みらいを つくる つたえる まもる。
大阪工業大学
OSAKA INSTITUTE OF TECHNOLOGY

Research Topic	State Estimation based on Unscented Kalman Filter for Vehicle Nonlinear Dynamics	Graduate School of Engineering
Host University	National Taiwan University of Science and Technology / Taipei / Taiwan	Electrical, Electronic and Mechanical Engineering
Duration	From August 16 to September 17, 2019	NAKAMURA Wataru

Summary of the Research Activities

   In recent years, Model Predictive Control (MPC) method is widely applied to solving various control problems of autonomous vehicles. MPC is a well-established control method in which the current control input is obtained by solving an optimal control problem and this procedure is repeated at each sampling instant.

   In the previous study, MPC method was applied to solving the stabilization problem of vehicle dynamics (Fig. 1) to avoid collision accidents under the assumption that all state variables of the system are exactly known. However, it is usual that the state variables of systems are measured through output sensors, hence, only limited parts of them can be used for designing control inputs. Therefore, MPC method proposed in the previous study is inapplicable to the vehicle control system with limited measurable state variables.

   In order to apply the MPC method to the automatic control systems for nonlinear vehicle dynamics, we need to establish a state estimation method for vehicle systems with limited measurable state variables. Kalman filter is a well-known optimal estimation method which enables us to minimize estimation errors with taking the process noise and sensor noise into account. The application of the Kalman filter to nonlinear systems has been well investigated in recent decades.

   In this study, a state estimation method for nonlinear vehicle dynamics is established using unscented Kalman filter that uses a set of appropriately chosen weighted points to parameterize the means and covariances of probability distributions. The effectiveness of the proposed method is verified by numerical simulations (Fig. 2).
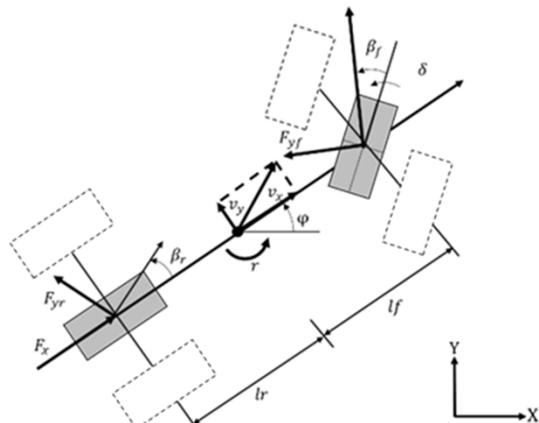

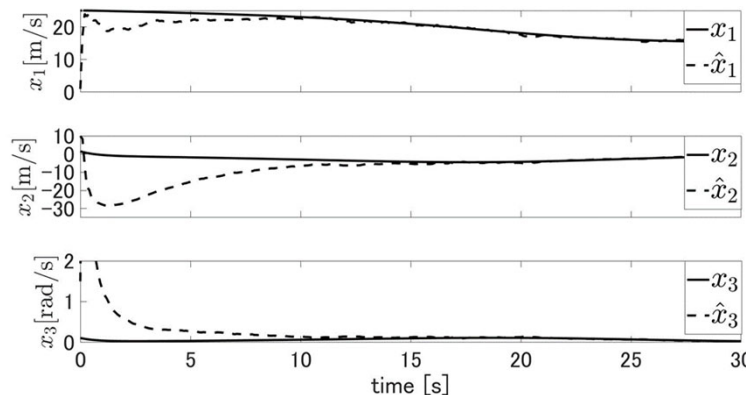
Fig. 1: Vehicle system model.

Fig. 2: Simulation results.

Living in Taiwan and College Life

   I stayed at a shared house where not only Taiwanese students but also international students live. I really enjoyed talking, cooking, sightseeing with them.

   All members in the lab I visited are very kind and interested in Japanese culture (Fig. 3). Especially, they are often excited to watch Japanese animes. I enjoyed a hike with lab members and Prof. Chen who supported my research project.

Fig. 3: Lab members

指導教員講評
海外での研究生活や異文化交流を通して，本学生にとって非常に有意義な経験を積むことができたと考えられる.

指導教員氏名：橋本　智昭