

Master's Thesis of Qinghui Yu

Mentoring:

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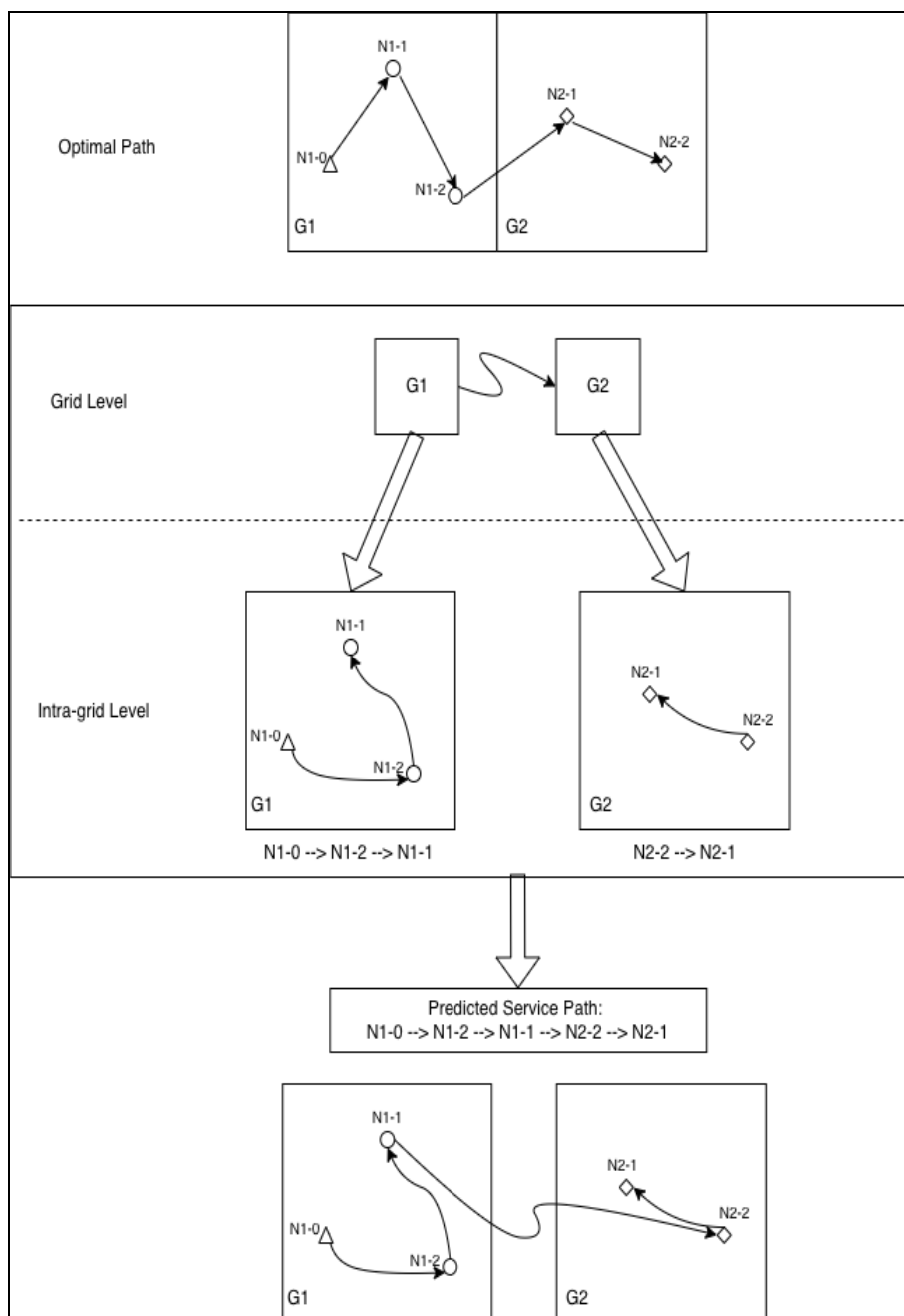
Introduction

With the rapid growth of meal delivery industry, online meal delivery platforms focus on improving delivery efficiency to meet the growing demand. There has been extensive research on traditional and meal delivery routing problems. However, in practice, couriers often deviate from the optimal service paths suggested by the platforms. research on how and why couriers deviate from the suggested paths, and methods for predicting real-world courier paths in meal delivery remains limited. This study investigates couriers' routing deviation behaviors using real-world data from Meituan to identify key influencing factors through data-driven analysis, and to propose a predictive framework to forecast couriers' actual service paths.

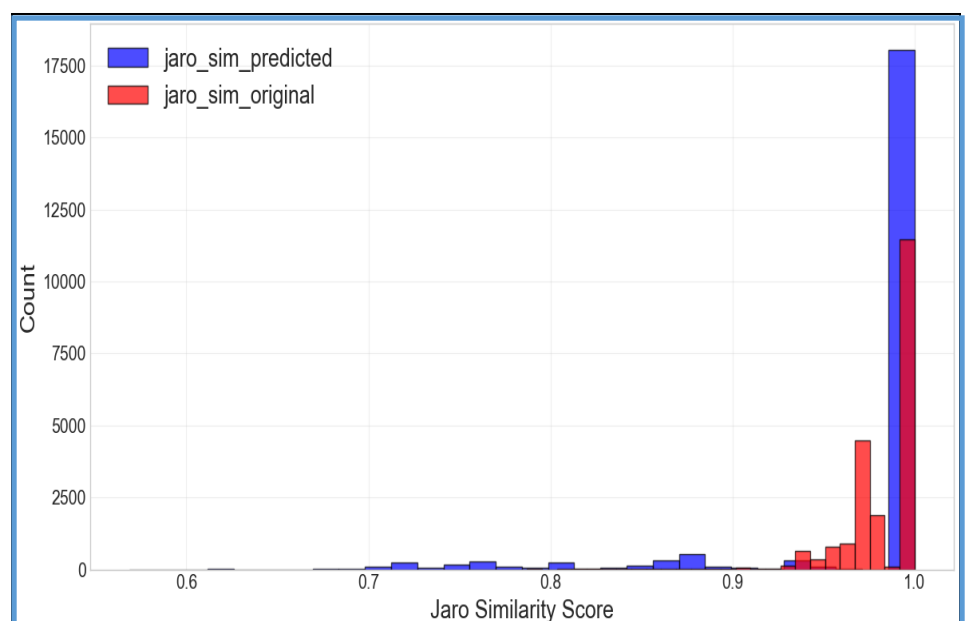
Deviation Metric and Methodology

A deviation can be defined as the difference between the optimal and actual delivery sequence executed by the courier. To quantify the deviation between the optimal service path generated by the optimization model and the actual service path taken by couriers, this study applies a deviation metric called Jaro similarity, which is used to quantify the similarity between two strings.

This study develops machine learning models to predict specific deviation metrics in grid level and in intra-grid level. Then, by combining results from the two-level prediction framework with a prior probability table constructed from historical delivery data, the optimal path is transformed into the most probable actual service path.



Methodology Overview of Courier Service Path Prediction



Most reconstructed paths have Jaro similarity >0.95 , showing high overall accuracy.

Reconstructed paths have a longer left tail and lower minimum, indicating some reconstructed paths deviate significantly.

Conclusion

The results show that route deviations are common but the actual service paths of most couriers are close to the system's suggested service paths. Deviations are mostly influenced by path complexity and district density. By proposing a two-level deviation prediction framework and a path reconstruction method, this study offers a novel perspective on predicting couriers' actual service paths. Future research can extend this work by incorporating richer external data, such as real-time traffic information, using more advanced learning models, and focusing on predicting the trajectories between stops to capture more behavioral pattern of couriers and to study more detailed trajectory patterns.