IAP Bestcom

Bestcom Meeting

BESTCOM meeting - Fall 2014

UCL, October 23, 2014

Venue: The meeting will be held in:
UCL/ICTEAM, Maxwell Building, 3 place du Levant, 1rst floor, Shannon and Nyquist meeting rooms, 1348 Louvain la Neuve, Belgium
http://uclouvain.be/en-268243.html

Program (slides)

- 09h15-09h45: Welcome coffee

- 09h45: Opening by L. Vandendorpe (BESTCOM coordinator)

- 10h00-10h30: Oral presentation I

Title : Blind Interference Alignment for Cellular Networks

Authors : Máximo Morales-Céspedes, Jorge Plata-Chaves*, Dimitris Toumpakaris, Syed A. Jafar, Ana García Armada and Marc Moonen*

Abstract : We propose a blind interference alignment scheme for partially connected cellular networks. The scheme cancels both intracell and intercell interference by relying on receivers with one reconfigurable antenna and by allowing users at the cell edge to be served by all the BSs in their proximity. An outer bound for the Degrees of Freedom is derived for general partially connected networks with single-antenna receivers when knowledge of the channel state information at the transmitter is not available. It is demonstrated that for symmetric scenarios this outer bound is achieved by the proposed scheme. Moreover, significant reduction of the supersymbol length is achieved compared to a standard blind interference alignment strategy designed for fully connected networks.

- 10h30-11h15: Keynote I

Title : Analysis and Design of Emerging Dense 5G Network Topologies

Author : **Dr. Marios Kountouris,** Department of Telecommunications, SUPELEC, France

Abstract : With the increase in data traffic driven by a new generation of wireless devices, data is expected to overwhelm cellular network capacity in the future. Novel radio network topologies, taking into account the need for autonomy, enhanced data rate and uniform user experience, energy efficiency, high capacity backhaul, and

smaller low power base stations, are proposed and several new communication techniques are envisaged for future 5G networks. In such emerging dense and heterogeneous network architectures, the spatial locations and dynamic interactions of communication entities will play a key role in the performance. In this talk, we discuss how advanced mathematical tools, such as stochastic geometry, can be used in order to provide key insights on the design and performance analysis (such as coverage, area spectral efficiency, average rate) of emerging 5G networks. In particular, we highlight key results and insights obtained using stochastic geometry in heterogeneous cellular networks, device-to-device (D2D) communication and caching-enabled networks. We finally discuss emerging topics in 5G networks, such as anticipatory communication and proactive resource allocation.

- 11h15-11h35: Coffee break

- 11h35-12h05 : Oral presentation II

Title : XXX

Authors : J. Louveaux

Abstract :

- 12h05-12h20: Poster spotlight presentation : each poster presenter will have one minute to introduce his/her poster by means of a single slide

- 12h20-12h50 : Oral presentation III

Title : Stochastic Analysis of High-Speed Interconnects via Polynomial Chaos

Authors : Dr. Paolo Manfredi

Abstract : With the increasing miniaturization of communication devices, the impact of manufacturing variability on high-speed links is becoming increasingly critical. During the design phase, the performance of such interconnects is therefore better assessed from a statistical standpoint. However, virtually all simulators rely on the inefficient and time-consuming Monte Carlo method. In this talk, an alternative modeling and simulation strategy, based on the so-called polynomial chaos framework, is presented. The approach is applied to the circuit-level governing equations of multiconductor transmission lines and turns out to be significantly more efficient. The challenging time-domain simulation and the inclusion of nonlinear terminations are discussed. It is also shown that the proposed simulation technique is compatible with commercial SPICE-type circuit simulators.

- 12h50-13h50: Lunch and PI meeting

- 13h50-14h30: Poster session (all posters)

- 14h30-15h15: Keynote II

Title : The Wireless Interference Paradigm - To Align and Harvest

Author : Bruno Clerckx, Electrical and Electronic Engineering Department, Imperial College London (London, United Kingdom).

Abstract : Wireless communication and energy networks have enabled a plethora of novel applications in the last years. Both make use of the same and unique RF medium, but have been so far designed independently from each other. In this talk, we will discuss some recent progresses in the area of Joint Wireless Information and Energy Transfer that wirelessly transfers energy jointly with information in wireless networks. The area, if found feasible, will create a new paradigm shift in future capacity and energy efficient wireless communication and energy networks (and in particular in M2M and IoT applications), by viewing them as a single network designed under a unified framework and by overcoming the energy constraint of wireless devices through the transfer/harvesting of RF energy. Contrary to current wireless communication networks, interference is viewed

as a source of energy to be harvested rather than mitigated. In the talk, we will discuss the role of interference in joint wireless information and power networks and identify the rate-harvested energy region and suitable interference management techniques in MIMO interference and broadcast channels.

- 15h15-15h45: Oral presentation IV

Title : Channel parameter estimation for Quantize-and-Forward Cooperative Communication

Authors : Iancu Avram, Nico Aerts and Marc Moeneclaey

Abstract : A method to improve the reliability of data transmission between two terminals without using multiple antennas is cooperative communication, where spatial diversity is introduced by the presence of a relay terminal. The Quantize and Forward (QF) protocol is suitable to implement in resource constraint relays, because of its low complexity. In this oral contribution, channel parameter estimation for Quantize-and-Forward is discussed. Two different estimation strategies are considered. A first approach is to estimate the source-relay channel at the relay and to compensate for the channel rotation caused by this channel before quantizing the received samples. While this yields a less complex estimation process at the destination, it imposes an additional computational burden upon the relay. A second approach is to estimate all channel parameters at the destination, including those concerning the source-relay channel. This approach shifts the computational burden from the relay to the destination, where typically there is more computing power available. It is shown that both approaches achieve an error performance that is very close to that of a system in which the channel parameters are assumed to be known.

- 15h45-16h15 : Coffee break and poster session (all posters)

POSTERS

(P1) Title : MMSE Network Coding Protocol for Double Relay Channel in Cellular Systems

Authors : Rodolfo Torrea-Duran*, Fernando Rosas, Zuhaib Ashfaq Khan, Sofie Pollin, Paschalis Tsiaflakis*, and Marc Moonen*

Abstract : The continuous growth of demand for wireless connectivity and high data rates has turned bandwidth into a scarce resource that should be carefully managed. A common solution is to assign disjoint portions of the bandwidth to different users, but the portion size decreases as the number of users grows. An alternative solution is to introduce spatial diversity through coordinated base stations, but such systems are very sensitive to timing and frequency synchronization offsets.To tackle these problems, we use principles of network coding for bandwidth management in a cellular system of two base stations and two users. Our approach consists of a three-time-slots transmission strategy and a MMSE reception strategy. It avoids the need of tight frequency or timing synchronization between base stations through a simple communication protocol. Also, it does not require additional bandwidth or infrastructure as it uses currently-deployed base stations as relays. By finding a balance between spatial diversity and transmission time, our approach achieves the system capacity in all SNR conditions. Finally, it reaches optimal fairness among users when compared to other time-multiplexing approaches.

(P2) Title : Power Allocation and Automatic Degrees of Freedom Selection for Interference Alignment

Authors : Jeroen Verdyck*, Jasper Wouters and Marc Moonen*

Abstract : In a multi-user MIMO scenario, interference is inherently present. This interference will degrade the performance of multi-user MIMO systems. Recently, a new class of schemes has been introduced that mitigate interference using interference alignment. These algorithms focus on aligning signaling spaces, but do not yet consider power allocation. Our contribution is a power optimization extension for the already existent Max SINR algorithm, which improves the overall data rate of the system. The power allocation algorithm for Max SINR will also allow for interference alignment without prior knowledge.

(P3) Title : Efficient performance analysis of opportunistic schedulers in wireless networks

Authors : Ekaterina Evdokimova, Koen De Turck, Sabine Wittevrongel and Dieter Fiems

Abstract : In our work we focus on the performance evaluation of wireless channel-aware or opportunistic schedulers. More specifically, we consider an access point in a wireless network transmitting to multiple users and operating under varying channel conditions. For such systems, in order to maximize system throughput and satisfy QoS requirements an efficient resource allocation scheme is required. Therefore, different channel- and buffer-aware schedulers are presented in recent literature. The performance measures, however, are usually derived based on simulations, as the adequate analytical tools are currently underdeveloped. To assess the performance at the access point, we consider a finite-capacity Markovian queuing model representing jointly the buffer behavior and channel quality variations. As the multidimensional model under study suffers from state-space explosion, we propose an efficient numerical method relying on MacLaurin series expansion techniques in order to estimate the steady-state distribution. The numerical results show that the suggested approach yields fast and accurate approximations for two extreme situations namely light and overload traffic

(P4) Title : A priority mechanism limited in time for discrete-time queues

Authors : Sofian De Clercq, Bart Steyaert, Herwig Bruneel

Abstract : To counter starvation of low priority customers in a queue subject to absolute priority scheduling, a number of alternatives can be used. We studied a priority mechanism that selects a low priority customer for service if there are no high priority customers left in the queue that arrived at most a given amount of time later than the selected low priority customer. This is functionally equivalent to earliest-due-date (EDD) scheduling, with the added remark that high priority customers are modelled as customers with an earlier deadline than low priority customers. The difference in deadline between low and high priority customers is then the parameter of the priority mechanism. When we consider only two deadlines, or two priority classes, we can obtain analytical results for the distribution of delay and buffer occupancy of both classes of customers using a generating functions approach. The analysis however, specifically uses the discrete-time paradigm, - i.e. the given amount of time is expressed as an integer number of time slots - so the same distributions in continuous time cannot yet be claimed.

(P5) Title : Cooperative hybrid localization using Gaussian processes and belief propagation

Authors : Samuel Van de Velde, Gundeep Arora, Luigi Vallozzi, Hendrik Rogier, Heidi Steendam

Abstract : Wireless localization using signal strength has been very popular in commercial applications due to the wide availability of 802.11 WiFi networks. However, signal strength information alone provides very rough location estimates. In this paper we consider supplementing the receiver of each user with a ranging unit required for accurate positioning. By allowing range-based cooperation between the users, it becomes possible to increase the positioning accuracy without the need of a fully deployed network of ranging anchors. To this end, we propose a fully distributed localization algorithm that uses belief propagation for fusing signal strength and ranging information. Extensive simulations, using 3D ray tracing to provide accurate radio maps, show that the proposed fusion of measurements results in a very scalable localization solution, where the localization performance smoothly transitions in accuracy, depending on the available infrastructure.

(P6) Title : Comparison of error-control schemes for high-rate communication over short DSL loops affected by impulsive noise

Authors : Julie Neckebroek, Marc Moeneclaey, Mamoun Guenach, Michael Timmers, Jochen Maes

Abstract : We consider Discrete Multitone Transmission over short Digital Subscriber Lines using bandwidths applicable to G.fast, in the presence of impulsive noise. Various combinations of coding and retransmission schemes are compared in terms of bit error ratio performance and error-free information bitrate (goodput). Our study shows that, under an error performance constraint, retransmission schemes allow to achieve larger goodput with smaller latency as compared to the traditional combination of Reed-Solomon coding and Trellis Coded Modulation with a large interleaver in between.

(P7) Title : Experimental observations about the performance on Multipath TCP

Authors : Juan Antonio Cordero, Olivier Bonaventure

Abstract : Multipath TCP is a major extension of TCP, which enables end users to leverage, when available, multiple available interface in reliable Internet connections. This work explores the performance of Multipath TCP, by comparing experimentally two user experience metrics (bandwidth and delay) with standard TCP in scenarios where users have two networking interfaces. A testbed with two disjoint networking paths (through local wired UCL network and through FON wireless access point) between a local server and a probe is deployed at UCL in order to evaluate Multipath TCP. Initial results confirm the potential of Multipath TCP, and suggest that the benefits on effective bandwidth and transmission delay strongly depend on the relationship between bandwidths at each available interface.

(P8) Title : A Stochastic Framework for the Variability Analysis of Textile Antennas

Authors : Marco Rossi, Arnaut Dierck, Hendrik Rogier, Dries Vande Ginste

Abstract : A novel framework to accurately quantify the effect of stochastic variations of design parameters on the performance of textile antennas is developed and tested. First, a sensitivity analysis is applied to get a rough idea about the effect of these random variations on the textile antenna's performance. Next, a more detailed view is obtained by a Generalized Polynomial Chaos technique that accurately quantifies the statistical distribution of the textile antenna's figures of merit, for a given range over which geometry and material parameters vary statistically according to a given distribution. The method is validated both for a simple inset-fed patch textile microstrip antenna and for a dual-polarized textile antenna. For the latter, the probability density function corresponding to its most sensitive design parameter, being the width, is experimentally estimated by means of measurements performed on 100 patches. A Kolmogorov-Smirnoff test proves that, for all considered examples, the results are as accurate as those obtained via Monte Carlo analysis, while the new technique is much more efficient. Indeed, speedups up to a factor 1667 are demonstrated.

(P9) Title : Power Delay Profile Modeling in Indoor environments

Authors : Aliou Bamba[1], Evgenii Vinogradov[2], Wout Joseph[1], Claude Oestges[2], Emmeric Tanghe[1] and Luc Martens

Abstract : Wireless local area networks (WLANs) are getting more and more attention from the wireless propagation community since they are increasingly launched in indoor environments. For instance, new short-range personal communication applications are being developed for indoor environments. These technologies have low transmitting power and offer new services. The total received power, the rms delay spread are important parameters for the efficient design of these systems. Therefore, the knowledge of the propagation characteristics within buildings is of main importance.
Wireless propagation is very complex in realistic indoor environments and site-independent propagation models that would take into account for all the impairments encountered in such environments are necessary. The ITU-R P.1238-7 recommendation encourages researchers to model the propagation in indoor environments with a minimum of input parameters. Following that recommendation, we propose a general-site channel model to characterize the propagation in indoor environments where the diffuse fields caused by diffractions, scatterings, etc. are prominent. The main input of the model is the reverberation time of the considered environment. Moreover, the small scale variations of the power level due to the transceivers and/or objects motion (dynamic scenario) will be account in the proposed model. Satisfactory preliminary results are obtained for the static scenario. However, extensive measurements in dynamic scenario should be conducted to complete the model.

(P10) Title :' Energy Efficient Precoder Design for MIMO-OFDM with Rate-dependent Circuit Power

Authors : Zijian Wang, Ivan Stupia, Luc Vandendorpe

Abstract : This paper studies an energy efficient design of precoders for point-to-point multiple-input-multiple-output (MIMO) orthogonal frequency-division multiplexing (OFDM) systems. Differently from traditional approaches, the optimal power allocation strategy is studied by modelling the circuit power as a rate-dependent function. We show that if the circuit power is a constant plus an increasing and convex function of the transmission rate, the problem of minimizing the consumed energy per bit received can be reformulated as a convex fractional program and solved by means of a bisection algorithm. The impact of the some system parameters is investigated either analytically or by means of computational results.