BESTCOM meeting, 22 April 2016, Gent

Keynote presentation (45 min)

Introduction to error correcting codes for network coded networks
Maria Ángeles Vazquez-Castro (Autonomous University of Barcelona)

Network coding generalises network transmission by allowing in-network nodes to not just forward packets, but to algebraically combine packet's payloads. The original seminal results (Ahlswede et Al, 2000) explicitly characterize the Max-flow Min-Cut Theorem for single-source multicast over noiseless networks. The remarkable consequence of the concept of network coding is that the network information flow can no longer be regarded as a commodity flow, information flows are actually not conserved. It offers several advantages over routing such as bandwidth and power efficiency, computational efficiency, and robustness to network dynamics. For networks with errors and erasures, the capability of nodes to re-encode offer additional reliability advantages with respect to end-to-end traditional techniques such as forward error correction (FEC) or automatic repeat-request (ARQ). In particular, coding for errors and erasures over random network coding based on subspace coding is a well established area of research. The key assumption underlying subspace coding is that channel and network codes operate separately, i.e. the error/erasure correcting code is designed end-to-end, oblivious of the network code. In this talk, we first introduce the origins, advantages and evolution of the concept of network coding for noiseless networks with illustrative examples. Then, we introduce error correcting codes for network coded networks with errors and erasures based on subspace codes.

Regular presentation 1 (30 min.)

Fast inhomogeneous plane-wave Physical Optics for radio-channel prediction
Quentin Gueuning, Christophe Craeye and Claude Oestges (UC Louvain)

A fast method for the radiation problem of large planar facets, i.e. as used in urban building databases, is presented. The radiation integral of Physical Optics is expected to better model the truncation effect thanks to the finite size dimension of the scatterer compared to GO/UTD, which is traditionally implemented in the context of channel characterization. We consider a spectral decomposition of the Green's function, leading to an "inhomogeneous", i.e. propagating and evanescent, plane-wave representation which doesn't suffer from any low-frequency, low-distance breakdowns. The integration parameters, i.e. the contour height, the sampling rate and the truncation limit of the integral are adaptively chosen according to the field of view and the distance from the source to accelerate the numerical convergence of the integral and thereby reach a lower number of plane-waves. First, an analytical expression for the plane-wave spectrum of illuminated polygonal surfaces, which allows a mesh-free evaluation of the field, is presented. Then, fast Laplace transforms are implemented to accelerate the computation of the complex patterns w.r.t the relative position of source and observation planes.

Regular presentation 2 (30 min)

Void creation: reculer pour mieux sauter
Kurt Van Hautegem, Wouter Rogiest and Herwig Bruneel (UGent-TELIN)

With ever-increasing demand for bandwidth, both optical packet switching and optical burst switching are proposed as alternatives to increase the capacity of optical networks in the future. In these packet-based switching techniques, Fiber Delay Lines are used to avoid contention between packets on a single wavelength. The involved scheduling algorithms decide on which Fiber Delay Line each packet is scheduled in order to minimize packet loss and/or packet delay. By selectively delaying packets longer than strictly necessary, we proposed a schedule called void-creation that outperforms existing void-filling algorithms without increasing the computational cost, and this by up to 50 % for a specific setting with fixed packet size. This contribution extends the concept of void-creation to the case of variable size packets. By conditioning the theoretical value of the packet size on the scheduling parameters, we are able to extend the applicability of the void-creating algorithm to a plurality of settings. We therefore developed a numerical procedure that assigns a theoretical value (or, equivalently, negative cost) to each void based on how likely the void will eventually be filled and thus proven useful. Results obtained by Monte Carlo simulation show that our void-values provide a solid and consistent basis to decide upon void creation, and this for a variety of packet size distributions.

Regular presentation 3 (30 min)

Latest advances in stochastic circuit and interconnect modeling
Paolo Manfredi, Dries Vande Ginste, Daniël De Zutter (UGent-INTEC)

This talk reviews the most recent advances in the stochastic modeling of electronic circuits and interconnects. Specifically, the presentation focuses on the latest developments of non-intrusive polynomial chaos methods for high-dimensional problems. The application examples include interconnect structures and power amplifiers with up to 25 independent random parameters. Furthermore, a perturbation technique for a faster simulation of nonuniform transmission lines is presented, with application to the efficient stochastic analysis of randomly twisted pair cables.

Regular presentation 4 (30 min.)

A multiple-relay communication protocol for achieving fairness in cellular systems
Rodolfo Torrea-Duran (KU Leuven, ESAT/STADIUS), Fernando Rosas (KU Leuven, ESAT/MICAS), Sofie Pollin (KU Leuven, ESAT/TELEMIC), Luc Vandendorpe (UC Louvain), Marc Moonen (KU Leuven, ESAT/STADIUS)

The continuously growing demand for large data rates has turned bandwidth into a scarce resource that has to be carefully managed. The most common bandwidth management policy is to allocate a disjoint set of resources to different users. However, even with an equal resource allocation, the variable channel conditions prevent from guaranteeing a fair service to all the users unless channel state information at the transmitter (CSIT) is used. One solution to reduce this variability without using CSIT, and hence to improve fairness, is to introduce spatial diversity through distributed antennas. Apart from requiring a backhaul connection, the distributed nature of these systems makes them very sensitive to synchronization offsets. An alternative that bypasses these problems is to deploy relays. Nevertheless, this solution involves additional infrastructure and requires extra transmission time for the relayed signals. To tackle these problems, we propose a multiple-relay communication protocol for achieving fairness in cellular systems. Inspired by network coding, it exploits spatial diversity without requiring extra transmission time or additional infrastructure. We show that our approach can guarantee fairness among users without using CSIT at the cost of a marginal sacrifice in the average spectral efficiency when compared to other communication schemes.