Electrical & Computer Engineering

S E M I N A R

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Inherent Limitations of Feedback Control

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Abstract—It is well known that feedback can be introduced to stabilize an unstable system, to attenuate the response of a system to disturbance, and to reduce the effect of plant parameter variations and modeling error. On the other hand, feedback design is also known to be contingent on many performance considerations and physical constraints, and use of feedback may suffer from certain serious potential disadvantages. Design difficulty may arise due to the very nature of feedback structure as well as plant properties, which generally manifests itself as limitations on achievable performance goals, and tradeoffs to be made between conflicting design objectives. An important step in the design process, therefore, is to analyze how plant characteristics may inherently impose constraints upon design and thus may fundamentally limit the level of achievable performance. This task has become even more tangible nowadays, as current control design theory and practice relies heavily on optimization-based numerical routines and tools.

In this talk I will discuss classical as well as new results in performance limitation studies. The first part of the talk will concentrate on reviewing the classical work by Bode and its more recent extensions for single-input single-output systems. Interpretations of these results from control perspectives will be particularly emphasized. The second part will focus on multivariable generalizations of Bode and Poisson type integrals, together with a number of intrinsic limits on the best achievable performance measured by sensitivity and complementary sensitivity functions. These developments lead to the discovery of new phenomena which have no analog in single-input single-output systems. A central and prevailing theme is that in a multivariable system performance and design limitation intrinsically depend upon the locations as well as directions of nonminimum phase zeros and unstable poles, and in particular, on the mutual orientation of the zero and pole directions.

When: **Monday, 15 November 1999, 11:00 - 12:00**
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