# SICE 2008
# Workshop on Model-Based Development of Embedded Systems
## in The University of Electro-Communications
## August 19th, 2008

## Advance Program

**Place: Communication Park Library, Information Center: Room301**

http://www.uec.ac.jp/eng/about/visual/campus.html (Building 21)

**Registration fee: 2,000JPY**

Workshop Chair: Kazushi Nakano (the University of Electro-Communications)

Co-Chair: Motohisa Funabashi (Hitachi, Ltd.)

10:00-10:15 **Opening Address**

Akira Nagashima (Yokogawa Electric Corporation)

10:15-11:15 Keynote Speech:

**Strategic Systems Design Approach and Application to Large-scale Technical Systems**

Yoshiaki Ohkami (Keio University)

11:15-12:15 **Formal Methods for Verification and Validation in Model-Based Design**

Mehran Mestchian, Brett Murphy, and Goran Begic (the MathWorks)

12:15-13:15 Lunch

13:15-14:15 **Formal Approaches to Model-Based Development of Real-Time/Hybrid Systems**

Kunihiko Hiraishi (Japan Advanced Institute of Science and Technology)

14:15-14:45 **Definition of Model-Based Development for Automotive Control Systems in JMAAB**

Akira Ohata (TOYOTA Motor Corp.), Hisashi Ogata (MITSUBA Corp.),

Satoshi Shimada (HONDA R&D Co.,Ltd.), and Yoshiyuki Shinya (MAZDA Motor Corp.)

14:45-15:00 **Break**

15:00-16:00 **Model-based Calibration of Powertrain Control Systems with Automated Test Facilities**

Mirko Knaak (IAV Co. Ltd.)

16:00-17:00 **Symbolic Manipulation for Modeling and Simulation**

Jürgen Gerhard (Maplesoft)

17:00-17:15 **Closing Address**

Seiichi Shin (the University of Electro- Communications)

# Abstracts

## Strategic Systems Design Approach and Application to Large-scale Technical Systems

**Yoshiaki Ohkami (Keio University)**

Dating back to the Apollo era in 1960's, the Systems Engineering was considered one of the most important methodologies for successful development of large-scale complex systems leading to extensive efforts to establish practically viable methods and tools. In parallel with this trend, system science was developed in academic fields and several standards were developed in government organizations and industries especially in the United States. On account of such endeavor Systems Engineering has spread over the world, and many universities had established departments of system science or similar ones to teach and do research works related systems sciences such as operations research, multivariable optimization, non-linear programming, and so on. They tend to move towards a pure science field by treating the problems purely mathematically and systems engineering has become a field of the applied mathematics departing from industrial applications.

On the other hand, boundaries or environment surrounding large scale projects had greatly changed in 1990's, and as a result a great number of large-scale projects ended up with serious failures. By investigations in search of root causes of failures, it has turned out that systematic way of designing and managing such large and complex systems is completely insufficient. This observation has indeed triggered the birth of the INCOSE (International Council of Systems Engineering) in mid 1999's that started in the U.S. and spread to European and Asian countries. This presentation will cover the topics around the INCOSE and its activities in Asian areas, covering the history, organizations, publications, symposium and workshop, and certification efforts.

## Formal Methods for Verification and Validation in Model-Based Design

**Mehran Mestchian, Brett Murphy, and Goran Begic (the MathWorks)**

One of the key advantages of Model-Based Design for embedded system development is early test and verification. We can take advantage of system and algorithm models to validate requirements and verify designs early in the development process. Numerical simulation has been used for years as an early test & verification technique. New techniques, based on formal methods, can make model verification and validation even more powerful. One of the key challenges in the wide adoption of formal verification in embedded software development is the absence of a practical specification language. Traditional formal specification languages have a steep learning curve and are typically not intuitive to design engineers in a production development environment. In this presentation we describe an approach for efficient and robust expression of functional requirements and design properties using widely adopted modeling languages – MATLAB and Simulink – and show several example properties that include safety critical properties with temporal logic. The demonstration part of the presentation will introduce a model checking component of the Simulink environment – Simulink Design Verifier – that integrates a formal analysis engine with the Simulink development environment.

## Formal Approaches to Model-Based Development of Real-Time/Hybrid Systems

**Kunihiko Hiraishi (Japan Advanced Institute of Science and Technology)**

Formal approaches are techniques for the specification, development and verification of software and hardware systems, and are mainly studied in computer science. In this talk, brief survey on mathematics, theories and techniques of formal approaches, particularly for those in real-time and hybrid systems, will be given.

## Definition of Model-Based Development for Automotive Control Systems in JMAAB

**Akira Ohata(TOYOTA Motor Corp.), Hisashi Ogata (MITSUBA Corp.), Satoshi Shimada (HONDA R&D Co.,Ltd.), and Yoshiyuki Shinya (MAZDA Motor Corp.)**

MBD (Model-Based Development) has been regarded as one of the promising directions to resolve the complexity problem of recent automotive control system developments. JMAAB (Japan MATLAB Automotive Advisory Board) has developed the shared definition of MBD consisting of seven technical areas, Plant Modeling, Control Design, Verification & Validation, Calibration, Model Execution, Plant/Controller Model Managements and Process Management. It indicates that MBD requires the close collaboration between OEMs and suppliers to integrate various technologies and engineering tools.

## Model-based Calibration of Powertrain Control Systems with Automated Test Facilities

**Mirko Knaak (IAV Co. Ltd.)**

The calibration of powertrain control systems with statistical modeling and design of experiments (DoE) methods is a already well-established. It is essential to balance the increased complexity with the limited development. Frequently, they are combined with automated measurement since statistical model rely on excellent data quality. However, the ability of static models to predict the exhaust gas emissions during the start and the warm-up phase, which are currently coming into the focus of exhaust gas regulations, is still very limited. In this work, we propose dynamical statistical models that achieve good accuracy for the prediction of the exhaust gases in these crucial operating states; Further, we present a test cell automation that allows a dynamical DoE for the test bed measurements.

## Symbolic Manipulation for Modeling and Simulation

**Jürgen Gerhard (Maplesoft)**

The presentation will focus on the role of symbolic manipulation for dynamical modeling and simulation. Some of the main areas where symbolic manipulation makes a difference are:

- simplification of the shape of the model equations (index reduction, linearization)
- symbolic preprocessing to speed up numerical integration
- the ability to perform symbolic analysis and parameter investigations on the model equations

(sensitivity analysis, parameter optimization, feasible parameter regions)

- automatic generation and compilation of C code from the model equations.

We will draw examples and illustrations from ongoing Maplesoft projects.