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Deep Learning Approach to Logistics Trips Generation: Enhancing Pseudo-PFlow* with Agent-Based Modeling

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Introduction

In this study, we propose a novel approach that combines the deep learning-based gravity model with the agent-based model to generate daily logistics trips. Our motivation is to use public and nationwide traffic census and statistics to augment the insufficient logistics trips in Pseudo People Flow (PFlow) data.

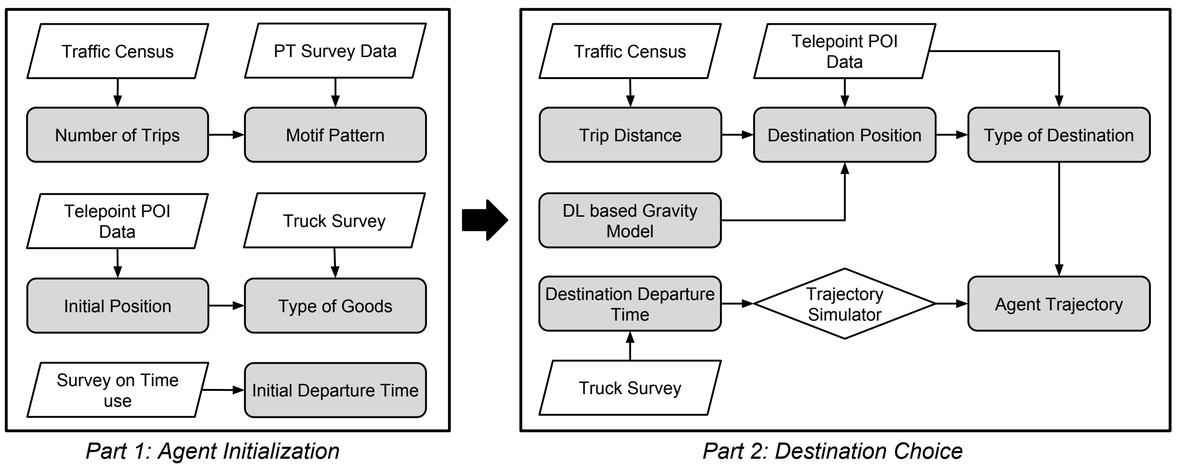

Fig. 1. Overall structure of this research.

Methodology

We introduce a deep learning-based gravity model to define destination choice strategies for logistics driver agents. Traffic census data and Zenrin POIs are as well assigned to define the restriction of agent's behavior.

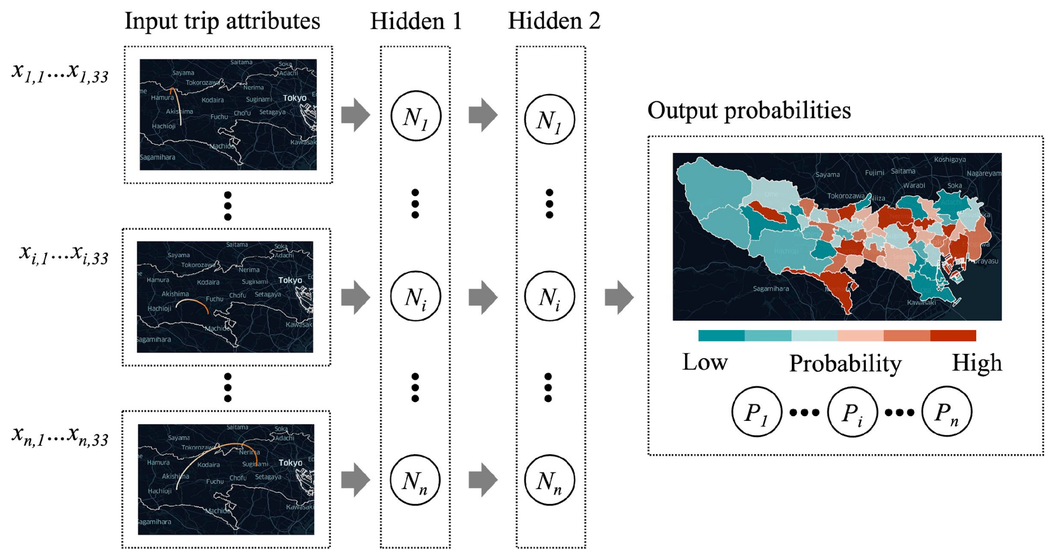

Fig. 2. Architecture of deep learning-based gravity model.

Result

The driver trips with business purposes in the PT survey are used to train the destination choice model. As shown in Figure 3, the deep learning-based gravity model achieves a high performance.

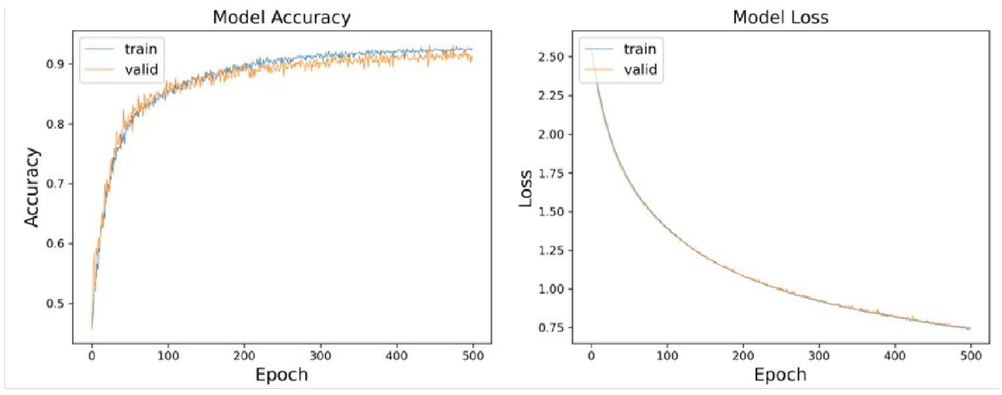

Fig. 3. Learning curve of DL based gravity model.

We compared the traffic volume of synthetic trips and pseudo-PFlow trips. Our model augments the lack of logistics trips by 74.92%, especially in the Tama area compared with original pseudo-PFlow business trips.

Fig. 4. Road network distribution of logistics traffic volume.

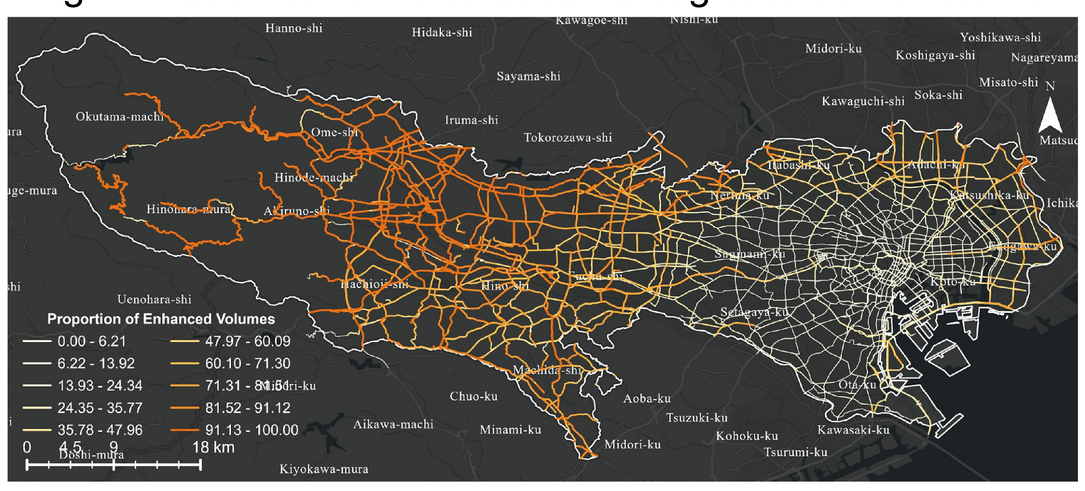

Fig. 5. Proportion of logistics volume in enhanced traffic volume.

We also conduct regression analysis with cross-section volume. The logistics trips have a good correlation coefficient with baseline data during the day.

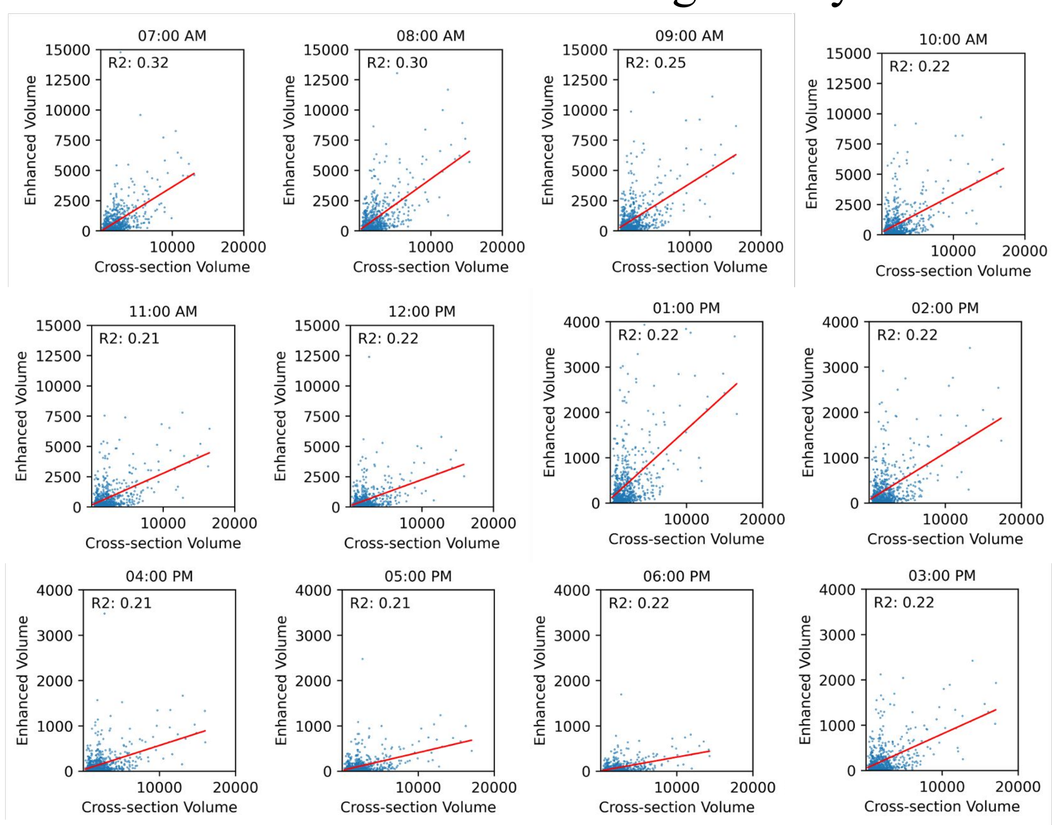

Fig. 6. Correlation between cross-section volume** and logistics volume in daily hour.

Conclusion

In summary, our model augmented 74.92% of the disparity between the traffic volume of baseline truck census and the pseudo-PFlow business trips, with an available correlation between 0.2 to 0.3 compared with cross-section volume.

* Pseudo People Flow is open data representing a person's daily behavior using only published statistical and GIS data.
** Cross-section traffic volume of road network collected by vehicle detectors is provided by Geospatial Platform.