BESTCOM meeting - Fall 2016

UCL, October 21, 2016

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

- 09h15-09h45: Welcome coffee

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

- 10h00-10h30: Oral presentation I

Title: Interference Management for *K*-Tier Networks without CSIT using Reconfigurable Antennas
Authors: Máximo Morales-Céspedes (UCL), Jorge Plata-Chaves (KULeuven), Syed A. Jafar (U. California Irvine), Marc Moonen (KULeuven), Luc Vandendorpe (UCL)

Abstract: Cellular networks are in a major transition from homogenous and carefully designed deployments based on BSs that cover a large geographical area to a very heterogenous network composed of macro, micro, pico, femto cells and relays. In this kind of scenario the costs of coordination and Channel State Information at the Transmitter result unaffordable. In this work, we consider the use of reconfigurable antennas as a means of achieving multiplexing gain, i.e., the number of Degrees of Freedom, in absence of Channel State Information at the Transmitter. In this work, we derive the DoF of a *K*-tier heterogeneous networks without CSIT, data sharing among BSs or cooperation among tiers. It is demonstrated that the achievable DoF in each tier does not depend on the parameters of the lower tiers. That is, the number of tiers below a considered tier does not involve a DoF penalty for the whole system. Indeed, it can be also demonstrated that providing zero-DoF in any tier with the aim of improving the achievable DoF in the lower tier obtain less DoF in the whole network than managing the inter-tier interference when the number of transmit antennas in the upper tiers is greater than in the lower tiers. Moreover, a transmission scheme based on Blind Interference Alignment that achieves the performance derived in the aforementioned information theory converse proof is derived. It is interesting to remark that the proposed scheme allows to cancel any source of interference, i.e., intracell, intercell and inter-tier interference.

- 10h30-11h15: Keynote I

Title: Evolution of 5G networks: interplay between communications and positioning
Authors: Ph. De Doncker, Fr. Horlin, Fr. Quitin, M. Van Eeckhaute, Th. Van Der Vorst (ULB)

Abstract: From the nineties onwards, cellular networks have continuously evolved to become one of the main blocks of our ICT all-pervasive world. The first 2G systems were dedicated to voice communications. Data communications with low to medium bit rates were included in 3G, while 4G now offers data rates similar to those experienced with Wi-Fi. But the demand for high performance cellular networks is still increasing, due on

the one hand to the explosion of the number of connected devices (the so-called Internet-of-Things), and on the other hand to the ever-growing user requirements in terms of capacity and availability. Cellular networks of the fifth generation (5G) are foreseen by 2020 to meet this evolution. In parallel, cellular networks have also evolved towards geo-located services: users are localized by the base stations. In 2G and 3G, this process is very crude, and mainly limited to cell ID localization. From 4G onwards, localization has become an essential part of network functionalities, with specific reference signals included in the protocol.
The talk will present recent research in the Wireless Communications Group (WCG) at the Université libre de Bruxelles (ULB) aiming at studying the interplay between the communications and positioning functionalities in the context of emerging 5G cellular networks. From a communication perspective, the knowledge of the terminal position potentially based on predictions enables the adaptation of the air interface based on pre-established databases and the use of directional communications to significantly enhance the energy and spectral efficiency. From a positioning perspective, the new waveforms foreseen for 5G must correctly be adapted to efficiently support the localization in complex environments based on their observations. The deployment of multi-antenna anchors foreseen in indoor environments opens the door to accurate positioning of narrowband sensors.
The presentation will not only address the main research objectives but also detail specific results obtained by the group on the communication and localization axes. A thorough comparison of the multi-carrier waveforms foreseen for broadband 5G will first be proposed aiming at selecting the best performance air interface. A new iterative time-of-arrival (ToA)-based positioning algorithm will secondly be presented that significantly enhances the localization accuracy compared to traditional two-step approaches. The methodology based on the chaos polynomial framework to evaluate the uncertainty of the MUSIC angle-of-arrival (AoA) estimation algorithm in the presence of antenna calibration errors will thirdly be introduced. Finally some last results on the implementation of positioning algorithms on SDR platforms taking into account hardware imperfections will be provided.

- 11h15-11h35: Coffee break

- 11h35-12h05: Oral presentation II

Title: Applying machine learning for improved wireless network performance

Authors: Merima Kulin, Eli De Poorter, Dirk Deschrijver, Tom Dhaene and Ingrid Moerman (UGent-INTEC)

Abstract: To cope with the complexity of wireless networks, academic and industry researchers are increasingly utilizing machine learning techniques to better understand, diagnose, optimize and remedy wireless networks. However, machine learning and wireless networking are two research domains that can, from time to time, be difficult to combine with each other. This presentation gives (i) an overview of application domains in which machine learning has successfully been applied, (ii) discusses the benefits and limitations of using different machine learning techniques for improving network performance and (iii) gives a detailed tutorial-style example on how to apply machine learning for detecting devices types and protocol types based on wireless traces. The presentation mainly targets an audience of researchers with network protocol experience that do not yet have a deep understanding of machine learning techniques and that wish to learn more about the possibilities and possible applications of these techniques for network optimisation.

- 12h05-12h25: Poster spotlight presentation: each poster presenter will have one minute to introduce his/her poster by means of a single slide

- 12h25-12h55: Oral presentation III

Title: Frame synchronization for coded signalling under pulsed jamming conditions

Authors: Nele Noels (UGent-TELIN), Marc Moeneclaey (UGent-TELIN)

Abstract: Due to its ability to increase resistance to intentional jamming and prevent eavesdropping, direct-sequence spread-spectrum (DS-SS) modulation is a promising technique to establish secure communications at the physical layer. An effective jamming strategy that is commonly employed against a (DS-SS) signal is pulsed jamming. To increase the system's vulnerability to pulsed jamming, DS-SS modulation is often combined with advanced error correction coding. Evidently, accurate frame synchronization, which is the process of locating the

individual code words within a received bit stream, is an essential prerequisite for the proper operation of the employed channel decoders. In this presentation, we discuss results of a current study that aims to identify and evaluate potential frame synchronization algorithms for a selection of coding schemes under pulsed jamming conditions.

- 12h55-14h00: Lunch and PI meeting

- 14h00-14h40: Poster session (all posters)

- 14h40-15h25: Keynote II

Title: Massive MIMO: from user separation to fairness to RAN slicing

Author: Sofie Pollin, KULeuven

Abstract: Massive MIMO is widely seen as promising candidate for 5G as it promises high throughput, long range and low cost or power consumption. In this presentation, we will first study the throughput in a Massive MIMO system, and show how it depends on the channel properties. Through measurements, we will illustrate how distribute Massive MIMO systems can positively impact channel properties, and hence system sum-rate. Then, we will study how and if power control can be used to not only increase sum-rate, but also user fairness especially for the cell edge users. It is shown that, also for Massive MIMO, fairness can be achieved only by sacrificing sum rate, similar to traditional cellular systems. Finally, we will zoom in to some of the implementation challenges, such as reciprocity calibration, channel estimation or adjacent channel leakage. To conclude the talk, we will explain the RAN slicing concept, and the implications for optimisation and radio resource management for 5G.

- 15h25-15h55: Oral presentation IV

Title: Cross-Layer Scheduling through Network Utility Maximisation for Digital Subscriber Line Networks

Authors: Jeroen Verdyck (KU Leuven), Jeremy Van den Eynde (University of Antwerp), Chris Blondia (University of Antwerp), Marc Moonen (KU Leuven)

Abstract: In DSL networks, crosstalk introduces competition for bandwidth among users. Dynamic spectrum management techniques, which are used to combat crosstalk, give rise to a rate region which contains no single point that simultaneously maximizes the data rate of all users. Instead, there is a set of Pareto-optimal resource allocation settings that result in a data rate tuple on the edge of the rate region. A DSL system typically uses a fixed operating point for the physical layer for an extended period of time, thus leaving unused a significant portion of the rate region. An alternative to this static resource allocation is to divide time into slots of short duration, and to change the resource allocation from one time slot to the next. A cross-layer scheduler then chooses a different resource allocation setting for each time slot by defining a non-linear utility function for each user, and solving the corresponding network utility maximization (NUM) problem. We introduce a fast algorithm, referred to as NUM-DSB, that solves the NUM problem for a DSL system that employs spectrum coordination. NUM-DSB can be applied to any NUM problem, regardless of the considered utility functions' characteristics. Simulations demonstrate that cross-layer scheduling using non-linear utility functions can result in significant performance improvements.

- 15h55-16h10: Oral presentation V

Title: Inclusive Radio Communication Networks for 5G and beyond (IRACON): the COST Action CA 15104

Authors: C. Oestges (UCL)

- 16h10-16h50: Coffee break and poster session (all posters)

POSTERS

(P1) Title: Class clustering in a system with dedicated servers and a global FCFS service discipline

Authors: Willem Mélange, Joris Walraevens, Dieter Claeys, Herwig Bruneel, Department of Telecommunications and Information Processing, Ghent University - UGent

Abstract: We consider a continuous-time queueing model with two types (classes) of customers each having their own dedicated server with exponential service times. The system adopts a "global FCFS" service discipline, i.e., all arriving customers are accommodated in one single FCFS queue, regardless of their types."Class clustering", i.e., the fact that customers of any given type may (or may not) have a tendency to "arrive back-to-back", is a concept that we believe is often neglected in literature. As it is clear that customers of different types hinder each other more as they tend to arrive in the system more clustered according to class. Our major objective is to estimate the impact of the degree of class clustering on the system performance. The motivation of our work are systems where this kind of blocking is encountered, such as security checkpoints.

(P2) Title: Exploration of user separation with distributed Massive MIMO

Authors: Cheng-Ming Chen, S. Pollin (KULeuven)

Abstract: In this paper, we present a novel exploration of spatial separation of closely-located users by a massive MIMO system in line-of-sight (LoS) for both an anechoic chamber and an indoor corridor propagation environments. A distributed massive multiple-input multiple-output (DM-MIMO) system powered by software defined radios (SDRs) has been used for the measurement campaign. For the user separation study, we first conduct an analysis with a spherical wave channel model for physically-large rectangular arrays. Preliminary simulation results show that a single antenna array achieves better user separation for users distributed on a line parallel to the array plane rather than when users are distributed on a line normal to the array. An intuitive idea is that, by splitting a collocated antenna array into two subarrays, additional diversity is created if the second sub-array is on a plane orthogonal to the first sub-array. Figures of merit such as the correlation coefficients, condition numbers and sum-rates of both centralized and distributed antenna arrays have been chosen to determine the impact of array split and positioning on user separation. Extensive measurements, performed on two 32- element antenna arrays of a massive MIMO testbed at 2.6GHz, show that an improvement of around 140% can be achieved in a poor scattered environment if distributed arrays are used instead of centralized ones.

(P3) Title: Exploiting Partial Connectivity in Dense Cellular Networks

Authors: Rodolfo Torrea-Duran (KU Leuven), Máximo Morales Céspedes (UCL), Jorge Plata-Chaves (KU Leuven), Luc Vandendorpe (UCL), and Marc Moonen (KU Leuven),

Abstract: Network densification has been proposed as a solution to cope with the ever-increasing demand in wireless connectivity, although it increases the interference levels in the network. Reducing this interference without compromising the network capacity requires a careful balance between an orthogonalizing, reusing, and borrowing resources. Channel state information at the transmitter (CSIT) and availability of a backhaul link can facilitate such a balance. However, obtaining reliable CSIT constitutes an expensive overhead, while the access to a backhaul link remains a challenge for dense networks. Physical-layer network coding can efficiently coordinate transmissions without the need of CSIT or a backhaul link. However, it has been used only for relay transmissions and small-size networks. Therefore, in this paper we propose a communication protocol that exploits connectivity of the network without the need of CSIT or a backhaul link. We show that the proposed protocol is able to achieve an increase of spectral efficiency and almost full spatial diversity when the connectivity of the system is correctly dimensioned.

(P4) Title: Joint α-fairness based DSM and user encoding ordering for zero-forcing nonlinear precoding in G.fast downstream transmission

Authors: Wouter Lanneer (KU Leuven), Paschalis Tsiaflakis (Nokia Bell Labs), Jochen Maes (Nokia Bell Labs), Marc Moonen (KU Leuven)

Abstract: In the G.fast frequency range with strong levels of crosstalk, nonlinear precoding (NLP) is proposed as a near-optimal technique for crosstalk precompensation in downstream transmission. While existing methods for multi-tone NLP user encoding ordering (UEO) are rather heuristic in how they approach fairness and suffer from substantial suboptimality, we develop a novel algorithm for joint dynamic spectrum management (DSM) and UEO that enforces a generalized α-fairness policy. Since finding the optimal UEO is a combinatorial optimization problem with excessive computational complexity, the proposed algorithm uses a low-complexity iterative method which provides near-optimal approximate solutions. Simulations demonstrate that the novel algorithm achieves a trade-off between fairness and performance that outperforms current UEO methods.

(P5) Title: Multi-Task Wireless Sensor Network for Joint Distributed Node-Specific Signal Enhancement, LCMV Beamforming and DOA Estimation

Authors: Amin Hassani (KU Leuven), Marc Moonen (KU Leuven), and Alexander Bertrand (KU Leuven)

Abstract: We consider a multi-task Wireless Sensor Network (WSN) where some of the nodes aim at applying a multi-channel Wiener filter to denoise their local sensor signals, while others aim at implementing a linearly constrained minimum variance beamformer to extract node-specific desired signals and cancel interfering signals, and again others aim at estimating the node-specific direction-of-arrival of a set of desired sources. For this multi-task WSN, by relying on distributed signal estimation techniques that incorporate a low-rank approximation of the desired signals correlation matrix, we design a distributed algorithm under which the nodes cooperate with reduced communication resources even though they are solving different signal processing tasks and do not know the tasks of the other nodes. Convergence and optimality results show that the proposed algorithm lets all the nodes achieve the network-wide centralized solution of their node-specific estimation problem. Finally, the algorithm is applied in a wireless acoustic sensor network scenario with multiple speech sources to show the effectiveness of the algorithm and support the theoretical results.

(P6) Title: Performance Comparison of Short-Length Error-Correcting Codes

Authors: J. Van Wonterghem (UGent-TELIN), A. Alloum (Nokia Bell Labs, France), J.J. Boutros (Texas A&M University, Qatar), and M. Moeneclaey (UGent-TELIN)

Abstract: We compare the performance of short-length linear binary codes on the binary erasure channel and the binary-input Gaussian channel. We use a universal decoder that can decode any linear binary block code: Gaussian-elimination based Maximum-Likelihood decoder on the erasure channel and probabilistic Ordered Statistics Decoder on the Gaussian channel. As such we compare codes and not decoders. The word error rate versus the channel parameter is found for LDPC, Reed-Muller, Polar, and BCH codes at length 256 bits. BCH codes outperform other codes in absence of cyclic redundancy check. Under joint decoding, the concatenation of a cyclic redundancy check makes all codes perform very close to optimal lower bounds.

(P7) Title: MMSE equalization of multi-Gb/s chip-to-chip interconnects with M-PAM signaling affected by manufacturing tolerances

Authors: Jelle Bailleul (UGent-TELIN), Lennert Jacobs (UGent-TELIN), Paolo Manfredi (UGent-INTEC), Dries Vande Ginste (UGent-INTEC), Marc Moeneclaey (UGent-TELIN)

Abstract: To further increase the communication speed on a chip-to-chip interconnect, more powerful equalization will be needed to reduce the considerable intersymbol interference caused by frequency-dependent attenuation. These interconnects however are prone to manufacturing tolerances, leading to equalization schemes that ideally are adjustable according to each specific realization. In this paper we make use of the minimum mean-square error criterion to obtain novel reduced-complexity equalizers, which have only some parts adjustable and the remaining parts fixed. These equalization schemes are compared with the all-adjustable equalizers in terms of mean-square error and symbol error rate, for communication speeds of 20 Gbit/s and 120 Gbit/s. For a microstrip with 10% tolerance on its parameters, we point out that using a fixed pre-equalizer and an adjustable decision-feedback filter gives rise to only a minor symbol error performance degradation (less than about 1.5 dB), both for 2-PAM and 4-PAM signaling at both considered bit rates.

(P8) Title: Adaptive modulation and coding for BIC-UFMC and BIC-OFDM systems taking CFO into account

Authors: E. Debels (UGent-TELIN), P. Del Fiorentino (UPisa), C. Vitiello (UPisa), V. Lottici (UPisa), J. Van Hecke (UGent-TELIN), M. Moeneclaey (UGent-TELIN)

Abstract: The performance of multi-carrier systems can be considerably degraded because of the inter-carrier interference (ICI) caused by a carrier frequency offset (CFO) between the transmitter and the receiver. A recently developed multi-carrier modulation technique, referred to as uniform filtered multicarrier (UFMC) system, improves the robustness against CFO, thereby relaxing the synchronization requirements. However, the goodput (GP) of the system still rapidly drops with increasing CFO when using the classical adaptive modulation and coding (AMC) schemes based on the SNRs of the subcarriers, because they ignore the presence of the CFO-induced ICI. To tackle this problem, this contribution performs the AMC taking into account also the ICI caused by the CFO, and thereby achieves a significant increase of the GP.

(P9) Title: Step Counting Using Machine Learning

Authors: Stef Vandermeeren (UGent-TELIN), Samuel Van de Velde (UGent-TELIN), Heidi Steendam (UGent-TELIN)

Abstract: The last decade, much research effort was devoted to accurate indoor positioning which has many applications, e.g. navigation in shopping centers, hospitals, airports or asset tracking. A promising technology is Ultra-Wideband (UWB) which should be able to achieve an accuracy of the order of tens of centimeters. A UWB network consist of anchors with a fixed known location and users with an unknown and possibly changing location. If a user wants to know its position, he transmits a pulse and an anchor sends a response. The time difference between the transmitted and received pulse changes proportionally with the distance between the user and the anchor. 2D (3D) positioning requires the knowledge of the distance between the user and three (four) anchors. Hence, a user needs to range with several anchors. As a user can range with only one anchor at a time, this implies that if multiple users want to know their position, the update rate can be low and range data can be outdated. To solve this problem, researchers attempt to increase the accuracy with other technologies, e.g. with an Inertial Measurement Unit (IMU), which captures data from an accelerometer, gyroscope and magnetometer. The accelerometer can be used to detect a step and its direction and length. We will use a support vector machine (SVM) to count steps and investigate which features influence the accuracy most. The advantage of using SVM for step counting is the absence of parameters: it simply suffices to include new training data for a different person or situation. A training data set of 2900 snippets and a test set of 405 snippets were acquired. In 91.85% of the time, the SVM correctly predicts the number of steps in a snippet of the test set. In our experiment, the correct number of steps in the test set, corresponding to about 15 minutes of data, was 925, while the SVM algorithm returned 921 steps. Hence, we obtained an error of 0.43%, although the SVM predicts the number of steps in a snippet correctly in only 91.85% of the cases.

(P10) Title: Analytical Formulation for the micro-Doppler Spectrum for Rotating Targets in the Near-Field

Authors: Jean Léger, Thomas Pairon, C. Craeye (UCL)

Abstract: The analysis of the Doppler signal returned by rotating targets is of great interest in the framework of target recognition and equipment monitoring. An analytical expression of such a signal already exists for the far-field case, based on the Jacobi-Anger expansion. An extension of this analytical expression is proposed for the near-field case. The solution involves a closed-form expression of each harmonic complex coefficient. An error analysis is carried out.

(P11) Title: A 1-bit quantized compressive scheme for RADAR

Authors: Thomas Feuillen, Laurent Jacques, Luc Vandendorpe (UCL)

Abstract: This paper studies a 1-bit Quantized Compressive Sensing (QCS) scheme of a radar signal receiver that could enable novel systems with reduced complexities or cheaper design compared to high resolution strategies. In particular, the range of a sparse set of targets is estimated with a dense or randomized Stepped Frequency Modulation (SFM) with an acquisition process limited to only two 1-bit Analog to Digital Converters (ADCs) per antenna, one for each ”I” and ”Q” channels. Extensive simulations on the corresponding (random) radar measurement model show first that close sparse target configurations are associated to close quantized observations up to some small distortions. Second, we develop a complex variant of the Binary Iterative Hard Thresholding algorithm, or CBIHT, for the estimation of a sparse set of targets from complex QCS radar

observations. Next, we show that the proposed 1-bit QCS framework reaches estimation errors similar to those obtained by both the common Maximum Likelihood Estimation (MLE) approach and the Iterative Hard Thresholding (IHT) algorithm when applied on full resolution radar observations. Finally, the feasibility of the QCS approach is studied over two different experimental setups in real conditions, with various sizes and quality.

(P12) Title: Modeling diffuse scattering correlation for effective roughness approaches

Authors: Yang Miao, Claude Oestges (UCL)

Abstract: Diffuse scattering (DS) is mostly caused by macroscopically rough surfaces. It can be modeled by effective roughness (ER) approaches, where the object surface is divided into tiles and the DS field amplitude for each tile is modeled. Conventionally, random phases are assigned to tiles therefore no correlation is endowed for DS. However, for a radio channel with a moving terminal, the characterization of the DS correlation can be crucial for the characterization of radio channel statistics in varying channel conditions. To this end, we propose a phase evolution model for adding DS correlation to ER approaches. The proposed model includes a deterministic part and a correlated (random) part, where the former is dependent on the distance variations between the moving terminal and each ER tile, and the latter is dependent on the angular variations. The predicted radio channel with DS correlation is compared and evaluated with the simulated/measured reference, in terms of the channel properties over spatial locations and spatial frequency.

(P13) Title: Performance study of Polynomial Chaos and Kriging based surrogate models for variability analysis of EM systems

Authors: Arun kaintura, Domenico Spina, Ivo Couckuyt, and Tom Dhaene (UGent-INTEC)

Abstract: Studying complex engineering problems via accurate physics-based simulation programs can be computationally very expensive. Alternatively, surrogate models, which approximate the input-output behavior of complex physical systems, are generally adopted as a reliable approach to study computational intensive problems. Once, these surrogate models are built with sufficient accuracy, they can be efficiently employed to perform various tasks, such as variability analysis. Various surrogate models exists in the literature and, moreover, have been applied in recent years for various design purposes: for example, Kriging and Polynomial Chaos Expansion (PCE). Recently, a combination of PCE and Kriging has been proposed in the literature (PCK), where the trend of the underlying problem (Kriging) is represented by a family of orthogonal polynomials, which are obtained by the Least Angle Regression Selection (LARS) algorithm. In this work, we investigate the properties and performance of the latter approach when applied to the unique characteristics of complex EM systems. The PCK approach is compared with state-of-the-art techniques for the variability analysis over a suitable example.

(P14) Title: Stochastic Analysis of the Efficiency of a Wireless Power Transfer System Subject to Antenna Variability and Position Uncertainties

Authors: Marco Rossi, Gert-Jan Stockman, Hendrik Rogier, Dries Vande Ginste (UGent-INTEC)

Abstract: The efficiency of a wireless power transfer (WPT) system in the radiative near-field is inevitably affected by the variability in the design parameters of the deployed antennas and by uncertainties in their mutual position. Therefore, we propose a stochastic analysis that combines the generalized polynomial chaos (gPC) theory with an efficient model for the interaction between devices in the radiative near-field. This framework enables us to investigate the impact of random effects on the power transfer efficiency (PTE) of a WPT system. More specifically, the WPT system under study consists of a transmitting horn antenna and a receiving textile antenna operating in the Industrial, Scientific and Medical (ISM) band at 2.45 GHz. First, we model the impact of the textile antenna's variability on the WPT system. Next, we include the position uncertainties of the antennas in the analysis in order to quantify the overall variations in the PTE. The analysis is carried out by means of polynomial-chaos-based macromodels, whereas a Monte Carlo simulation validates the complete technique. It is shown that the proposed approach is very accurate, more flexible and more efficient than a straightforward Monte Carlo analysis, with demonstrated speedup factors up to 2500.

(P15) Title: Generative Statistical Modelling of High-Speed Interconnects

Authors: Simon De Ridder, Paolo Manfredi, Jan De Geest (Amphenol-FCI), Tom Dhaene, Daniel De Zutter, Dries Vande Ginste (UGent-INTEC)

Abstract: A novel method is proposed to construct a generative statistical model for interconnects based on a limited set of S-parameter samples, obtained either by measuring or by simulating a few random realisations of these interconnects. The proposed method converts these original samples to a pole-residue representation with common poles. The distribution of the corresponding residues is modelled by sequential application of a principal component analysis and a kernel density estimation. Because this model is generative, new samples can be created with statistics similar to those of the original samples. A passivity check ensures that only passive generated samples are retained. This method is applied to a representative multiconductor transmission line example.

(P16) Title: Modular Transmitter and Receiver for Space-Time Coding

Authors: Quinten Van den Brande, Patrick Van Torre, Jo Verhaevert, Jan Vanfleteren, Hendrik Rogier (UGent-INTEC)

Abstract: Space-time coding is a technique providing transmit diversity, thereby significantly improving the Bit Error Rate (BER) in Rayleigh fading channels. In order to empirically evaluate the BER performance of different forms of space-time coding techniques, a Multiple Input Single Output (MISO) hardware system is developed, comprising both a transmitter and a receiver for space-time coded signals. The transmitter implements Alamouti space-time coding, while the receiver uses maximum likelihood estimation to decode the space-time codes. As a result, the hardware communication system is configured as a 2x1 MISO link. The hardware is designed modularly, in order for the system to be easily extendible for the connection of multiple antennas. A digital core allows high-speed data generation in the signal generator units, forwarding analog I and Q signals to the radio-frequency modules connected to it. The Bit Error Rate (BER) performance of the Alamouti diversity scheme is compared to the performance of Single Input Single Output (SISO) and Maximum Ratio Combining (MRC) systems. This comparison is based on simulation results, providing a good approximation of the theoretical BER performance, and a series of hardware measurements to empirically support this theoretical performance.

(P17) Title: Analysis of On- and Off-body Propagation for Energy Efficient WBAN Design in Dairy Barns

Authors: Said Benaissa, David Plets, Emmeric Tanghe, Günter Vermeeren, Luc Martens, Bart Sonck, Frank Tuyttens, Leen Vandaele, Wout Joseph (UGent-INTEC)

Abstract: The size of dairy cattle farms and the number of animals per stockperson are increasing. This makes the herd monitoring - especially the detection of animals that require attention (e.g., care, treatment or assistance) - a challenging task. Wireless body area networks (WBANs) could be effectively used on herds of dairy cows to monitor their health and welfare. However, the success of such a health care monitoring system relies on a good characterization of the on-body (e.g., udder to neck) and the off-body (e.g., neck to backend access point) wireless communications. In this work, we present propagation modelling of different on-body and off-body wireless communication scenarios for dairy cows in barns at 2.4 GHz. Based on the obtained propagation models, a WBAN that monitors multiple heath parameters is designed for optimal performances in terms of energy efficiency and packet error rate.

(P18) Title: Polarimetric Properties of Indoor MIMO Channels for Different Floor Levels in a Residential House

Authors: S. R. Kshetri, E. Tanghe, D. P. Gaillot, M. Liénard, L. Martens, W. Joseph (UGent-INTEC)

Abstract: This paper analyzes polarimetric characteristics of power delay profiles (PDPs), cross polarization discrimination (XPD), and received power of specular and diffuse multipath components of MIMO radio channels at 2.45 GHz. Measurements were done in a residential house at two floors levels: “same floor” and “cross floor”'. Variations of 5 to 15 dB in PDPs between co-and cross-polar links were found in the same floor level; however these changes decrease as links go from line-of-sight to non-line-of-sight. XPDs of the radio waves were found to be higher for the cross floor configuration, about 5 dB in horizontally and 7 dB in vertically polarized waves. Also, diffuse components of the radio channels were less affected in cross-polar subchannels compared to that of specular components in the same floor level. The results demonstrate the contribution of diffuse components to the total channel power is higher than previously presented studies for indoor environments.

(P19) Title: Aligning the Light without Channel State Information for Visible Light Communications

Authors: Máximo Morales-Céspedes (UCL), Cecilia Paredes (Universidad Carlos III de Madrid), Luc Vandendorpe (UCL)

Abstract: Light-emitting diode (LED)-based visible light communications (VLC), combining both illumination and communication, is a promising technique for providing high-speed, low cost indoor wireless services. Considering an indoor environment, the user terminal detect several sources of interference, and therefore, inter-user interference may severely degrade the system performance. In this work, we propose the use of multiple light sources to obtain multiplexing gain in absence of Channel State Information at the Transmitter (CSI), which is not usual in VLC, or cooperation among transmitters. To do so, a novel photodiode design providing distinct channel responses is devised with the aim of implementing Blind Interference Alignment (BIA)-based schemes. It is interesting to remark that VLC offers several advantages for the use of BIA schemes such as long coherence time or high Signal-to-Noise Ratio (SNR).

(P20) Title: Resource Allocation and Subcarrier Pairing for Energy Efficient Relay-Assisted OFDMA Systems

Authors: Zijian WANG, Luc Vandendorpe (UCL)

Abstract: The energy efficiency (EE) maximization problem in relay-assisted downlink channels with orthogonal frequency-division multiple access (OFDMA) is studied. The power allocation is optimized together with subcarrier allocation and pairing at the relay. An alternating optimization approach is adopted to solve the problem. Numerical results show that the proposed algorithm outperforms those without subcarrier pairing and/or without subcarrier allocation.

(P21) Title: Multi-objective Resource Allocation Optimization for SWIPT in Small-cell Networks

Authors: Nafiseh JANATIAN, I. Stupia, Luc Vandendorpe (UCL)

Abstract: In this work, we consider the optimized design of spatial precoding and resource allocation algorithms for simultaneous wireless information and power transfer (SWIPT) in a small-cell network consisting of multiple multi-antenna access points (APs) which serve multiple single antenna user equipments (UEs). The design problem is formulated under a multi-objective optimization (MOO) framework and is solved using majorization-minimization approach. Numerical results are provided for small cell network setup with MISO configuration. The results illustrate the trade-off between harvested energy and information data rate objectives and show the effect of network design parameters such as the distance between APs and the number of UEs on this trade-off.