Lab profile

Control Systems Design and Dynamics Lab
Professor Hidekazu Nishimura

The specialties of Professor Hidekazu Nishimura are control systems design, dynamical systems, mobility systems design, and universal design. He is the co-author of "Control System Design Using MATLAB" and "Frontiers of Motion and Vibration Control" and the author of other published works.
▶ http://lab.sdm.keio.ac.jp/nismlab/

1 Laboratory profile and its collaborations with other laboratories and centers

In addition to Professor Hidekazu Nishimura and Assistant Professor Terumasa Narukawa, eight doctoral students (including Assistant Professor Keiichi Yamamoto), 15 master's students and Assistant Professor Zhu Shaopeng, who earned a doctoral degree in systems engineering in March this year, are working in Control Systems Design and Dynamics Lab. A researcher from Hitachi joined them in April. Around a half of the lab members are working students, and the other half are full-time students who are new graduates. Three are international students. Since the students' research subjects are broad, the lab works in collaboration with other organizations including Mobility System Management Center, Universal Design Lab, Model-Driven Systems Development Lab, Visual Simulation Lab, and Aerospace and Intelligent Systems Lab.

Prof. Nishimura in front of driving simulator, with Prof. Ogi (right)

2 Supporting safe and comfortable lives

The lab develops various systems to support safe and comfortable lives. Lab members think outside the box and grasp what is really needed in system design and management. The main research topics are as follows:

3D immersive driving simulator, Joint research with Prof. Tetsuro Ogi

System design for passenger protection

» Integrated control system design for safety and passenger protection in vehicle collision
» Motion and safety controls for moving vehicles (personal mobility, two-wheel and four-wheel vehicles)
» Integrated driving and braking control system design for hybrid/electric car
» 3D immersive driving simulator for maintaining safe driving by the elderly
» System management and universal design of public transportation
» Development of anomaly detection system to secure safety
» Development of product model-driven collaborative and distributed system
» Development of model-driven system for small artificial satellites
» Analysis of bipedal movement and walk control system design
Many other research projects are jointly conducted with various corporations.
Tools used for the research are SysML, MATLAB/Simulink, MADYMO and others.

3 Activities at centers and labs

Mobility System Management Center

Public transportation is influential in compact cities and regions, and it will be increasingly important in view of environment-friendliness. In addition to public transportation such as LRT, road maintenance and improvement becomes a critical issue for promotion of personal mobility, including the bicycle. This Center is working with the Study Group of Public Transportation (chaired by Professor Hidekazu Nishimura) and researching urban mobility systems and their operations along with Dean Yoshiaki Ohkami, Professor Shoichi Sasaki, and Professor Masaru Nakano.

Universal Design Lab

Research on universal design is conducted to provide a barrier-free environment for all the people at Universal Design Lab. The lab is analyzing the needs of the disabled and social requirements in perspective of the environment surrounding the mobility, and accurately designing the systems (products / services) required in such a society. The lab is run along with Professor Yasushi Nakano of the Faculty of Economics and Professor Takashi Maeno, also in collaboration with outside corporations.

Model-Driven Systems Development Lab

The aims of the lab is to systematize model-driven systems development (MDSD), and apply it to the entire process of system design including requirement analysis, concept design, architecture, component design, procure/build/code, verification, and validation so that a system can be developed without redoing a previous phase. Using System Modeling Language (SysML) to integrate software as well as hardware, such as mechanical and electronic parts, into a system, the Lab drives concurrent design in various fields including the development of increasingly integrated electronic devices, automobile assembly with complex control systems, and small satellites which require a huge number of components. In cooperation with Guest Professor Laurent Balmelli (IBM), a developer of SysML, the Lab has been offering systems engineering education and research using SysML since SDM was established in 2008.
In research on motorcycle drive stabilization control using SysML, we identified the required control systems functions during the motorcyclists' various actions and developed the function architecture. The designed control system was verified in the test case based on the use case analysis.