



High-Gain Observers in Nonlinear Feedback Control



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ABSTRACT: High-gain observers play an important role in the design of feedback control for nonlinear systems. This lecture overviews the essentials of this technique. After a brief historical background, a motivating example is used to illustrate the main features of high-gain observers, with emphasis on the peaking phenomenon and the role of control saturation in dealing with it. The use of the observer in feedback control is discussed and a nonlinear separation principle is presented. The use of an extended high-gain observer as a disturbance estimator is covered. Challenges in implementing high-gain observers are discussed, with the effect of measurement noise as the most serious one. Techniques to cope with measurement noise are presented. The lecture ends by listing the speaker's experience with experimental testing of high-gain observers.

BIO: Hassan K. Khalil received the B.S. and M.S. degrees in electrical engineering from Cairo University, Egypt, in 1973 and 1975, respectively, and the Ph.D. degree from the University of Illinois, Urbana-Champaign, in 1978, all in electrical engineering. Since 1978, he has been with Michigan State University (MSU), where he is currently University Distinguished Professor of Electrical and Computer Engineering. He has consulted for General Motors and Delco Products, and published several papers on singular perturbation methods and nonlinear control. He is the author of *Nonlinear Control* (Pearson 2015), *Nonlinear Systems* (Macmillan 1992; Prentice Hall 1996 & 2002) and coauthor of *Singular Perturbation Methods in Control: Analysis and Design* (Academic Press 1986; SIAM 1999). Dr. Khalil was named IEEE Fellow in 1989 and IFAC Fellow in 2007. He received the 1989 IEEE-CSS George S. Axelby Outstanding Paper Award, the 2000 AACC Ragazzini Education Award, the 2002 IFAC Control Engineering Textbook Prize, the 2004 AACC O. Hugo Schuck Best Paper Award, the 2009 AGEP Faculty Mentor of the Year Award, and the 2015 IEEE-CSS Bode Lecture Prize. At MSU he received the 1994 Withrow Distinguished Scholar Award, and the 1995 Distinguished Faculty Award. He was named University Distinguished Professor in 2003.