

UCLA Electrical Engineering ARR 2011

Session 14. High-Performance Coding Applications Grand Horizon Room

3:15-3:40

"Soft Information for LDPC Decoding in Flash: Mutual-Information Optimized Quantization"

Jiadong Wang, Thomas Courtade, Hari Shankar and Richard Wesel

Abstract:

High-capacity NAND flash memory can achieve high density storage by using multi-level cells (MLC) to store more than one bit per cell. Although this larger storage capacity is certainly beneficial, the increased density also increases the raw bit-error-rate (BER), making powerful error correction coding necessary. Traditional flash memories employ simple algebraic codes, such as BCH codes, that can correct a fixed, specified number of errors. This talk investigates the application of low-density parity-check (LDPC) codes which are well-known for their ability to approach capacity in the AWGN channel. We obtain soft information for the LDPC decoder by performing multiple cell reads with distinct word-line voltages. The values of the word-line voltages (also called reference voltages) are optimized by maximizing the mutual information between the input and output of the multiple-read channel. Our results show that using this soft information in the LDPC decoder provides a significant benefit and enables us to outperform BCH codes over a range of block error rates.

3:40-4:05

"Extending the Lifetime of Flash Memory Using Coding Techniques"

Ryan Gabrys and Lara Dolecek

Talk:

Flash memories promise faster data access, less power consumption, and greater durability than traditional storage mediums. However, these benefits are accompanied with greater lifetime variability. In this talk, we will demonstrate how a novel coding methodology can be used with great success to mitigate device wear-out and to substantially extend memory lifetime. Coding methods that opportunistically exploit the nature of intracell variability of dense Flash memories will be discussed.

4:05-4:30**"Superposition Coding for Constrained Modulations"***Thomas Courtade and Richard Wesel***Abstract:**

In this talk, we consider a network of n nodes, each initially possessing a subset of packets. Each node is permitted to broadcast functions of its own packets and the messages it receives to all other nodes via an error-free channel. We provide an algorithm that efficiently solves the Weighted Universal Recovery Problem and the Secrecy Generation Problem for this network.

4:30-4:55**"Protograph-Based Raptor-Like LDPC Codes for Rate Compatibility with Short Blocklengths"***Tsung-Yi Chen, Dariush Divsalar, Jiadong Wang and Richard Wesel***Abstract:**

In this presentation we will introduce a new class of rate-compatible LDPC codes, protograph-based Raptor-like (PBRL) LDPC codes. The proposed PBRL codes are jointly decodable with an iterative belief propagation decoder. As with Raptor codes, additional parity bits can be easily produced by exclusive-or operations on the precoded bits, providing extensive rate compatibility. We will present a design procedure that optimizes this class of rate-compatible LDPC codes. The new PBRL codes outperform 3GPP rate-compatible turbo codes with the same short blocklength at high SNR and show no sign of an error floor at the FER region of 10^{-7} .