TIM ALDERSON
University of New Brunswick Saint John

Arcs and Optical Orthogonal Codes

We exhibit constructions for some new families of optical orthogonal codes that are optimal or asymptotically optimal with respect to the Johnson bound. In particular, for any prescribed value of λ, we construct infinite families of (n, w, λ)-OOCs that in each case are asymptotically optimal. Our constructions rely on various techniques in finite projective spaces involving normal rational curves and Singer groups. These constructions generalize and improve previous constructions of OOCs,in particular, those from lines and conics.

RICHARD BLAHUT
University of Illinois

Source coding

ROBERT CALDERBANK
Princeton University

Space-Time Codes: Geometry versus Algorithms

There is a large class of space-time codes where guarantees on worst case performance are derived from the difficulty of solving an associated diophantine approximation problem. One example is the Golden Code, a remarkable space-time code that employs two antennas to transmit four complex QAM symbols over two time slots. It achieves full diversity and this tradeoff between rate and reliability is best possible in terms of the diversity multiplexing bound derived by Zheng and Tse. Moreover, the minimum determinant is bounded below by a constant that is independent of the size of the signal constellation.

This talk will describe low complexity decoding algorithms that take advantage of the special cyclotomic structure of this code. Space- Time Codes: Geometry versus Algorithms

VINCENT GAUDET
University of Alberta

Energy Efficient Decoding Algorithms

Traditionally, the design of forward error control codes such as low- density parity check codes, has focused on minimizing transmit energy. In other words the signal-to-noise ratio at which error-free decoding can be achieved is minimized. However, the combination of battery life and technological limitations in nanoscale CMOS integrated circuit processes, along with greater throughput requirements of recent communications standards require the design of low-power decoder chips. For instance, if a Gigabit Ethernet chip's decoder consumes 1 Watt of power, it is entirely conceivable that a 10 Gigabit Ethernet chip designed using a similar approach would consume an unacceptable power of 10 Watts. In this talk we will see that many of the information-theoretic techniques that have traditionally been used to design good error control codes, can also be used to design low-power decoders. More specifically, we will see that by using appropriate power consumption models, an extension to the technique of density evolution can be used to predict the energy consumption requirements per transmitted bit. We will present comparisons between this technique and Monte Carlo simulation results that measure the activity in decoder chips. We will also demonstrate how the technique can be used to craft LLR message encodings that lead to low power decoder designs.

OLOF HEDEN
KTH - Royal Institute of Technology, Stockholm

A survey of perfect codes

Some results on perfect 1-error correcting binary codes, mainly from the last ten years, are presented. These results concerns enumerations, classifications, constructions, symmetries and some general results on the structure of perfect codes.

TONY MACULA
Geneseo College, SUNY

DNA codes

DNA nanotechnology often requires collections of oligonucleotides called DNA free energy gap codes that do not produce erroneous crosshybridizations in a competitive muliplexing environment. In this talk we address the question of how to design these codes to accomplish a desired amount of work within an acceptable error rate. Using a statistical thermodynamic and probabilistic model of DNA code fidelity and mathematical random coding theory methods, theoretical lower bounds on the size of DNA codes are given.

More importantly, DNA code design parameters, e.g., strand number, strand length and sequence composition, needed to achieve experimental goals are identified.

MICHELE MOSCA
Institute for Quantum Computing (UW) and Perimeter Institute

Quantum information theory

DMITRY TRUKHACHEV
University of Alberta

Multiple User Detection and Throughput of Ad-Hoc Wireless Networks