

Bio of Naira Hovakimyan

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. She is the recipient of the SICE International scholarship for the best paper of a young investigator in the VII ISDG Symposium (Japan, 1996). 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, UIUC scholar and Schaller faculty scholar of Mechanical Science and Engineering. She has co-authored a book and more than 250 refereed publications. She is the recipient of 2011 AIAA Mechanics and Control of Flight award. Her current interests are in the theory of robust adaptive control and estimation with an emphasis on aerospace applications, control in the presence of limited information, networks of autonomous systems and game theory.

L₁ Adaptive Control and Its Transition to Practice

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, fueled 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 **L₁ 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* L₁ 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.