IEEE Control Systems Society Distinguished Lecture

Friday, Feb. 23 **1 p.m.** **3043 ECpE Building Addition**

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Practical Adaptive Control

ABSTRACT: Adaptive Control is viewed as a game changer in many application domanis where real-time feedback control is essential to ensure the desired performance. Adaptive controllers, whose distinguishing feature is a parameter estimator that prescribes the rule for changing the control parameters in real-time, have been studied extensively over the past forty years, with fundamental properties of stability and robustness well understood. Guidelines for analysis and synthesis for adaptive controllers have been laid out for linear and (specific classes of) nonlinear systems, continuous and discrete-time systems, single-input and multi-input systems, and deterministic and stochastic systems. There are glaring gaps in adaptive control theory that remain to be closed for adaptive control to be a viable, practical, and easily implementable methodology. Guarantees have to be provided that ensure robustness to a wide variety of non-parametric perturbations. Guidelines have to be in place for a systematic design of all free parameters in the controller. Bounds have to be derived, not only for steady-state behavior, but also for transient characteristics. Implementation issues will have to be satisfactorily addressed. The ability to accommodate actuator constraints in terms of bandwidth, magnitude limits, and rate limits has to be precisely characterized.

BIO: Anuradha Annaswamy received her Ph.D. in Electrical Engineering from Yale University in 1985. She has been a member of the faculty at Yale, Boston University, and MIT where currently she is the director of the Active-Adaptive Control Laboratory and a Senior Research Scientist in the Department of Mechanical Engineering. Her research interests pertain to adaptive control theory and applications to aerospace, automotive, and propulsion systems, cyber physical systems science, and CPS applications to Smart Grids, Smart Cities, and Smart Infrastructures. She is the author of a hundred journal publications and numerous conference publications, co-author of a graduate textbook on adaptive control (2004), co-editor of several reports including "Systems & Control for the future of humanity, research agenda: Current and future roles, impact and grand challenges," (Elsevier) "IEEE Vision for Smart Grid Control: 2030 and Beyond," (IEEE Xplore) and Impact of Control Technology.

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