*Guest Editorial*

# Smart Antennas

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Smart antennas have become an essential paradigm for the enhancement of capacity in cellular communications systems. In 2nd Generation Systems smart antennas were aiming at increasing capacity either by *reuse within cell* (Space Division Multiple Access - SDMA) or by intercell interference reduction (Spatial Filtering for Interference Reduction - SFIR). Later in 3rd Generation UMTS UTRA (Universal Terrestrial Radio Access) smart antenna concepts evolved from pure beamforming techniques merely based on directional information of the radio channel to more general space-time processing concepts which exploit a variety of available processing gains and sources of diversity. As a natural consequence the adaptive antenna and smart antenna concepts in mobile communication systems have become a hot topic in the Technical Specification Groups for Radio Access at 3GPP (Third Generation Partnership Project) who shall prepare, approve and maintain the 3GPP Technical Specifications and Technical Reports.

In this Special Issue of the European Transactions on Telecommunications journal, aimed at presenting original results in the field of *Smart Antennas*, contributions are collected, which emerged from a special session of the World Micro-Technologies Congress (Hannover, Germany, 2000) which has been incorporated within EXPO 2000.

The presented selection of papers comprises almost all varieties of considering and deploying smart antenna concepts in mobile communication systems both in radio layer 1 and 2. The first three papers explicitely refer to applications of smart antennas for UTRA FDD and UTRA TDD. The first paper, by C. Brunner, W. Utschick, and J.A. Nossek, presents an overview of eigenbeamforming concepts in the uplink and downlink techniques for UTRA FDD; the focal point of the paper is the efficient use of short-term and long-term properties of the radio channel. In the second paper, A. Jarosch and D. Dahlhaus focus on the downlink in UTRA FDD; simple linear demodulation schemes exploiting the space and time diversity of the mobile radio channel are derived. Smart Antennas for UTRA TDD is the tenor of the paper by M. Haardt, C.F. Mecklenbräucker, M. Vollmer, and P. Slanina: here both uplink and downlink techniques are discussed; whereas in the uplink the emphasis is on joint detection techniques and its efficient implementation, for the downlink again the efficient use of short-term and long-term properties of the radio channel is discussed.

The next two contributions are devoted to more principal investigations of downlink processing. First, H. Tröger, T. Weber, M. Meurer, and P.W. Baier present a performance survey of Joint Transmission, a novel downlink transmission scheme, by exemplary system assessments and comparisons. In the next paper, by H. Boche and M. Schubert, the problem of joint downlink beamforming and power control in wireless communication systems is addressed.

The third selection of papers contains two prospective topics of smart antennas in wireless communications. In the first paper, R.S. Thomä, D. Hampicke, A. Richter, and G. Sommerkorn present a new real-time MIMO vector radio channel sounder; the proposed MIMO measurement principle can be exploited to estimate channel properties at both ends of the wireless link simultaneously, and thus, dramatically enhance overall resolution of the multi path parameters. Finally, very promising strategies for radio resource management using smart antenna cellular networks are discussed by C. Hartmann and J. Eberspächer; the focus is on adaptive strategies which combine spatial reuse within the cell with dynamic inter-cell channel allocation.

We would like to take this room to thank the Editor-in-Chief of the European Transactions on Telecommunications for the opportunity of publishing this Special Issue, as well as the editorial staff at ETT for their assistance during the preparation of the issue and we are especially indebted to the reviewers for their critical comments and their constructive suggestions. We also wish to express our sincere appreciation to all the authors of this Issue, whose contributions made tis work an important document of recent theoretical and practical advancement of smart antenna concepts.

**Wolfgang Utschick,** born in Ingolstadt, Germany, on May 6, 1964, completed several industrial education programs before he received his diploma degree in electrical engineering in 1993 and the Dr.-Ing. degree in 1998, both from the Technische Universität München. He published a couple of conference and journal papers in the field of neural computation where he studied the design of error-correcting classification systems, and in the field of adaptive array processing where he focuses on the physical layer of wireless communication systems. During summer 2000 he held an invited research position at the Eidgenössische Technische Hochschule Zürich, Switzerland. Wolfgang Utschick is member of the IEEE and VDE/ITG.
Dr. Utschick is currently Habilitand Assistant Professor) and supervisor of the signal processing research group at the Institute of Circuit Theory and Signal Processing at the Technische Universität München. His industrial consulting activities are in the field of the 3GPP (Third Generation Partnership Project) and beyond 3G.

**Josef A. Nossek**, born in Vienna, Austria, on Dec. 17, 1947, (S'72 - M'74 - SM'81 - F'93) received the Dipl.-Ing. and Dr. degrees, both in electrical engineering, from the Vienna University of Technology, Austria, in 1974 and 1980, respectively. In 1974 he joined SIEMENS AG, Münich, Germany, where he was engaged in the design of passive and active filters for communication systems. In 1978 he became a supervisor, in 1980 head of a group of laboratories concerned with the design of monolithic filters (analog and digital) and electromechanical and microwave filters. Since 1982 he has been head of a group of laboratories designing digital radio systems within the Transmission Systems Department. From 1987 - 1989 he was head of the Radio Systems Design Department, where he was instrumental in introducing high speed VLSI signal processing into digital microwave radio.
Since April 1989 he is Professor for Circuit Theory and Signal Processing at the Münich University of Technology. He is teaching undergraduate and graduate courses in the field of circuit and system theory and conducting research on signal processing algorithms for communication systems, theory of linear systems and VLSI architectures.
He has been a guest professor in 1984 at the University of Cape Town, South Africa and in 1992 and 1998 at the University of California at Berkeley and 1995 at the University of Technology in Vienna. He has published more than 100 papers in scientific and technical journals and conference proceedings. He holds a number of patents. In 1988 he received the ITG prize and was the co-winner of the 1998 innovations award of the "Mannesmann-Mobilfunkstiftung" foundation in recognition of his work on smart antennas in mobile radio communications and the Golden Jubilee Medal of the IEEE Circuits and Systems Society for "Outstanding Contributions to the Society". He has been a member of numerous organizing and program committees and is member of editorial boards of several scientific journals. In 2002 he will be the President of the IEEE Circuits and Systems Society.