"Technical Research and Development for Road Policy Quality Improvement" Study Summary

No.	Title	Principal Researcher
No.31-4	Research and development on new mobility services integrating autonomous driving and sharing, and their future society, cities and lifestyles	Kumamoto Gakuen Univ. Prof. Shoshi Mizokami

To realize the introduction of Autonomous Vehicle Sharing (AVS) services that integrate both Autonomous and Sharing technologies, this study aims to investigate the transformation of mobility services, society, cities and lifestyles when AVS services are implemented. Specifically, the following were carried out: 1) estimation of appropriate parking spaces in urban centers when AVS services are introduced; 2) development of a simulation model that enables prior evaluation of usage demand and effects; 3) implementation of a MaaS demonstration experiment and analysis of its effects; and 4) proposal of a design method for automated priority driving zones.

1. Backgrounds and Objects

Automatic Driving" and "Sharing" are key technologies supporting Society 5.0. To realize the introduction of Autonomous Vehicle Sharing (AVS) services that integrate both technologies, this study aims to investigate the transformation of mobility services, society, cities and lifestyles when AVS services are implemented. Specifically, the following were carried out: 1) estimation of appropriate parking spaces in urban centers when AVS services are introduced; 2) development of a simulation model that enables prior evaluation of usage demand and effects; 3) implementation of a MaaS demonstration experiment and analysis of its effects; and 4) proposal of a design method for automated priority driving zones.

2. Activities in Research Period

The tasks of this research are as follows.

(1) To analyze the findings and effects obtained from demonstration experiments on the introduction of ridesharing services and regional MaaS, and monitoring of actual operational services.

(2) To develop and apply a multi-agent mobility simulator in conjunction with external systems for demand forecasting and policy evaluation due to the introduction of MaaS and new mobility services.

(3) To develop method designing parking capacity in city centers and priority lanes for autonomous driving vehicles in the Level 4 by using macro-simulation models and mathematical models.

3. Study Results

The main activities in this research period are as follows.

(1) The usage characteristics and introduction effects of on-demand mobility services were analyzed using reservation log data and questionnaire survey data obtained from demonstration experiments and implemented operations in three different usage scenarios: mountainous areas, urban transit hubs and the entire local city. Based on these findings, recommendations were made on the requirements for implementing a Schering service and MaaS.

(2) The usability of the MAUMS&SAVS, which links a multi-agent traffic simulation model MAUMS (Multi-Agent Urban Mobility Simulator) with an optimal vehicle allocation system SAVS (Smart Access Vehicle System) was verified. Furthermore, in order to reduce the error of the predicted values obtained from MAUMS&SAVS, a method was developed to update the parameters of the modal conversion model interior to MAUMS using observation data.

(3) A mathematical model was constructed to plan the ODD (Operational Design Domain). The computational feasibility and applicability were verified by applying them to the Kumamoto urban area road network and checking the validity of the solutions. One is a spatio-temporal assignment model that predicts the share of SAVs and sets priority sections when sharing and autonomous driving services are integrated. The other is a model for designing the optimum exclusive lanes for automated vehicles under a given share of autonomous vehicles. For

the latter, the exclusive lanes for autonomous vehicles were set up in the MAUMS network to analyze their impact on road traffic flow.

4. Papers for Presentation

1) Ueno, K., Yae, R., Mizokami, S. (2021), Analysis on Preference for Public Transport Services Connected by Share Mobility, Journal of JSCE D3, Vol.76, No.5, pp. I_869-I_878.

2) Yae, R., Koga, H., Mizokami, S. (2021), Actual Condition of Moving and Parking Time of Vehicles, and Calculation of Appropriate Parking Capacity in the City Center, Journal of JSCE D3, Vol.77, No.1, pp.12-22.

3) Mori, K., Mizokami, S., Kanamori, R., Matsudate W. (2021), Evaluation of Introducing a Ride Sharing Taxi Service to Urban Area using Traffic Simulation Model, Journal of JSCE D3, Vol.76, No.5, pp. I-1321-I_1330.

4) Yae, R., Mori, K., Mizokami, S., Kanamori, R., Matsudate W. (2022), Model and Fact-Finding Analysis on Demand and Operation of Ride-Sharing Arao 'Omoyai Taxi', Vol.77, Journal of JSCE D3, No.5, pp. I_1023-I_1035.

5) Koga, H., Mizokami, S., Yae, R., (2022), Estimation of appropriate parking capacity based on actual conditions of moving and parking of vehicles, Journal of the Eastern Asia Society for Transportation Studies, Vol.14, pp.2456-2469.

6) Mori, K., Mizokami, S., Kanamori, R., Liu, Q., (2023), Developing an Agent-based Simulator Combining Mesoscopic Traffic Simulator with Dynamic Vehicle Allocation System to Evaluate a Ride-Sharing Service in Urban Area, International Journal of Intelligent Transportation Systems Research, pp.1-14.

5. Study Development and Future Issues

In order to achieve the initial objectives of predicting the demand and effects of the new mobility integrated ridesharing and autonomous driving technology, and to clarify their impact on urban structure and lifestyle behavior, the following research questions should be addressed in the future.

(1) Collect information on shared mobility services and MaaS social experiments conducted in various regions, and conduct a meta-analysis on the effects of their introduction.

(2) Apply MAUMS to sharing services in operation and confirm their practical feasibility.

(3) Development of models for setting up priority road sections and exclusive driving lanes for autonomous driving vehicles, considering the performance of the autonomous vehicles and the driving environment conditions in detail.

(4) Gathering citizens' opinions and understanding of social acceptability regarding cities, society and lifestyle behaviors that are likely to change as a result of the spread of autonomous vehicle sharing (AVS: Autonomous Vehicle Sharing).

6. Contribution to Road Policy Quality Improvement

Recommendations on issues and measures for MaaS implementation have been disseminated based on the results of the research not only in self-organized symposia on policy and technology for the implementation of MaaS, but also in committees and symposia organized by public organizations and in academic conferences. Principal investigator Mizokami has been appointed chairperson of the "Kyushu Academy ITS Mobility Study Group" of EMoBIA, which aims to match the needs of private companies and local authorities in the Kyushu region regarding MaaS and autonomous driving technology with academic seeds. Theoretical and empirical research is carried out with the aim of solving mobility problems and stimulating the economy in the region. The research findings are reflected in practice and contribute to improving the quality of road policy.

7. References, Websites, etc.

At present, no dedicated website has been set up. In the future, the performance, functions, and application examples of MAUMS will be made public so that it can be widely applied to the analysis of traffic flows and the evaluation of transport policies.