Nonlinear Oscillations and the Steady-State Behavior of Nonlinear Feedback Systems

Christopher I. Byrnes
Department of Electrical and Systems Engineering
Washington University

Abstract: In this talk, we will focus primarily on periodic steady-state behavior, a phenomenon that is pervasive in nature and in man-made systems. As an example, we review how a rotation in a magnetic field produces a stable nonlinear oscillation in a three dimensional, nonlinear model of an AC controlled rotor resulting in a constant steady-state angular velocity of the rotor. We next present sufficient conditions for the existence of nonlinear oscillations in terms of a multi-valued analogue of Lyapunov functions, in much the same way as the angular variable theta in polar coordinates is multi-valued. Moreover, using the recent solution of the Poincare Conjecture and more, we show these sufficient conditions are necessary for the existence of an asymptotically stable oscillation. We apply these methods to the analysis and design of the frequency response for nonlinear systems. This design is the result of joint work with R. Brockett and with A. Isidori.

Friday, February 13, 2009
11:00 a.m.
Bryan Hall, room 305

Host: Arye Nehorai

Short Bio: Chris Byrnes is the Edward H. and Florence G. Skinner Professor of Systems Science and Mathematics at Washington University in St. Louis. The author of more than 250 technical papers and books, Chris received an Honorary Doctorate of Technology from the Royal Institute of Technology (KTH) in Stockholm in 1998 and in 2002 was named a Foreign Member of the Royal Swedish Academy of Engineering Sciences. He is a Fellow of the IEEE, has twice received (with his coauthors) the IEEE George Axelby Award for best paper in the IEEE Trans. in Auto. Control and has also received the IFAC Best Paper Award. In 2005, he was awarded the Reid Prize from SIAM for his contributions to control theory and differential equations. In December 2008, he received the IEEE Hendrik W. Bode Prize and gave the Bode Prize Lecture at the annual IEEE Conference on Decision and Control.