Seminar on L1 Adaptive Control

The Automation and Control Group at DTU Electrical Engineering is pleased to invite you to a half day seminar on "**L1 Adaptive Control: Theory and Applications**", which will be held at Technical university of Denmark on Thursday, October 3.

The seminar will have the honour to host Professor Naira Hovakimyan from the University of Illinois at Urbana-Champaign, who will give a broad and inspiring lecture on "**L1 Adaptive Control and Its Transition to Practice**". Prof. Hovakimyan is a leading scientist in the area of robust adaptive control and estimation, and in the last 8 years she has brought to the international attention, academic and industrial, this novel adaptive control theory with breakthrough results on flight control systems.

The talk by Prof. Hovakimyan will be followed by two mini-sessions: a live demonstration with quad-copters augmented by L1 adaptive flight controllers performed by Jussi Hermansen, UAV special consultant at Viacopter, and two presentations about L1 adaptive control for maneuvering and station-keeping of high-speed personal watercrafts given by Assistant Prof. Roberto Galeazzi and PhD candidate Lukas Theisen, both from DTU Electrical Engineering.

If you wish to participate in then send an email at the soonest, and not later than **Monday, September 30 at 12:00**, to our secretary Lisbeth Winter (lw@elektro.dtu.dk).

L1 Adaptive Control: Theory and Applications

Special guest	Professor Naira Hovakimyan (University of Illinois at Urbana-Champaign)
Date	October, Thursday 3
Time	13:00 – 16:00
Place	Building 306, Auditorium 38 Technical University of Denmark
Organizer	Assistant Professor Roberto Galeazzi (DTU Electrical Engineering) rg@elektro.dtu.dk 0045 45 25 35 49
Registration	Open until Monday, September 30 at 12:00 Send an email to lw@elektro.dtu.dk

Schedule

Time	Event
13:00	Seminar opening and welcoming by Assistant Prof. Roberto Galeazzi
13:15	“L1 Adaptive Control and Its Transition to Practice” Keynote lecture by Prof. Naira Hovakimyan
14:15	Coffee-break
14:30	“L1 Adaptive Flight Controller for Quad-copters” Live demonstration by UAV special consultant Jussi Hermansen
15:00	“L1 Adaptive Manoeuvring Control of Unmanned High-speed Water Craft” Presentation by Assistant Prof. Roberto Galeazzi
15:20	“Unmanned Water Craft Identification and Adaptive Control in Low-Speed and Reversing Regions” Presentation by PhD candidate Lukas Theisen
15:40	Concluding remarks and greetings by Assistant Prof. Roberto Galeazzi

Keynote Lecture

L1 Adaptive Control and Its Transition to Practice

Professor Naira Hovakimyan

Abstract: The history of adaptive control systems dates back to early 50-s, when the aeronautical community was struggling to advance aircraft speeds to higher Mach numbers. In November of 1967, X-15 launched on what was planned to be a routine research flight to evaluate a boost guidance system, but it went into a spin and eventually broke up at 65,000 feet, killing the pilot Michael Adams. It was later found that the onboard adaptive control system was to be blamed for this incident. Exactly thirty years later, fuelled by advances in the theory of nonlinear control, Air Force successfully flight tested the unmanned unstable tailless X-36 aircraft with an onboard adaptive flight control system. This was a landmark achievement that dispelled some of the misgivings that had arisen from the X-15 crash in 1967. Since then, numerous flight tests of Joint Direct Attack Munitions (JDAM) weapon retrofitted with adaptive element have met with great success and have proven the benefits of the adaptation in the presence of component failures and aerodynamic uncertainties. However, the major challenge related to stability/robustness assessment of adaptive systems is still being resolved based on testing the closed-loop system for all possible variations of uncertainties in Monte Carlo simulations, the cost of which increases with the growing complexity of the systems. This talk will give an overview of the limitations inherent to the conventional adaptive controllers and will introduce the audience to the **L_1 adaptive control theory**, the architectures of which have guaranteed *robustness in the presence of fast adaptation.* Various applications, including flight tests of a subscale commercial jet, will be discussed during the presentation to demonstrate the tools and the concepts. With its *key feature of decoupling adaptation from robustness* L_1 adaptive control theory has facilitated new developments in the areas of event-driven adaptation and networked control systems. A brief overview of initial results and potential directions will conclude the presentation.

Bio sketch: Naira Hovakimyan received her MS degree in Theoretical Mechanics and Applied Mathematics in 1988 from Yerevan State University in Armenia. She got her Ph.D. in Physics and Mathematics in 1992, in Moscow, from the Institute of Applied Mathematics of Russian Academy of Sciences, majoring in optimal control and differential games. In 1997 she has been awarded a governmental postdoctoral scholarship to work in INRIA, France. In 1998 she was invited to the School of Aerospace Engineering of Georgia Tech, where she worked as a research faculty member until 2003. In 2003 she joined the Department of Aerospace and Ocean Engineering of Virginia Tech, and in 2008 she moved to University of Illinois at Urbana-Champaign, where she is a professor, university scholar and Schaller faculty scholar of Mechanical Science and Engineering. She has co-authored a book and more than 300 refereed publications. She is the recipient of the SICE International scholarship for the best paper of a young investigator in the VII ISDG Symposium (Japan, 1996), and also the 2011 recipient of *AIAA Mechanics and Control of Flight* award. She is an associate fellow and life member of AIAA, a Senior Member of IEEE, and a member of SIAM, AMS and ISDG. Her research interests are in the theory of robust adaptive control and estimation, control in the presence of limited information, networks of autonomous systems, game theory and applications of those in safety-critical systems of aerospace, mechanical, electrical, petroleum and biomedical engineering.