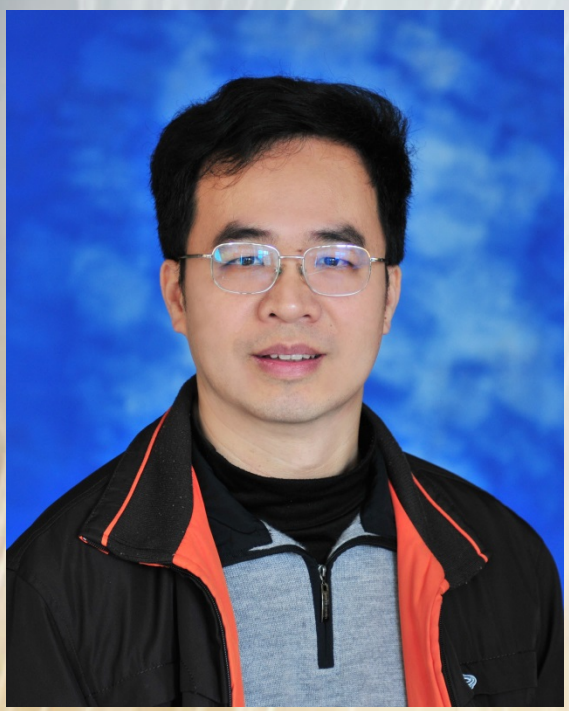
黃元豪 教授



Yuan-Hao Huang Yuan-Hao Huang (S'98-M'02) was born in Taiwan in 1973. He received the B.S. and Ph.D. degrees in electrical engineering from National Taiwan University, Taipei, Taiwan, R.O.C., in 1995 and 2001, respectively. He was a Member of Technical Staff with VXIS Technology Corporation, Taiwan from 2001 and 2005. Since 2005, He has been with the Department of Electrical Engineering and the Institute of Communications Engineering, National Tsing-Hua University, Taiwan, where he is currently an Associate Professor. His research interests include VLSI design for digital signal processing systems and telecommunication systems. He is currently a member of Design and Implementation of Signal Processing Systems (DiSPS) technical committee of IEEE Signal Processing Society, and also a member of VLSI Systems and Applications (VSA) technical committee of IEEE Circuits and Systems Society.

Design and Implementation of Multiple-Input Multiple-Output Systems - From MIMO to massive MIMO

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Abstract

Spatial-multiplexing multiple-input multiple-output (MIMO) system has become a major technique to increase the information capacity of modern communication systems. For the design and implementation of MIMO systems, many researchers in the literature have designed 4x4 MIMO detector chips with up to several Gbps throughput by improving the algorithm, architecture, or IC process. However, as the number of antenna arrays further increases (8x8, or massive MIMO), MIMO detector designers must face many challenging issues, such as cubic growth of decoding complexity O(N^3), huge power consumption of RF chains, MIMO channel correlation, antenna interference, etc.

This talk will first present the fundamentals of the design of MIMO detectors including linear and nonlinear MIMO detection algorithms and their architectures. To investigate the design issues for massive MIMO detector, the second part of the talk will further present an 8x8 MIMO detector based on lattice reduction preprocessing technique. The lattice reduction technique searches for a unimodular matrix T that transforms the MIMO channel to a more orthogonal channel matrix so that the channel interference between antennas can be greatly reduced, especially for a correlation MIMO channel. The third part of the talk will introduce several new techniques that have recently been proposed for massive MIMO systems. The systematic research usually defines massive MIMO as a MIMO system with up to hundreds of antenna. The large number of antennas leads to several critical several design issues for MIMO detectors, including employment of the large-sized antenna arrays, huge power consumption of RF chains, and the high-complexity MIMO detection in the baseband processing. This part will introduce several techniques that tries to address these design issues, such as spatially-modulated multiple-input multiple-output (SM-MIMO), hybrid RF/baseband MIMO precoding (beamforming), and 2D antenna arrays. This part will also summarize several potential research problems for the design and implementation of future massive MIMO systems. Finally, a conclusion will be given.