BCWS Seminar Series

Linear Precoder Design for Finite Alphabet Signaling over MIMO channels: Theory, Algorithm, and Hardware Implementation

by

Dr. Chengshan Xiao and Dr. Yahong Rosa Zheng
Missouri University of Science and Technology, Rolla, MO, USA

Time: Friday, June 15, 10:00 - 11:00 am
Place: Room ME 4124, Mackenzie Building, Carleton University

Abstract: Finite alphabet signaling refers to commonly used discrete-constellation modulations in practical communication systems, such as PAM, PSK or QAM. This talk will present new theory for maximizing the mutual information between finite alphabet inputs and fading channel outputs through linear precoders for Multiple-Input Multiple-Output (MIMO) systems. When the mutual information is formulated directly with finite-alphabet inputs rather than Gaussian inputs, it becomes a nonlinear and non-concave function of the precoder parameters, thus imposing a major obstacle to the design optimization. We present a parameterized iterative algorithm that achieves the global maximum of the mutual information via the Gram matrix of the precoder matrix and channel matrix. Numerical examples show that this approach provides higher achievable rate and lower coded bit error rate than the commonly used approaches that design the precoder with Gaussian input assumption and then apply it to practical discrete-constellation systems. The precoder design is applied to a practical 2-by-2 MIMO OFDM system to harvest both diversity gain and multiplexing gain. Furthermore, FPGA-based implementation of a hardware test bed is also completed using turbo equalization and LDPC codes. Experiment results verify the theoretical analysis and computer simulations.

Biography:

Chengshan Xiao received his Ph.D. degree in Sydney University, Sydney, Australia in 1996. He held positions in Nortel Networks, University of Alberta, and University of Missouri-Columbia during 1997 – 2007. He is now a Professor of Electrical and Computer Engineering at Missouri University of Science and Technology, Rolla, Missouri, USA. His research interests include wireless communications, signal processing, and underwater acoustic communications. He is the holder of three U.S. patents. His algorithms were implemented in Nortel's base station radios after successful field trials and network integration. Prof. Xiao is Editor-in-Chief of the IEEE Transactions on Wireless Communications, Fellow of the IEEE, Member of Fellow Evaluation Committee of IEEE Communications Society (ComSoc), and Member-at-Large of IEEE ComSoc Board of Governors. Previously, he served as the founding Chair of the IEEE Technical Committee on Wireless Communications and the Technical Program Chair of the 2010 IEEE International Conference on Communications, Cape Town, South Africa.

Yahong Rosa Zheng received the Ph.D. degree from the Department of Systems and Computer Engineering, Carleton University, Ottawa, Canada, in 2002. She was an NSERC Postdoctoral Fellow from 2003 to 2005 with the University of Missouri-Columbia. She is now an Associate Professor with the Department of Electrical and Computer Engineering, Missouri University of Science and Technology, Rolla. Her research interests include array signal processing, wireless communications, and wireless sensor networks. She serves as technical program Co-Chair for the IEEE Globecom 2012 Wireless Communications Symposium, and as Associate Editor for the IEEE Transactions on Vehicular Technology. Previously, she was an Associate Editor for the IEEE Transactions on Wireless Communications during 2006 --2008. She is the recipient of an NSF CAREER award in 2009.