Chairman’s Note

Dear Colleague,

This is the first issue of COST2100 Newsletters that will be disseminated inside and outside the Action borders. Other projects will receive them, and will learn about COST2100 activities; among them, NEWCOM++, the Network of Excellence in Wireless Communications funded by the EC through FP7 that addresses scientific topics very close to COST2100, and with similar objectives. COST2100 and NEWCOM++ have recently agreed to work towards joint initiatives.

This issue comes after a very successful couple of events held in Wroclaw, Poland, at the beginning of February 2008: the first COST2100 Training School, and the 4th Management Committee (and Working Groups) Meeting.

The two-days-and-a-half Training School, whose subject was “Wireless Network Optimisation”, was attended by 106 people, who expressed their very positive judgement on the programme and lectures. The School has been professionally video recorded, and a set of DVDs produced, which will be commercialised in the next months. The DVDs include the 15 hours of speeches, given by ten lecturers coming from academia, two major network operators and other companies.

The number and quality of scientific contributions to the 4th MCM clearly showed that most activities within the Working Groups have achieved maturity level.

The next challenge is now the 1st COST2100 Workshop on “MIMO and Cooperative Communications” that will be organised next June in Trondheim, Norway. This is an open event, and contributions are solicited from both inside and outside COST2100; I expect a very successful workshop, both in terms of attendance and high scientific value.

See you in Trondheim.

Roberto Verdone
Real-time Multi-User MIMO Channel Sounding and Capacity Evaluations

We study the DL channel of a multi-user (MU) MIMO system in which there are multiple antennas at the base station (BS) and possibly multiple antennas at the user equipment (UE). Information theory reveals that if the channel is fully known at the transmitter (Tx) and the receiver (Rx), the optimum transmit strategy for the MU-MIMO broadcast channel involves a theoretical pre-interference cancellation technique known as dirty paper coding (DPC) combined with an implicit user scheduling and power loading algorithm. However, DPC is very computationally expensive, thus simpler, linear transmit strategies, such as MMSE precoding, have been proposed.

Compared to a single-user (SU) MIMO TDMA system, DPC can bring a theoretical performance gain of up to $\max(\min(M/N,K),1)$ in an i.i.d. Rayleigh fading channel, where $M$ and $N$ are the number of Tx and Rx antennas, respectively, and $K$ is the number of users. In theory, MU-MIMO is also more immune to most of propagation limitations plaguing SU-MIMO systems, such as channel rank loss or antenna correlation. However, little is known about the performance of MU-MIMO schemes in real-world channels. We compare the sum rate capacity of MU-MIMO using DPC and MMSE precoding to SU-MIMO using real channel measurement data.

The measurement data has been acquired using Eurecom’s MIMO Openair Sounder (EMOS). The EMOS can perform real-time MIMO channel measurements synchronously over multiple users moving at vehicular speed. The EMOS consists of a BS with 4 Tx antennas, and 1 or more UEs with 2 Rx antennas. It uses an OFDM modulated sounding sequence consisting of a synchronisation symbol, a broadcast data channel and pilot symbols used for channel estimation.

The results of the capacity evaluations confirm the theoretical results in the sense that MU-MIMO provides a higher sum rate capacity than SU-MIMO TDMA. Among the studied MU-MIMO schemes, DPC performs better than linear MMSE precoding at a higher computational cost. It is worth noting that MU-MIMO with MMSE precoding and 1 Rx antenna at each UE even has a higher sum rate capacity than SU-MIMO TDMA with 2 Rx antennas. Thus, the receiver design in MU-MIMO is greatly simplified. On the other hand MU-MIMO requires full channel state information at the Tx. It can be obtained by means of feedback in an FDD system or by exploiting channel reciprocity in a TDD system.

The results further show that the sum rate capacity in the measured channels is worse than the one in the uncorrelated synthetic channel. However, even in the measured channels DPC increases the sum rate capacity by a factor of 3.2 compared to SU-MIMO at high SNR using four transmit and four users with one receive antenna each. Linear precoding still increases the sum rate capacity by a factor of 2.7 at high SNR but provides little gains at low SNR.

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Highlights

WG 1 has considered a wide range of topics. MIMO continues to be a very important research topic, including multi-user MIMO and MIMO-OFDM systems, and there have also been several papers on the physical layer of UWB. Distributed MIMO or wireless relay systems are also an area of increasing interest - among other topics too numerous to list!

Further progress was achieved on the analysis of the time variant behaviour of radio channels within WG 2. In particular, the careful definition of consistency intervals and the detection of significant changes in the radio environment by statistically validated methods have been addressed. The tracking of double directional path parameters through extended Kalman filtering has also been demonstrated, even in the case of dense multipaths.

Coming to WG 3, apart from the usual wide interest on Resource Management, Optimisation and Wireless Ad-hoc Networks, the new concept of Environmental Opportunistic Networks (EON) has been presented, which relates to the integration of ad-hoc sensors networks to infrastructure networks, through mobile terminals that appear in the area of the ad-hoc network and establish the link between sensors and the cellular network. The interest of this concept for COST 2100 includes aspects of all WGs, with new challenges on channel modelling, transmission techniques and networking. Some contributions during next meetings are expected to appear on this topic.

SWG 2.1 saw papers dealing with propagation modelling, UWB channel measurements, antenna design and interactions between UWB and narrow-band systems. Of particular interest was a paper about channel modelling in a car, which introduces one of the typical scenarios for future UWB applications.

SWG 2.2 has continued to strike a good balance between interest from industry and academia, with an equal number of contributed papers from both. The former strive to initiate/support standardisation efforts in testing compact antenna systems, while the latter studies the negative impacts of compact design on multiple antenna systems, and techniques to mitigate any resulting performance degradation. One discussion topic of current interest is the impact of phase information in calculating MIMO metrics, such as capacity, since it is more convenient to measure only the amplitude of antenna patterns.

In SWG 2.3, a number of papers were related to cluster extraction (in view of completing the COST 273 model) and to dual-polarised measurements (which is a new COST 2100 focus). Additionally, two tutorial-like presentations aimed at demystifying the COST 273 model and its differences/similarities with the WINNER model. These presentations sparked intense discussions as to what is required from a channel model, by comparing different perspectives, such as propagation vs. signal processing, and analytical formulation vs. link-level simulations.

SWG 3.1 focused on auto-tuning of RRM parameters as on-line adaptation or off-line optimisation, with use of live measurements in automated network planning process. The former strive to initiate/support standardisation efforts in testing compact antenna systems. Of particular interest was a paper about channel modelling in a car, which introduces one of the typical scenarios for future UWB applications.

Regarding SIG B, work has focused lately on DVB-H issues. In particular, two contributions have been given on the development of a dynamic DVB-H system-level simulator, on the performance evaluation of application layer coding for streaming services using field measurements, and on the network planning and optimisation of local service areas in single frequency networks. Presentations showed very encouraging results on the feasibility and accuracy of the proposed simulation approach, the significant transmission robustness gain that can be achieved for streaming services by performing multi-burst forward error correction, and on the increase of the frequency usage efficiency using localised service areas.

SIG C focused on measurement results and on the modelling of the mobile-to-mobile channel in the 5 GHz band. Two approaches on modelling have been proposed: ray tracing and geometric stochastic ones. The reference scenarios currently being defined will be delivered to SIG A for discussion.

Finally, the new born SIG D initiated its work in Wroclaw.
The goal of this first COST 2100 Workshop is to gather researchers and industrial partners to share the latest results in the various fields of MIMO and cooperative communications, covering the gamut from antennas and propagation to signal processing and network aspects, with applications to MIMO systems, multi-hop cellular networks, ad hoc networks, wireless multi-sensor networks (including UWB networks), vehicle-to-vehicle systems, and other techniques.

We seek full papers, from both COST2100 participants and researchers belonging to Institutions not participating to COST2100.

Paper submission will be preceded by a paper registration phase indicating Title, Authors and Abstract. Paper submissions must follow guidelines reported on the COST2100 website at www.cost2100.org. A pdf file must be sent to secretariat@cost2100.org.

Important Dates:
- Mar. 21, 2008 — Paper Registration
- Mar. 28, 2008 — Paper Submission
- May 05, 2008 — Notification
- May 23, 2008 — Camera Ready Submission

Hosted by the Norwegian Univ. of Science and Technology.

Other News

The COST IC0603 "ASSIST" Action

Traditional antenna areas still demand research and innovation efforts, but also new unforeseen and challenging problems are appearing. Antennas and electromagnetic sensors are also becoming a major system component in areas such as Consumer Electronics, Health Care, Biology, Radio Astronomy, Satellite-based Mobile Systems, Earth Sciences, and Earth Resources Monitoring. Cooperation towards a deeper understanding of antenna operation in these new complex environments and for the corresponding development of adequate modelling and measuring tools are the main scientific objectives of this Action. http://www.cost-ic0603.org.

The COST 293 "GRAAL" Action

The main objective of this Action is to elaborate on global and solid advances in the design of communication networks, by letting experts and researchers with strong mathematical background meet peers specialised in communication networks and share their mutual experience by forming a multi disciplinary scientific co-operation community. Areas of application include broadband packet network design, backbone optical network design, multi-layer network planning, as well as wireless network optimisation and mobile ad-hoc networks. http://www.cost293.org.

News from ERA

Two new agencies were created on 2007/Dec/14 to manage projects funded under the EU's research framework programs: the European Research Council Executive Agency will help to manage the projects funded by the European Research Council (ERC), established under FP7, being responsible for around €7 billion; the Research Executive Agency will administer the Marie Curie fellowship schemes, research programs designed for SMEs, and parts of the space and security research themes, managing funding of €6.5 billion. http://ec.europa.eu/research/rea, http://erc.europa.eu.