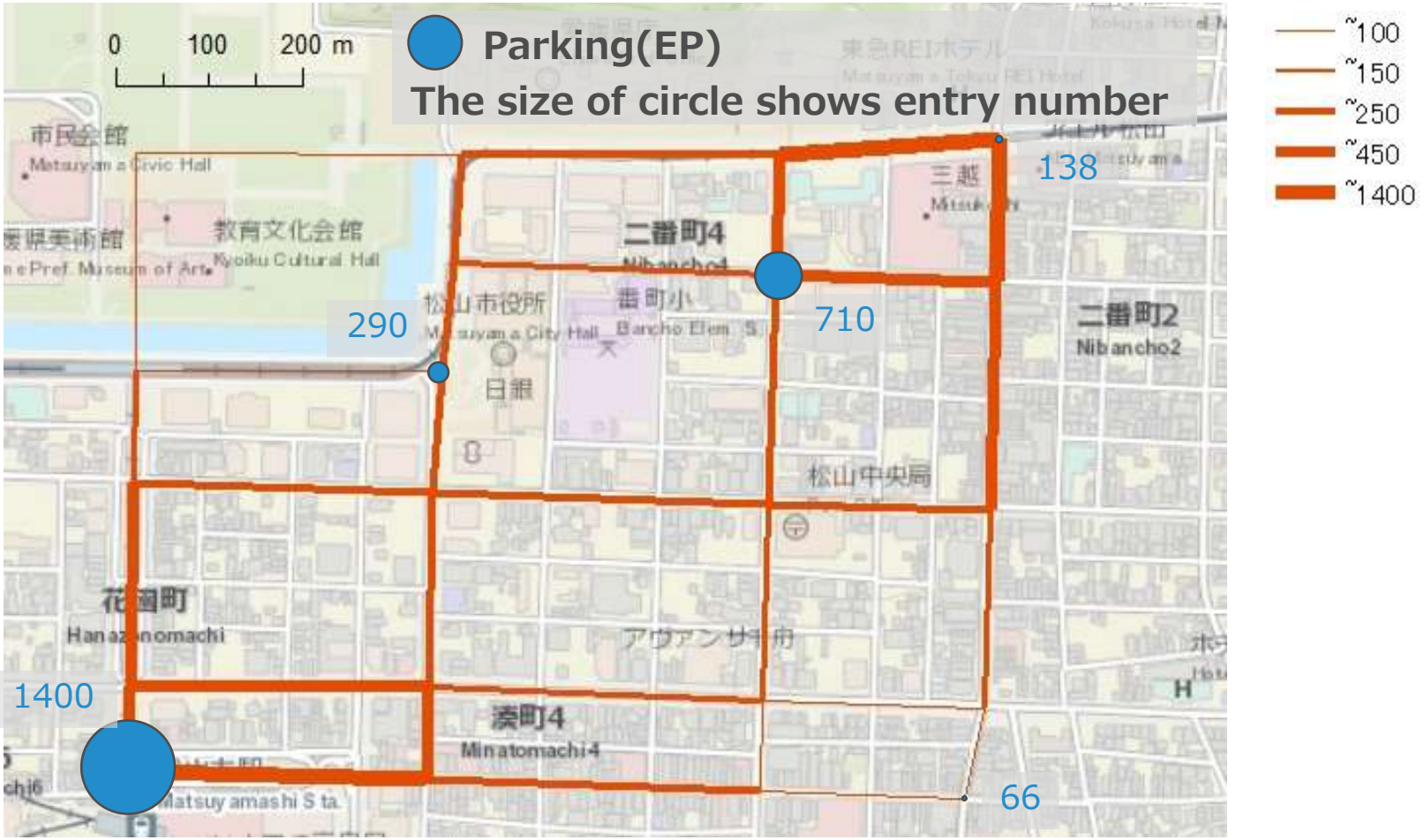


Fig.7 : Assignment Result (present parking lots location)

Simulation

After: 駐車場の容量を増やしたとき(EP=LP)
When a larger parking lot installed

Fig.8 : Assignment Result (when a larger parking lot installed)

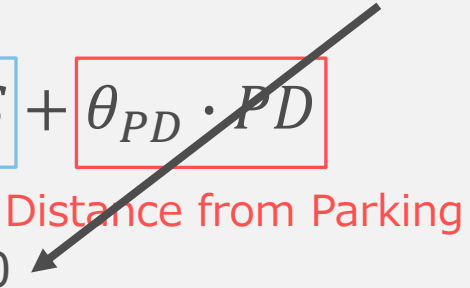
自動運転や乗り捨て型カーシェアの発展
Development of autonomous cars and one-way car-sharing

駐車場まで戻る必要がなくなったら？（EP≠LP）
What will happen if you need not come back to the entry parking lot?

Method

- 全ノードに同一吸収状態へのリンクを追加 ＝ LP-free
  To add links from all the nodes to the single sink dummy link (LP-free)

- $v(a_{j+1}|a_j) = \theta_{LD} \cdot LD + \theta_{NS} \cdot NS + \theta_{PD} \cdot PD$



Simulation

Before: 現状の駐車場配置のとき(**EP=LP**)
When assigned to the network with current parking lots location

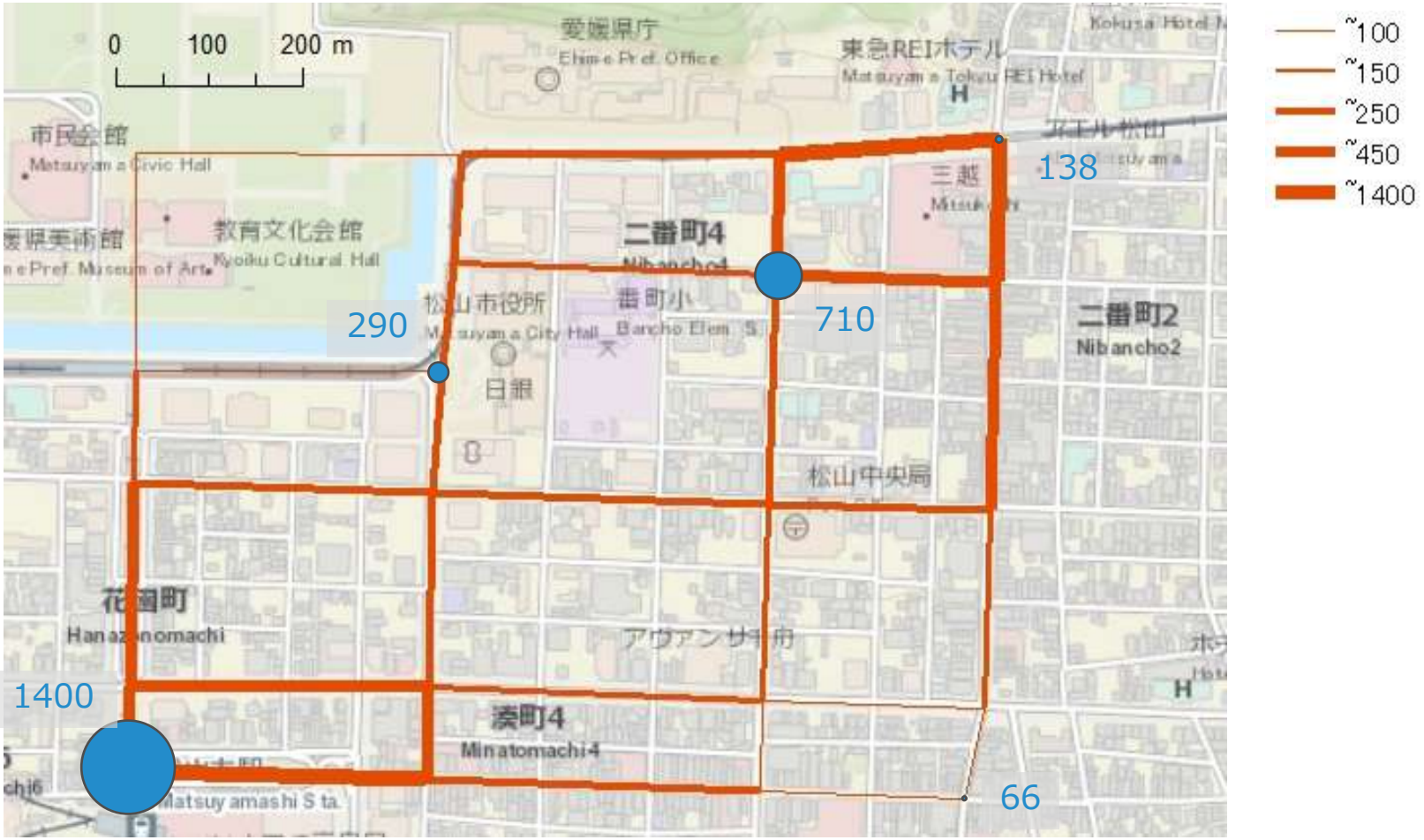


Fig.7 : Assignment Result (present parking lots location)

Simulation

After: 駐車場まで戻る必要がないとき(**EP≠LP**)
When you need not come back to the entry parking lot

Fig.10 : Assignment Result (when EP=LP restriction is removed)

Conclusion

- 駐車したところまで戻らなければならない制約は徒歩回遊範囲を狭める
  Restriction that people go back to the parking point narrow pedestrian activity area

- 駐車場は位置により徒歩回遊範囲を変えることができる
  By managing the location of parking lots, we can manipulate the pedestrian activity area

- 将来、駐車したところまで戻る必要がなくなると徒歩回遊範囲は大きく変わる
  In the future, if the restriction of going back to parking lots, the pedestrian walking area will be largely changed

Future Work

- 徒歩回遊行動をActivity Model として記述
  Formulating the pedestrian activity model using Activity Model

- 駐車場選択－その後の回遊行動を一体的にActivity Model として記述
  Formulating integrally the parking-choice and the following pedestrian activity using Activity Model