Hindawi Publishing Corporation
EURASIP Journal on Wireless Communications and Networking
Volume 2009, Article ID 415736, 2 pages
doi:10.1155/2009/415736

Editorial

Advances in Propagation Modeling for Wireless Systems

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Received 18 March 2009; Accepted 18 March 2009

Advanced wireless systems face an ever-increasing number of challenges, such as the limited availability of the radio frequency spectrum and the demand for faster data transmissions, better quality of service, and higher network capacity. Yet, the true challenge faced by new communication technologies is to achieve the expected performance in real-world wireless channels. System designers classically focus on the impact of the radio channel on the received signals and use propagation models for testing and evaluating receiver designs and transmission schemes. The needs for such models evolve as new applications emerge with different bandwidths, terminal mobility, higher carrier frequencies, new antennas, and so forth. Furthermore, channel characterization also yields the fundamental ties to classical electromagnetics and physics as well as the answers to some crucial questions in communication and information theory. In particular, it is of outstanding importance for designing transmission schemes which are efficient in terms of power or spectrum management. Advanced channel modeling is also recognized as a major topic by two on-going research programs in Europe: the Network of Excellence in Communications NEWCOM++ and the European COST 2100 Action "Pervasive Mobile & Ambient Wireless Communications." While the former only includes a number of European partners (see http://www.newcom-project.eu/), the latter is a large network of coordinated national research projects in the fields of interest to participants coming from different EU and non-EU countries (see http://www.cost2100.org/).

The objective of this special issue, published following an initiative by NEWCOM++ and COST 2100 partners, is to highlight the most recent advances in the area of propagation measurement and modeling. We received 25 high-quality submissions, which were peer-reviewed by experts in the field, and we selected 9 papers for inclusion in this special issue. These articles cover the gamut from electromagnetic models to experimental characterizations of complex environments as well as the measurement-based parameterization and analysis of geometry-based stochastic models.

Three papers deal with the modeling of complex media or environments. One of the challenges of emerging or future technologies is indeed the large variety of application scenarios, for which classical models might not apply. Furthermore, more and more techniques rely on adaptive and/or multiple antenna signal processing, so that the dynamic and spatial behaviors of the propagation channel should be covered as well.

The paper by Molina-Garcia-Pardo et al. proposes the experimental characterization and modeling of propagation in tunnels, at various frequencies in the 2.8–5 GHz band. Path loss, large-scale correlation, and fading statistics are derived from measurements conducted by means of a vector network analyzer. It is shown that the tunnel behaves as a low-loss waveguide, and the fading is strongly dependent on the distance. An extension to a multiple-input multiple-output (MIMO) channel model is also presented.

The paper by Moraitis et al. presents experimental results related to the propagation inside a passenger aircraft, at various frequencies between 1.8 and 2.45 GHz. Empirical formulas are inferred for the path loss, slow- and fast-fading, and interference modeling. A comparison with a physical-optics-based ray-tracing model is also successfully conducted.

The paper by Cheffena and Ekman combines fading measurements from 2.45 up to 60 GHz with wind speed data to study the dynamic effects of swaying vegetation on radiowave propagation. A simulation model based on a multiple mass-spring system is developed and empirically validated. The outputs of the model are the fading first- and second-order statistics.

Two papers cover the area of physical models. Physical models traditionally consist of electromagnetic theory combined with engineering expertise that allows making reasonable assumptions about the propagation mechanisms involved. Provided that the correct propagation phenomena are identified, such theoretical models are capable of making very accurate predictions in a deterministic manner. The output being specific to particular locations rather than being an average value, the model can be applied to very wide ranges of system and environment parameters, certainly well beyond the range within which measurements have been made. The two drawbacks of such models are the computational effort and the required accuracy of the geometrical and electrical properties of the environment. These two issues are dealt with by the following papers.

The paper by Jemai and Kürner investigates the performance boundaries of a calibrated ray-tracing model in indoor scenarios. It is indeed well known that the precision of ray-tracing tools is limited by the accuracy of the environmental description. The proposed approach improves the prediction accuracy by means of a calibration procedure, whose sensitivity is further analyzed in the paper.

The paper by Valcarce et al. applies a finite-difference time-domain (FDTD) method in the framework of WiMAX femtocells. Two optimization methods are proposed to tackle the issue of computational complexity. Calibration is also carried out. The paper eventually presents mobile WiMAX system-level simulations that make use of the developed model.

Finally, the last set of papers deals with geometry-based models for MIMO systems. In geometrical channel models, the channel impulse response is related to the location of scatterers, the location of which is chosen stochastically. A further important generalization is the existence of multiple clusters of scatterers. Geometry-based models emulate the physical reality and thus reproduce many effects implicitly: small-scale fading, correlation of the signals at different antenna elements, and even large-scale changes of delays and directions. Due to the close relationship with physical reality, it is also relatively easy to parameterize that model, for example, from measurement results. In a first step, the matrix impulse responses are measured with a channel sounder. High-resolution algorithms are then employed to extract the required information.

Two papers deal with multipath clustering. The paper by Czink et al. presents the so-called Random-Cluster Model, which is a stochastic time-variant frequency-selective MIMO channel model directly parameterized from experimental data. A fully automated clustering algorithm is used to identify multipath clusters which define the model. The approach is then validated based on different metrics applied to indoor data.

The paper by Materum et al. presents a methodology to identify multipath clusters in an automatic way. The approach is then applied to the clustering at the mobile station in small urban macrocell at 4.5 GHz. Each identified cluster is manually confronted with its physical counterpart, and conclusive results are drawn on the various propagation mechanisms.

The last paper on geometry-based modeling by Zhang et al. investigates several possible simplifications of geometry-based models in view of reducing their complexity without compromising their accuracy. The analysis relies on simulation and experimental results and a number of metrics.

Finally, the paper by Sivasondhivat et al. focuses on the modeling of the double-directional power spectrum in urban macrocells when considering dual-polarized MIMO transmissions. In particular, the separability of the power spectrum between the base station and the mobile is investigated, and a model is proposed and validated, based on the sum of polarization pairwise Kronecker product approximation.

Acknowledgments

We would like to take this opportunity to express our sincere thanks to the authors for contributing to this special issue and to the reviewers for providing prompt and detailed remarks that helped improve the quality of the manuscripts. We also wish to thank the Editor-in-Chief and the editorial office for their support through the entire editing process. Finally, C. Oestges acknowledges the contribution of the European Commission through the FP7 research program (European Network of Excellence NEWCOM++, which started in January 2008 for a period of 3 years). C. Oestges and J-i. Takada are also members of the European COST 2100 Action.

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International Journal of Digital Multimedia Broadcasting

Special Issue on IP and Broadcasting Systems Convergence

Call for Papers

In order to achieve access and core network interworking and service ubiquity within the vision of the Internet of the Future, IP arises as a key element for the realization of a unified/fusion environment which enables the convergence/synergy between traditional and emerging technologies. In this context, IP can be also seen as the "gluing factor" in the rapidly progressing convergence between the technologically different sectors of *networking and broadcasting*.

This convergence, witnessed both at technological and service levels, is mainly empowered by the evolution of broadcasting standards (DVB, ISDB, ATSC, CMMB) and the recent advances in IP networking.

In this way, a broadcasting platform is no longer restricted to transmitting 'bouquets' of TV programs. The ability to include IP services into the broadcast multiplex, along with the large coverage area and the high bit rate capabilities, allows broadcasting systems to constitute flexible broadband IP networking infrastructures, complementing existing and emerging wireless access networks such as 3G, WiMAX, and LTE. Conversely, the provision of broadcast TV services over IP networks and over the Internet is further fading the borders between the IP/networking and broadcast worlds.

The aim of this special issue is to attract state-of-the-art contributions focusing on the convergence between the IP and broadcasting systems, that is, the provision of IP services over broadcasting platforms and vice versa; the streaming of A/V broadcasting services over IP networks. Areas of interest include, but are not limited to:

- Broadband IP access over DVB, ISDB, CMMB, ATSC, DMB, MediaFLO
- Satellite-based access networks
- IPv4/IPv6 encapsulation and transport
- Broadcast TV and radio over IP
- Security and quality of service
- Architectural and design aspects
- Interaction channel technologies
- Cross-layer optimization
- IP datacast issues and ESG
- IPTV over broadcasting systems
- Social television and novel services
- Business aspects and standardization activities
- Regulatory issues
- Digital dividend and exploitation for broadband IP access

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Manuscript Due	October 1, 2009
First Round of Reviews	January 1, 2010
Publication Date	April 1, 2010

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Special Issue on Filter Banks for Next-Generation Multicarrier Wireless Communications

Call for Papers

Digital filter banks find various good applications in communications signal processing. In general, they can be used to obtain very sharp frequency selectivity to isolate different communications frequency channels from each other and from interfering spectral components. This can be done in a very flexible and dynamic manner. Thus, filter banks constitute a very powerful generic tool for software-defined radios and spectrally agile communication systems.

The theoretical capacity limits in communications can be approached by multicarrier techniques. With radio channels, multicarrier techniques can be combined with multiantenna transmitters and receivers to provide efficiency. Existing or planned transmission systems rely on the OFDM technique to reach these goals. However, OFDM has a number of drawbacks, such as the use of the cyclic prefix to cope with the channel impulse response which results in a loss of capacity and the requirement of block processing to maintain orthogonality among all the subcarriers. Furthermore, the leakage among frequency subbands has a serious impact on the performance of FFT-based spectrum sensing and OFDM-based cognitive radio in general.

So far, some attempts have been made to introduce filter bank multicarrier (FBMC) in the radio communications arena, in particular, the isotropic orthogonal transform algorithm (IOTA). However, the full exploitation and optimization of FBMC techniques in the context of radio evolution have not been considered sufficiently. Consequently, advances in communication aspects of FBMC are still required to make it useful for future radio systems.

This has motivated advanced research in the European ICT project PHYDYAS, which supports this special issue. Topics of interest include, but are not limited to:

- Filter bank-based multicarrier transmission and prototype filter design
- Filter bank-based signal processing for other communication waveforms
- Filter bank applications in software-defined radio
- Data-aided and blind techniques for synchronization and channel estimation
- Preamble and pilot-pattern design
- Equalization and demodulation
- FBMC MIMO techniques and beamforming
- Radio scene spectrum analysis and cognitive radio
- Interference management
- Interlayer optimization and FBMC-specific scheduling
- Filter bank for channel coding
- Filter bank in AD and DA conversions

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Manuscript Due	June 1, 2009
First Round of Reviews	September 1, 2009
Publication Date	December 1, 2009

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Special Issue on Theoretical and Algorithmic Foundations of Wireless Ad Hoc and Sensor Networks

Call for Papers

This special issue is devoted to distributed algorithms and theoretical methods in the context of wireless ad hoc and sensor networks. Recent research in mobile ad hoc networks and wireless sensor networks raises a number of interesting, and difficult, theoretical and algorithmic issues. While much work has been done in protocol and system design, simulation, and experimental study for wireless ad hoc and sensor networks, the theoretical research, however, falls short of the expectation of the future networking deployment. The needs to push the theoretical research forward for a deeper understanding about wireless ad hoc and sensor networking and to foster cooperation among networking researchers and theoreticians establish the motivation behind this special issue.

The objective of this special issue is to gather recent advances in the areas of wireless ad hoc and sensor networks, with a focus on theoretical and algorithmic aspect. In particular, it will concentrate on distributed algorithms, randomized algorithms, analysis and modeling, optimizations, and theoretical methods in design and analysis of networking protocol (at link layer or network layer) for wireless ad hoc and sensor networks. Specific topics for this special issue dedicated to theoretical and algorithmic foundations include but are not limited to:

- Channel assignment and management
- Distributed and localized algorithms
- Dynamic and random networks
- Dynamic graph algorithms
- Energy conservation methods
- Localization and location tracking
- Mechanism design and game theory
- Modeling and complexity analysis
- Routing, multicast, and broadcast
- Scheduling and synchronization
- Throughput optimization and capacity

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Manuscript Due	November 1, 2009
First Round of Reviews	February 1, 2010
Publication Date	May 1, 2010

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