T7. Cooperation and Coordination over Cellular Networks: Taking a New Look at Interference

Abstract:
Pushed by the demand for bandwidth-hungry multimedia and internet-related wireless services, communication engineers seek to maximally exploit the spectral resources in all available dimensions. Together with the increased density of base stations in cellular networks in the most populated areas, the aggressive reuse of frequencies planned in so-called next generation cellular networks results in a novel situation where interference (along with the classical fading problem) is no longer just an issue but rather emerges as the key limiting factor. As the many radio links sharing the resource in the network can no longer be treated as independent, the classical approach of individually optimizing communication over the point-to-point channels between a mobile and a base station, using say advanced codes, or single-link MIMO, must be revisited to offer a truly "multi-terminal" view of the network. At the core of this view, lies the notion of network coordination and cooperation which can take place between base stations, or even between the terminals themselves. Although cooperative communications was until recently much associated with the notion of relaying, this concepts is now re-inventing itself to find its way into the cellular network framework, notably as a way to deal with interference using distributed MIMO concepts. A powerful weapon against fading and interference, cooperative communication finds itself particularly well suited to the context and constraints of cellular communications because of pre-existing backhaul infrastructure linking the base stations together. When infrastructure links do not exist or are saturated, the notion of Network Coordination has been proposed as a promising emerging alternative for dealing with interference. Coordination can take place is a variety of domains such as resource control, scheduling, beamforming, interference alignement, etc. and poses both new theoretical and practical challenges.

Such concepts of MIMO cooperation, interference alignement and coordinated resource control have been the subject of numerous special session and journal issues in the past months. In this tutorial they will be addressed in a unifying manner, for the first time, under the general framework of interference coordination.
In this tutorial we will review the fundamentals as well as the latest evolutions in network multicell cooperation and coordination research. Applications will be described along with the current status of discussion in key standards.

Speaker's Biography:
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David Gesbert (IEEE Fellow) is Professor in the Mobile Communications Dept., EURECOM, where he heads the Mobile Communication Dept. He obtained the Ph.D degree from Ecole Nationale Superieure des Telecommunications, France, in 1997. From 1997 to 1999 he has been with the Information Systems Laboratory, Stanford University. In 1999, he was a founding engineer of Iospan Wireless Inc, San Jose, Ca.,a startup company pioneering MIMO-OFDM (now Intel). Between 2001 and 2003 he has been with the Department of Informatics, University of Oslo as an adjunct professor.

Publications, awards, and editorialship
D. Gesbert has published about 170 papers and several patents all in the area of signal processing, communications, and wireless networks.

D. Gesbert was a co-editor of several special issues on wireless networks and communications theory, for JSAC (2003, 2007, 2009), EURASIP Journal on Applied Signal Processing (2004, 2007), Wireless Communications Magazine (2006).He served on the IEEE Signal Processing for Communications Technical Committee, 2003-2008. He's an

associate editor for IEEE Transactions on Wireless Communications and the EURASIP Journal on Wireless Communications and Networking. He authored or co-authored papers winning the 2004 IEEE Best Tutorial Paper Award (Communications Society) for a 2003 JSAC paper on MIMO systems, 2005 Best Paper (Young Author) Award for Signal Proc. Society journals, and the Best Paper Award for the 2004 ACM MSWiM workshop. He co-authored the book “Space time wireless communications: From parameter estimation to MIMO systems”, Cambridge Press, 2006.