Mobile MIMO-OFDM Systems -- An overview of the technology and recent research results

Abstract:
Multiple-Input Multiple-Output (MIMO) systems are a key technology in future high data-rate wireless communications. MIMO systems make use of several antennas at the transmitter and receiver sides in order to improve the spectral efficiency and link reliability of the system. Multicarrier techniques are another important broadband wireless transmission technology. This idea is exploited in DVB-T/H systems and xDSL, for example. The data is transmitted on several parallel narrowband subcarriers. This makes the receiver design particularly easy. Combining MIMO with multicarrier techniques provides the fundamental physical layer technology for future beyond 3G and 4G wireless communications including WiMAX, 3G LTE and WLANs.

The benefits of MIMO and OFDM systems may not be fully achieved in broadband mobile applications because the channels are time and frequency selective. In order to enjoy all the advantages of OFDM transmission, two key tasks must be successfully accomplished: channel estimation and carrier frequency offset CFO compensation. Frequency offsets are caused by oscillator mismatches and Doppler shift due to mobility. Moreover, in MIMO systems rich scattering environment may cause the directions of arrival and consequently CFO change rapidly for each MIMO branch. This causes severe time-varying intercarrier interference. Statistically optimal methods requiring small sample support for CFO compensation are introduced and fast algorithms are developed.

Bio:
Visa Koivunen (Senior Member, IEEE) received his D.Sc. (EE) degree with honors from the University of Oulu, Dept. of Electrical Engineering. From 1992 to 1995 he was a visiting researcher at the University of Pennsylvania, Philadelphia, USA. Year 1996 he held a faculty position at the Department of Electrical Engineering, University of Oulu. From August 1997 to August 1999 he was an Associate Professor at the Signal Processing Laboratory, Tampere University of Technology. Since 1999 he has been a full Professor of Signal Processing at the Department of Electrical and Communications Engineering, Helsinki University of Technology (HUT), Finland.

He is one of the Principal Investigators in SMARAD (Smart and Novel Radios) Center of Excellence in Radio and Communications Engineering nominated by the Academy of Finland. Since year 2003 he has been also adjunct full professor at the University of Pennsylvania, Philadelphia, USA. During his sabbatical term year 2006-2007 he is Nokia Visiting Fellow at Nokia Research Center, Helsinki and a Visiting Fellow at Princeton University, NJ, USA.

Dr. Koivunen's research interest includes statistical, communications and sensor array signal processing. He has published more than 200 papers in international scientific conferences and journals. He received the best paper award in IEEE PIMRC 2005 (co-authored with C. Ribeiro and A. Richter) and EUSIPCO2006 (co-authored with J. Salmi and A. Richter). He served as an associate editor for IEEE Signal Processing Letters. He is a member of the editorial board for the Signal Processing journal and Journal of Wireless Communication and Networking.

He is also a member of the IEEE Signal Processing for Communication Technical Committee (SPCOM-TC). He is the general chair of the IEEE SPAWC (Signal Processing Advances in Wireless Communication) 2007 conference in Helsinki, Finland June 2007.