A Suitability Analysis of On-Demand Mobility Services Using the Example of Munich's Metropolitan Area

Master's Thesis of Kerimcan Ürel

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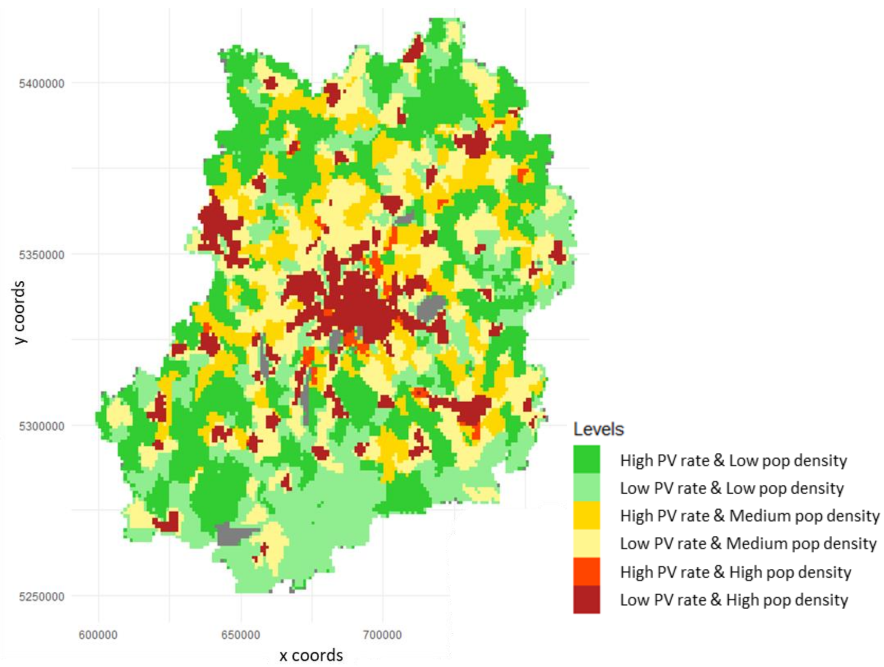

Fig. 1: Classified areas by 1x1 km grid cells

The selection of study areas was based on population density and vehicle ownership rates, which were used for categorization (Fig. 1). The aim was to identify areas with similar attributes, and for this purpose, the DBSCAN algorithm was used for clustering (Fig. 2).

In the study, both flexible and directional-band service types, commonly used in the Munich region, were simulated (Fig. 3). For the directional-band application, a timetable was involved, and corridor detection was performed based on predefined thresholds. The process aimed to achieve maximum demand coverage with minimum distance, and the areas included in the corridor were determined accordingly. An agent-based pooling simulation tool called FleetPy was employed as the simulation infrastructure.

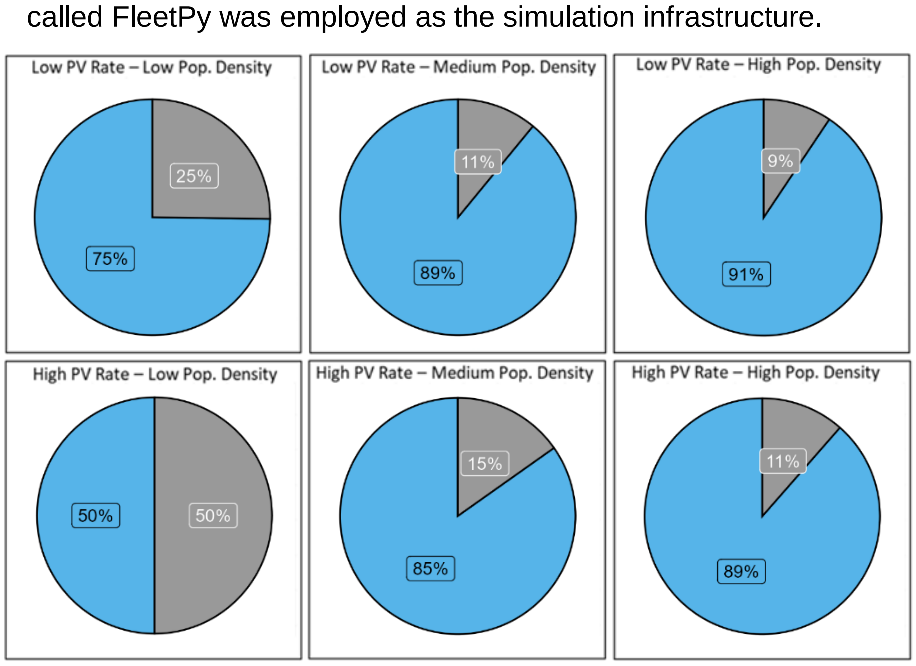

Fig. 4: Areal coverages of directional-band service and flexible service for each study area. Blue: Covered area by both services, Grey: Covered area by flexible service.

In contrast to urban spaces, rural areas cannot grab a high attention and investments due to lesser demand. In the 21st century, technology is revolutionizing transportation, and options like On-Demand-Mobility (ODM) are becoming operationally more applicable.

The objective of this study was to examine the suitability of various types of on-demand mobility services for areas with different spatiotemporal characteristics. The Munich metropolitan area was chosen as the study area. Thus, analyses and simulations were conducted in various regions within this area. To reach this goal; a correlation analysis was made to find the most effective characteristics, a pattern detection method was implemented to detect specific types of areas, and a list of performance indicators was used to compare simulation results of various scenarios.

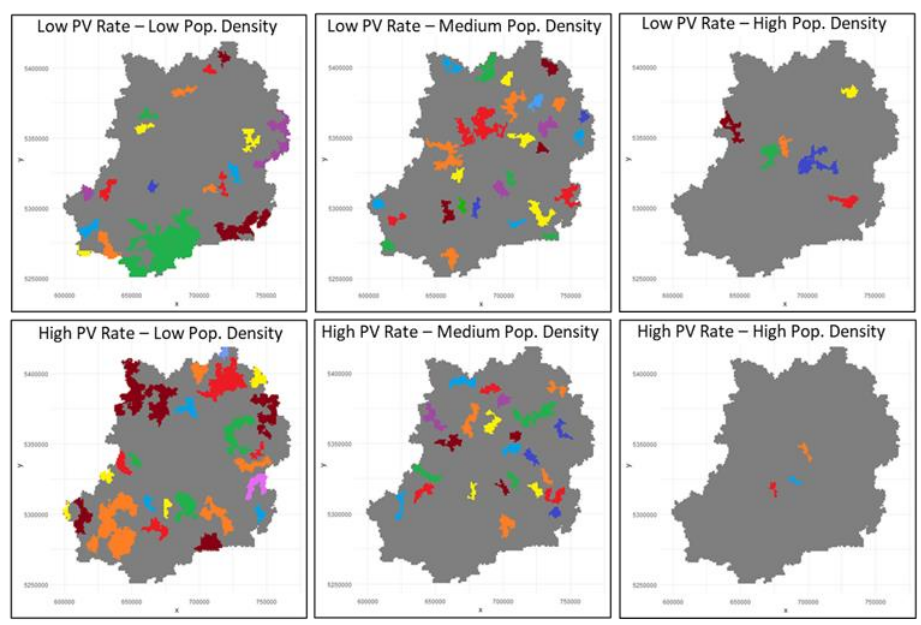

Fig. 2: Clustering results of grid cells in the study area by categories

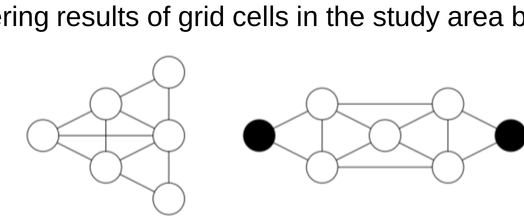

Fig. 3: Example schemas for flexible operation (left) and directional-band operation (right)

For simulation input, various demand sets were generated. In this process, the demand matrix of travel zones was disaggregated using land-uses and stop locations in the area. The simulation results were evaluated based on factors such as coverage (Fig. 4), performance, comfort, and pooling success.

As a result, in areas with low population density and sparse settlements, the flexible service type yielded more successful outcomes. As population density increased, the preference for the directional-band service type grew due to its increased coverage area. In various time intervals, both systems' capacities were found insufficient, particularly during peak hours when demand was high. A reverse correlation was observed between vehicle density and demand ratio in an area. Accordingly, areas with lower vehicle density among two regions with similar attributes generated higher demand.