Laboratory / Center profile

Symbiotic System Design Laboratory

Representative: Professor Shoichi Sasaki

The Symbiotic System Design Laboratory studies hybridization of vehicles, such as automobiles.

1. Add-On Type Hybrid Drive System

We study compositions and effects of add-on hybrid drive system, which is a conventional gasoline engine vehicle with a motor attached to the dead axle. Normally, in case of automobiles, low-power is observed in many parts of the distribution of outputs and inputs that are needed to move vehicles. This idea of hybrid aims to improve fuel efficiency to the maximum by adding the smallest motor. With this technology, up to 30% of improvement in fuel efficiency is expected for inner-city driving.

2. Trailer Electrification

While it is known that electrification of logistics is beneficial for the environment, it is more difficult to electrify large-size vehicles than compact cars that are sold in the market, because the batteries have low energy density. Nevertheless, one could make the most out of expensive batteries by taking advantage of the fact that starting points, routes, and destinations are known for most logistics vehicles. Currently, we are exploring the possibility of combining it with engine generators and fuel cells.

3. Hybridization of Construction Machinery

We are studying the hybridization of construction machines, such as power shovels, which are used to excavate dirt and load it onto dump trucks, as well as crane vehicles, which are wheeled and used to hoist materials for the construction of buildings.

4. Hybridization of Small Aircrafts

Utilizing the advancing technologies of microminiaturizing electric motors and lightening batteries, we are studying the possibility of hybridizing small aircrafts. What we foresee to develop is the type of airplanes that take off from the top of a building and land on an empty lot with faster speed and longer range than helicopters.

Example of the application to conventional automobiles

Example of the application to logistics vehicles

Example of the application to construction machinery

Example of the application to aircrafts
(Picture from: www.toysoftimespast.com Ebay-seller belgianmonk)

Control Systems Design and Dynamics Laboratory

http://lab.sdm.keio.ac.jp/nismlab/ (in Japanese)

Representative: Professor Hidekazu Nishimura

Specialized Areas: designing driver assistance and control systems using driving simulators; controlling vehicle motions for micro-compact electronic vehicles; electric and electron architecture; system safety; model-based systems engineering (MBSE); SysML.

The Control Systems Design and Dynamics Laboratory aims to contribute to the development of products and services, to designing a control system, and to the system analysis. To that end, we collaborate with the Systems Engineering Center, the Mobility System Management Center, the Symbiotic System Design Laboratory (represented by Professor Shoichi Sasaki) and the Visual Simulation Laboratory (represented by Professor Tetsuro Ogi), as well as with external partners, such as private companies and associations.

Concerning our research on automobiles and mobility, we have developed a driving simulator (Figure 1) and a motorbike simulator (Figure 2). We are proposing a way to utilize these simulators to design driving assistance and a control system so as to help drivers and riders in the driving/riding process, thereby increasing car and road safety. What we call "Operator-in-the-Loop Design" utilizes driving simulators, which were traditionally used to verify and validate systems, from the stage of concepts and architecture setting. This control system can be interpreted as a system of systems, because operators, such as drivers and riders, exist in-between. Thus, it is crucial to take account of operators that are not the direct subject of the design when designing the control system.

Through joint research with the Visual Simulation Laboratory funded by Tokio Marine & Nichido Risk Consulting Co., Ltd., we are developing an immersive driving simulator, including the verification of its consistency with the experiments using actual cars, with a view to helping elderly drivers maintain their driving abilities. With the Symbiotic System Design Laboratory, on the other hand, we plan to conduct joint research about the hybridization of construction machinery at the Shin-Kawasaki Town Campus (K2 Town Campus).

In addition, we promote the utilization of SysML as a system modeling method and the dissemination of MBSE through our research on the development of hardware-software collaborative systems for consumer electronics, the service design for mobility systems (joint research with Professor Yoshiyuki Matsuoka of the Faculty of Science and Technology), and the design of sound based on the 1D CAE methodology.

As expressed in the phrase "a system of systems", we will soon be surrounded by social and technological systems that are becoming increasingly complex. Under such circumstances, we will continue to explore what system safety and architecture, which supports system safety, should entail.

Figure 1: Driving Simulator

Figure 2: Motorbike Simulator

SDM Research Institute, Graduate School of System Design and Management at Keio University
Collaboration Complex, Keio University, 4-1-1 Hiyoshi, Kohoku-ku, Yokohama, Kanagawa 223-8526
Tel：045-564-2518 Fax：045-562-3502 E-mail：sdm@info.keio.ac.jp

SDM System Design and Management