



BRIGHAM YOUNG UNIVERSITY

CS Department Colloquium Series



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Communication Channels in Loops: Limitations and Opportunities

In this talk we consider systems involving communication channels in loops. In the first part, we focus on communication systems with access to feedback and show how such systems could be designed using control theory ideas and tools. We present a tight connection between the Sensitivity Bode Integral formula, (a fundamental limitation of feedback systems), and the achievable communication rate expressed in term of the average Directed Information of the channel. We apply our approach to several Gaussian channels and Gaussian networks and show that either achieves or improves on the available results. In the second part of the talk, we concentrate on feedback control systems over communication channels. We describe some new results on performance limitations induced by the presence of Gaussian channels in the feedback loop. We then consider fading channel models. The simplest model is the analog erasure channel, which is used as a model for packet-drop links. We present a general framework to analyze the performance of linear systems with linear controllers over fading channels. The approach is to consider the fading nature of the channels as a source of (stochastic) uncertainty, and to recast the whole problem as a robust control problem over stochastic perturbations. We present several examples to elucidate the setup and the framework, including the simultaneous design of controller encoders and decoders that exploit the channel state information. Finally, we apply the framework to predict the emergence of power laws distributions in the behavior of networked control systems.

Biography

Nicola Elia received the Laurea degree in Electrical Engineering from Politecnico of Turin in 1987, the Ph.D. degree in Electrical Engineering and Computer Science from Massachusetts Institute of Technology in 1996. He worked at Fiat Research Center from 1987 to 1990. He was Postdoctoral Associate at the Laboratory for Information and Decision Systems at MIT from 1996 to 1999. Presently is an associate professor with the Dept. of Electrical and Computer Engineering at Iowa State University. He received the NFS CAREER Award in 2001. His research interests include computational methods for controller design, complex systems, networked control systems.

Donuts will be provided