Plenary Sessions

Plenary Lecture I **Monday, August 23, 1999, 8:30 am - 9:30 am**

Hapuna Ballroom

Dr. Hilding Elmqvist, President Dynasim AB, Lund, Sweden

Modelica - A Language for Physical System Modeling, Visualization, and Interaction

Abstract:

Modelica is an object-oriented language for modeling of large, complex and heterogeneous physical systems. It is suited for multi-domain modeling, for example for modeling of mechatronics including cars, aircrafts and industrial robots which typically consist of mechanical, electrical and hydraulic subsystems as well as control systems. General equations are used for modeling of the physical phenomena. No particular variable needs to be solved for manually. A Modelica tool will have enough information to do that automatically. The language has been designed to allow tools to generate efficient code automatically. The modeling effort is thus reduced considerably since model components can be reused and tedious and error-prone manual manipulations are not needed. The principles of object-oriented modeling and the details of the Modelica language as well as several examples are presented.

Biographical Sketch:

Hilding Elmqvist attained his Ph.D. at the Department of Automatic Control, Lund Institute of Technology in 1978. In 1972-1975, he developed the first version of the simulation program Simnon which is sold world wide and has more than 2000 users. His Ph.D. thesis contains the design of a novel object-oriented modeling language called Dymola and algorithms for symbolic model manipulation.

Elmqvist spent one year in 1978-1979 at the Computer Science Department at Stanford University, California. He was in 1984-1990 the principal designer and project manager at a subsidiary to Alfa-Laval called SattControl in Malmo for developing SattGraph, a user interface system for process control and SattLine, a graphical, object-oriented and distributed control system. In 1992, he founded Dynasim AB in Lund, Sweden. The company develops software tools for modeling and simulation of large dynamical systems. The first product was Dymola for object-oriented modeling, which has been followed by Dymosim for simulation and Dymoview for 3D animation of dynamical and visual models. Finally, Dymodraw is a model diagram editor. These products have demonstrated the benefit of object-oriented modeling for both research and industrial applications.

Plenary Lecture II **Tuesday, August 24, 1999, 8:30 am - 9:30 am**

Hapuna Ballroom

Professor Hidenori Kimura, University of Tokyo

Uncertainty, Complexity and Learning: Control Perspective

Abstract:

Control theory has produced a number of design methods ranging from Ziegler-Nichols ultimate sensitivity method to H_∞ method. We may add some "model-free" design strategies like fuzzy control and neural network, which recently emerged as, tools for intelligent control. Enormous variety of design methods gives wide range of options for practitioners of real control systems. The increase of options, however, sometimes gives a trouble to practitioners, if they do not know which design method is appropriate for achieving their control objectives. This is sometimes the case even for well-experienced practitioners and we must admit that control theory has not been helpful in this respect. The complexity of controllers is the central issue of the selection of design method. The simpler control configuration is desirable from the viewpoint of implementation and maintenance, but simpler controller is limited in its performance, which is most crucially measured by its ability of dealing with uncertainty. Thus, the uncertainty/complexity tradeoff is the most relevant feature of the issue of control configuration selection.

In this talk, we discuss the limitation of LTI controllers, as the simplest scheme of feedback control, from the viewpoint of uncertainty management and establish the necessity of the switching control as the most complex control configuration. We shall show the switching control is a natural framework of active learning.

Biographical Sketch:

Hidenori Kimura graduated from the University of Tokyo in 1965. He received the degrees of the Master and Doctor of Engineering from the University of Tokyo in 1967 and 1970, respectively. In 1970 he joined the Faculty of Engineering Science, Osaka University, where he engaged in research and education of control theory, signal processing and system theory for 17 years. In 1987, he moved to the Faculty of Engineering, Osaka University, where he was engaged in some applications of control theory in rolling control, robotics and automotive control. In 1995, he moved to the Faculty of Engineering, the University of Tokyo, where he is currently a professor of control engineering.

He has written more than 100 papers and several books on multivariable control, signal processing and robust control including various application papers of control system design.
His current research interest lies in system identification of model set, learning and adaptation, control of complex systems and control of quantum mechanical systems. He received the Paper Award several times from the Society of Instrumentation and Control Engineers (SICE). He received paper awards from IFAC in 1984 and in 1990. He also received the George Axelby Award from IEEE Control Systems Society in 1984. He is a Fellow of SICE and IEEE and is a distinguished member of the IEEE Control Systems Society. He served as a member of the Board of Governors from 1989-1997. He was the General Chair of the 35th CDC in Kobe.

Plenary Lecture III **Wednesday, August 25, 1999, 8:30 am - 9:30 am**

Hapuna Ballroom

Professor Stephen Boyd, Stanford University

Convex Matrix Optimization Problems, with Applications in Control, Signal Processing, and Circuit Design

Abstract:

The recent development of efficient interior-point algorithms for convex optimization problems involving linear matrix inequalities (LMIs) has spurred research in a wide variety of application fields, including control system analysis and synthesis, combinatorial optimization, circuit design, structural optimization, experiment design, and geometrical problems involving ellipsoidal bounding and approximation.

In the first part of the talk, I will describe the basic problems, semidefinite programming (SDP) and determinant maximization, discuss their basic properties, and give a brief description of interior-point methods for their solution.

In the second half of the talk I will survey applications from several areas.

Biographical Sketch:

Stephen Boyd received the AB degree in Mathematics from Harvard University in 1980, and the PhD in EECS from the University of California, Berkeley, in 1985. In 1985 he joined the Electrical Engineering Department at Stanford University, where he is now Professor and Director of the Information Systems Laboratory. He has held visiting Professor positions at Katholieke University (Leuven), McGill University (Montreal), Ecole Polytechnique Federale (Lausanne), Qinghua University (Beijing), and Universite Paul Sabatier (Toulouse).

He was a member of the Board of Governors, IEEE Control Systems Society, from 1989 through 1992, is a Fellow of the IEEE, and has been a Distinguished Lecturer of the Control Systems Society since 1993. Awards and honors for his research in control systems engineering and optimization include the AACC Donald P. Eckman Award, an ONR Young Investigator Award, a Presidential Young Investigator Award, and an IBM faculty development award. He has given many plenary lectures in both optimization and control. He has received several awards for teaching and lecturing, including the 1994 Perrin award for outstanding undergraduate teaching in Stanford's School of Engineering, and the 1991 ASSU Graduate Teaching Award.

He is the author of two books: Linear Controller Design: Limits of Performance} (with Craig Barratt, 1991) and Linear Matrix Inequalities in System and Control Theory, (with L. El Ghaoui, E. Feron, and V. Balakrishnan, 1994). He is currently working (with Lieven Vandenberghe) on a book on convex optimization with engineering applications.

His interests include computer-aided control system design, and convex programming applications in control, signal processing, and circuits.

Plenary Lecture IV **Thursday, August 26, 1999, 8:30 am - 9:30 am**

Hapuna Ballroom

Dr. James Winkelman, Ford Motor Company

Control in the Automotive Industry: Accomplishments in the Twentieth Century, Challenges in the Twenty-First Century

Abstract:

The automotive industry is one of the most global industries in the world. It is an intensely competitive business, which affects the economies and environments of essentially every country in the world. World wide annual vehicle production reached 30 million around 1970, today it is about 50 million and by the end of the next decade it is projected to reach around 70 million. The impact of the automobile on the environment was recognized in the United States in the late 1960's and since then, vehicles are over ten times cleaner and have over twice the average fuel economy. Further, vehicles are significantly safer and offer the customer comfort and convenience levels untaught of in the 1970's. These advancements have been driven to a large part by the explosive development of low cost embedded micro processor control systems.

What does the future hold? There will be emission challenges, which could be more difficult than those faced in the past. A significant reduction in all emissions, including CO_2 , must simultaneously be achieved. This may require the use of new powertrains and/or alternative fuels. The market will push for safer vehicles through electronically augmented control of vehicle dynamics under both normal and emergency conditions. All of this while providing greater comfort for the passengers. Development of control systems to allow the next generation vehicles to meet governmental regulations, customer expectations and be manufactured at an affordable cost will be key to successful product development.

Biographical Sketch:

Dr. Jim Winkelman obtained his B.S.E.E., M.S.E.E., and Ph.D. degrees from the University of Wisconsin in 1971, 1972 and 1976, respectively. Whereupon he spent the next ten years at General Electric working on the application of singular perturbation methods and adaptive control techniques to the area of power systems. From 1987 on, he has been at the Ford Motor Co. where he was involved in development electronic vehicle controls until 1993. He managed the Motorsports Electronics Department at Ford from 1993 to 1997 where they developed electronic controls for both chassis and powertrain systems. These included low bandwidth active suspension, four wheel steering, variable slip set point traction control, drive by wire throttle control and electronic brake proportioning controls. Since 1997 he has been with Visteon where he leads their advanced powertrain systems activities, which includes an in-house development of a gasoline direct injection system.