The Center for Control, Dynamical Systems, and Computation
University of California at Santa Barbara
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Presents

Stability and Stabilization of Networked Control Systems: A Discrete-Time Modeling Approach

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Abstract:
Networked Control Systems (NCSs) are control systems in which (part of) the control loop is closed over a realtime communication network. The advantages of the use of an NCS are its flexible architecture and a reduction of installation and maintenance costs. The main disadvantages of NCSs are the network effects that influence the control loop, such as delays, variable sampling intervals and packet dropouts. In this presentation the focus will be on the effects of these uncertain and time-varying delays, time-varying sampling times and packet loss on the stability and the stabilization of the control loop. Via an example, we will show what the (negative) effects of these phenomena can be on closed-loop stability and performance. To analyze these effects in more detail, we present a discrete-time model, describing an NCS including the above network phenomena. This model can describe both the small delay case (delays smaller than the sampling time) and the large delay case. Moreover, it incorporates the effects of message rejection and vacancy sampling. Based on this discrete-time NCS model sufficient LMI conditions are proposed for the stability analysis and stabilizing controller synthesis. A reduction of the conservatism is obtained by exploiting the real Jordan form of the continuous-time model during the discretization step. The presentation will mainly focus on the above work on NCS. However, given the fact that I will be around for 4 months, I will provide a short overview of some of the other work that I am involved in, as this might trigger some future (off-line) discussions and collaborations with the CCDC members.

About the Speaker:
Maurice (W.P.M.H.) Heemels (born 1972) received the M.Sc. degree in Mathematics and the Ph.D. degree from the department of Electrical Engineering (EE) of the TU/e (Technische Universiteit Eindhoven) in 1995 and 1999, respectively. His M.Sc. thesis was related to LQR control of linear systems under input constraints (supervised by Anton Stoorvogel and Malo Hautus) and his Ph.D. thesis was entitled “Linear complementarity systems: a study in hybrid systems” and supervised by Hans Schumacher and Siep Weiland. He was the recipient of the ASML-award for his Ph.D. thesis. Currently, he is an associated professor in the DCT group (http://www.dct.tue.nl) at the Department of Mechanical Engineering of the Eindhoven University of Technology. He is also working at the Embedded Systems Institute (http://www.esi.nl) as a research fellow (since 2004). In 2001, he was a visiting professor at the Automatic Control Lab of the ETH in Zurich, Switzerland for 3 months and in 2004, he spent 4 months at the R&D lab of the printer manufacturer Océ in Venlo (The Netherlands). He is a member of international program committees for the leading conferences in the domain of hybrid systems and control (HSCC, ADHS, ACC,CDC) and acts as an associate editor for the Elsevier journal ”Nonlinear analysis: hybrid systems.” He organized three international summer schools in the area of hybrid and embedded systems in 2003 (Veldhoven, The Netherlands), 2005 (Siena, Italy) and 2007 (Siena, Italy). His current research interests include: Hybrid and non-smooth dynamical systems in particular piecewise linear and linear complementarity systems; Control of constrained systems including MPC; Networked and event-driven control systems.