EURASIP Journal on Applied Signal Processing 2004:9, 1189–1190

Editorial

Andreas Czylwik
Department of Communication Systems, University of Duisburg-Essen, 47048 Duisburg, Germany
Email: czylwik@sent5.uni-duisburg.de

Alex B. Gershman
Department of Electrical and Computer Engineering, McMaster University, Hamilton, Canada L8S 4K1
Email: gershman@ieee.org

Thomas Kaiser
Department of Communication Systems, Faculty of Engineering, University of Duisburg-Essen, 47048 Duisburg, Germany
Email: thomas.kaiser@uni-duisburg.de

Smart antennas have recently emerged as a key technology for third (3G) and higher generations of wireless communication systems. They are able to add a new *spatial* dimension on top of the currently used *time*, *frequency*, and *code* multiple access schemes. The past of 3G wireless systems licensing process in Europe has shown that spectral bandwidth may cost wireless system providers billions of Euros. In light of this fact, smart antennas offer an elegant and relatively inexpensive opportunity of increasing data rate, system capacity and flexibility, and quality of service. Today developments and progress in this area are still away from cost-efficient practical implementations, and further theoretical and experimental studies are crucial to enable successful applications of smart antennas in the future.

The aim of this special issue is to present recent advances of the smart antenna research. The contributions cover a broad range of topics. We classified them into three major categories, namely, *link level*, *system level*, and *applications*.

The first ten papers of the issue are related to the link-level study of smart antennas. In the paper by Meurer et al., the MIMO transmitter design approach with a priori given structure of the receiver (the so-called receiver-oriented design scheme) is compared to the case when the MIMO receiver design is performed for a fixed transmitter structure (the so-called transmitter-oriented design scheme). The paper by Khaled et al. is devoted to the optimization of the MMSE-based joint MIMO transmitter and receiver design from the BER perspective. In the paper by Jiang and Sidiropoulos, a new algorithm for blind identification of out-of-cell CDMA users is developed for the case when multiple antennas are used at the base station. The paper by Chen et al. investigates a nonlinear detection technique for multi-antenna receivers. In the next paper, Uysal and Georghiades study the performance of space-time block codes (STBCs) which are concatenated with outer trellis codes. The study of STBC schemes is continued in the paper by Sharma and Papadias, where a class of full-rate full-diversity linear quasi-orthogonal STBCs is proposed and their practical decoding algorithm is studied, and in the paper by Zhao et al., which develops a linear precoder for OSTBCs when the channel covariance matrix is available at the transmitter. In the paper by Liu and Li, a new soft detector for MIMO systems is proposed which combines the advantages of the LS soft detector and sphere decoder. The paper by Tubbax et al. compares the multiple-antenna generalizations of the OFDM and single-carrier schemes, and the paper by Jin and Acampora investigates the outage capacity regions for a multiuser SDMA system with multiple antennas at the base station.

The next four papers consider system level aspects. The paper by J.-S. Kim et al. considers the link quality in a single cell of a CDMA-based system using adaptive antenna arrays and proposes a receiver which combines beamforming and RAKE reception. The analysis of CDMA-based systems is extended towards multicellular systems with adaptive antennas in the paper by Czylwik and Dekorsy. A more specific problem of angle-of-arrival estimation at base stations with multibeam antennas is investigated in the paper by Bevan et al. In the next paper, Biguesh and Gershman study downlink channel estimation techniques in cellular systems using training signals.

The next two papers are devoted to multiantenna channel measurements. Kotterman et al. focus on diversity properties of multiple antennas at hand-held terminals. The paper by Pesavento et al. proposes an algorithm for simultaneous estimation of MIMO channel parameters from channel sounder measurements.

The last five papers are devoted to hardware and applications issues of smart antennas and MIMO technologies. The first paper by Sun and Karmakar studies the use of active single port antennas with surrounding parasitic antennas in order to perform direction-of-arrival estimation. In the second paper by Zekavat et al., an oscillating antenna array pattern with fixed main lobe direction is introduced to provide transmit diversity. This approach is applied to CDMA systems. The next paper by Rodríguez-Osorio et al. deals with a practical implementation of a W-CDMA multiantenna testbed with the main focus on the most relevant digital signal processing operations such as modulation, demodulation, synchronization, and beamforming. Another multiantenna testbed for ISM band transmission is presented in the paper by Rinas et al. In this paper, the hardware concepts are highlighted and the feasibility of current single- and multicarrier MIMO algorithms is studied via measurements. The last paper by S. Kim et al. studies the use of smart antennas in another relevant 3G standard, CDMA2000.

In summary, the twenty-one papers published in this issue cover a broad range of recent advances of smart antenna research and a variety of their applications to existing and future wireless systems.

We thank the authors, the reviewers, the publisher, and the Editor-in-Chief for their efforts which were critical for the success of this special issue.

Andreas Czylwik
Alex B. Gershman
Thomas Kaiser

Andreas Czylwik studied electrical engineering at the Technical University of Darmstadt, Germany, from 1978 to 1983. In 1988, he received the Ph.D. degree and in 1994 the Habilitation degree, both from the Technical University of Darmstadt and both in the field of optical communications. From 1994 to 2000, he was with the Research and Development Center (Technologiezentrum) at Deutsche Telekom in the Department for Local Area Broadband Radio Systems. He was in charge of several research projects, for example, a broadband radio communication demonstrator based on single-carrier transmission with frequency domain equalization as well as several projects on smart antenna concepts in cellular mobile radio systems. In 2000, he became a Full Professor at the Technical University of Braunschweig, heading the Department for Microcellular Radio Systems. Since 2002, he has been with University of Duisburg-Essen and in charge of the Department of Communication Systems. He published some 70 papers and was the Editor for IEEE Journal on Selected Areas in Communications and IEEE Transactions on Wireless Communications. In numerous national and international scientific conferences, he was member of the technical program committee and organized or chaired sessions, respectively. His research interests are in the fields of adaptive transmission techniques in radio communications such as smart antennas and adaptive modulation and coding techniques.

Alex B. Gershman received his Diploma and Ph.D. degrees in radiophysics from the Nizhny Novgorod University, Russia, in 1984 and 1990, respectively. From 1984 to 1989, he was with the Radiotechnical and Radiophysical Institutes, Nizhny Novgorod. From 1989 to 1997, he was with the Institute of Applied Physis, Nizhny Novgorod. From 1997 to 1999, he was a Research Associate at the Department of Electrical Engineering, Ruhr-University Bochum, Germany. In 1999, he joined the Department of Electrical and Computer Engineering, McMaster University, Hamilton, Ontario, Canada, where he is now a Professor. He also held visiting positions at the Swiss Federal Institute of Technology, Lausanne, Ruhr-University Bochum; and Gerhard-Mercator University, Duisburg. His main research interests are in statistical and array signal processing, adaptive beamforming, MIMO systems and space-time coding, multiuser communications, and parameter estimation. He has published over 220 technical papers in these areas. Dr. Gershman was a recipient of the 1993 URSI Young Scientist Award, the 1994 Outstanding Young Scientist Presidential Fellowship (Russia), the 1994 Swiss Academy of Engineering Science Fellowship, and the 1995-1996 Alexander von Humboldt Fellowship (Germany). He received the 2000 Premier's Research Excellence Award, Ontario, Canada, and the 2001 Wolfgang Paul Award, Alexander von Humboldt Foundation, Germany. He was also a recipient of the 2002 Young Explorers Prize from the Canadian Institute for Advanced Research (CIAR), which has honored Canada's top 20 researchers aged 40 or under. He is an Associate Editor for the IEEE Transactions on Signal Processing and EURASIP Journal on Wireless Communications and Networking, as well as a Member of the SAM Technical Committee of the IEEE Signal Processing Society.

Thomas Kaiser received the Diploma degree from the Ruhr-University Bochum in 1991, the Ph.D. degree in 1995 with distinction, and the second Ph.D. degree in 2000 (so-called Habilitation) from Gerhard-Mercator-University Duisburg, all in electrical engineering. From 1995 to 1996, he spent a research leave at the University of Southern California, Los Angeles, grant-aided by the German Academic Exchange Service. From April 2000 to March 2001, he has been Head of the Department of Communication Systems at Gerhard-Mercator-University Duisburg, and from April 2001 to March 2002, he has been Head of the Department of Wireless Chips & Systems (WCS) at Fraunhofer Institute of Microelectronic Circuits and Systems. Now he is with the Department of Communication Systems and Coleader of the Smart Antenna Research Team (SmART) at the University of Duisburg-Essen. Dr. Kaiser published more than 75 papers in international journals and conferences and is coeditor of forthcoming books and special issues on *UWB communication systems* and *Smart Antennas*. He belongs to the editorial board of EURASIP Journal on Applied Signal Processing, the advisory board of a European multiantenna project, and is technical program comittee member of several international conferences. His current research interest focuses on applied signal processing with emphasis on multiantenna systems, especially its applicability to ultra-wideband systems and on implementation issues.