Hindawi Publishing Corporation
EURASIP Journal on Wireless Communications and Networking
Volume 2007, Article ID 24595, 2 pages
doi:10.1155/2007/24595

Editorial

Space-Time Channel Modeling for Wireless Communications

Thushara Abhayapala,[1] Mérouane Debbah,[2] and Rodney A. Kennedy[3]

[1] *Research School of Information Sciences and Engineering, The Australian National University, Canberra, ACT 0200, Australia*
[2] *Mobile Communications Department, Eurécom Institute, 2229 Route des Crêtes, 06904 Sophia Antipolis, France*
[3] *Wireless Signal Processing Program, National ICT Australia (NICTA), Canberra, ACT 2601, Australia*

Received 12 December 2007; Accepted 12 December 2007

The relatively recent surge in activity centered around multiple-input multiple-output (MIMO) techniques for wireless communications is based on capacity gains obtained by more fully exploiting the spatial and temporal aspects of wireless channels. The early indications moving to the use of multiple transmitters and multiple receiver elements could lead to quite significant performance improvements that were based on theoretical studies which made quite idealistic simplifying assumptions about the MIMO channel. Although an understanding of the likely channel models to be found in practice was incomplete, even a modest portion of the promised MIMO gains would lead to significant performance improvements. This has been manifested by the successful deployment of new wireless standards that have MIMO products alreadyin the marketplace. Although theoretical studies can well define theupper limits to the capacity gains of MIMO, it is of interest to know how much of that limiting performance can be obtained under realistic channel conditions. This naturally leads to two classes of investigation: significant measurement studies of using MIMO in different real environments and development of more refined theoretical models that incorporate, in their structural aspects, what is either observed in practice or expected in practice. This highlights the important ongoing role that research into space-time channel modeling plays in understanding what is practicallyachievable by MIMO techniques.

The goal of this special issue was to present recent results in space-time channel models which more realistically capture what is found in practice. The papers to be found in this issue certainly advance that goal. This special issue collects eight papers clustered into two groups: papers dealing with the capture and analysis of channel measurements and papers dealing with theoretical models.

The first paper by L. Garcia et al. considers measurements of an indoor and an outdoor wireless channel at 1800 MHz to guide the selection of the most effective MIMO configuration particular focusing on spatially configuring two transmitters, in a 2×4 configuration, to approach the performance of a 4×4 configuration. Path loss and spatial correlation properties for the different configurations are analyzed.

The paper by A. Pal et al. evaluates three candidate antenna array designs for wideband MIMO at a center frequency of 5.2 GHz where the application is in small devices such as personal digital assistants, mobile phones, and laptops. The wideband MIMO measurements in an open-plan office environment are compared with results from channel models which combine measured far field radiation patterns of the antenna elements with the spatial-temporal multipath parameters of the channel using a ray tracing model. The diversity in polarization, space, and angle are considered.

The third paper by H. Suzuki et al. considers indoor measurements of a 4×4 MIMO-OFDM channel operating at 5.25 GHz with bandwidth of 40 MHz corresponding to the maximum data rate configuration for the IEEE 802.11n standard. The measurements are done in line-of-sight and non-line-of-sight-cases. These measurements form the basis of a critical review of the validity of proposed correlation channel models.

The fourth and final paper in the first group, which considers measurement, is the paper by M. Landmann et al. This paper considers the polarization behavior of mobile radio channel in a macrocell rural environment. The emphasis is on modeling changing and transient propagation phenomena which are overlooked in available channel models. The polarization behaviour is analyzed by separating the effects due to specular reflections from the diffuse multipath components.

The second group of papers deals with modeling aspects and not directly with measurements. As with measurements, the emphasis is to find MIMO models which properly capture the appropriate wireless environments.

The first paper in the second group of papers is by P. Almers et al. It is an up-to-date survey of radio propagation and channel models used to emulate wireless channels for MIMO systems. A distinction is drawn between two classes: models that bundle the antenna configuration with the propagation and those that just treat the channel propagation independent of the antenna configuration. The paper provides a critical analysis which highlights deficiencies in the current MIMO channel and radio propagation models including models found in wireless MIMO standards.

The second paper by J-M. Conrat and P. Pajusco presents a versatile physical channel simulator model developed by France Telecom for wideband MIMO systems. The simulator incorporates the key physical attributes: geometry, delay, directions of arrival and departure, and polarization. The model subsumes common simpler ones and has the strong advantage that permits the implementation of physical models in a link-level simulation chain. The paper also describes the software implementation and provides details of the processing time efficiency with realistic simulation configurations.

The third model paper by C-X. Wang et al. investigates the spatialtemporal correlation characteristics of the Spatial Channel Model in the Third Generation Partnership Project and the Kronecker Based Stochastic MIMO Model. The spatial temporal separability is investigated at the various levels (cluster, link, and system) for these two models. Further, the advantages and disadvantages of these models are discussed with the Spatial Channel Model being less restrictive but with greater implementation complexity. This paper also provides a very useful analysis and classification of different models which have been proposed in the literature.

The final paper by K. Popovski et al. looks at the effects multipath propagation on UWB systems and proposes a time-reversed channel impulse response strategy to implement prefiltering at the transmitter. This enables the received signal to be temporally and spatially focused at the receiver. The IEEE 802.15.3a channel model is employed and a comparison is made between time-hopped time-reversed systems and equalization RAKE-based systems.

ACKNOWLEDGMENTS

We would like to thank all researchers who submitted papers to this special issue and the large time commitments of the numerous reviewers. The revisions of the accepted papers have further enhanced the quality of the papers which should make this issue a valuable archive of material on Space-Time Channel Modeling for Wireless Communications. Finally, we would like to thank the Editorial Office of EURASIP Journal on Advances in Signal Processing and the Editor-in-Chief for the unremitting efforts to see this special issue appear in a timely fashion.

Thushara Abhayapala
Mérouane Debbah
Rodney A. Kennedy