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Guest editorial

Recent advances in cooperative communications for wireless systems

Cooperative transmission techniques have been proposed in order to improve the system performance in terms of availability, coverage range and throughput. The cooperative techniques and the smart interactions among the network nodes have been proposed in order to enhance the QoS of their connections and the performance of the whole network. Radio channel and physical communication characteristics are of paramount relevance to the optimum design of efficient cooperative communications and mobile computing technologies. In recent years, a substantial amount of research effort has been devoted to the development and the design of advanced communication systems that employ the concept of cooperation in order to support highly reliable and spectral efficient transmissions.

The focus of this special issue is to present recent advances in cooperative communications and state-of-the-art research contributions and practical implementations that advance design of wireless communication systems employing cooperative techniques. Our call for papers attracted numerous submissions worldwide. After a rigorous review process, we present the following eleven papers.

The first paper entitled "Cooperative Communication with Imperfect Channel Information: Performance Analysis and Optimum Power Allocation", by M.B. Abarghouei and A.M.D. Hoseini [1] provides a symbol-error-rate (SER) performance analysis is provided for decode-and forward (DF) and amplify-and-forward (AF) cooperation schemes in wireless networks with imperfect channel information. Closed-form SER formulations for a single relay system with square M-QAM signals under flat Rayleigh fading channel are given and finally the optimum power allocation is determined for the AF and DF cooperation scenarios.

In the second paper entitled "Reputation-based Network Selection Mechanism using Game Theory" by R. Trestian, O. Ormond, G.-M. Muntean [2], a theoretical framework for combining reputation-based systems, game theory and network selection mechanism is presented. Using the repeated Prisoner's Dilemma game, the authors model the user network interaction as a cooperative game and show that by defining incentives for cooperation and disincentives against defecting on service guarantees, repeated interaction sustains cooperation.

In the next paper entitled "A Distributed and Collaborative Beamforming Algorithm for a Self-Organizing Wireless Sensor Network", by M.F. Urso, S. Arnon, M. Mondin, E. Falletti, and F. Sellone [3], a novel self-localization technique for wireless sensor networks using distributed and collaborative beamforming technique is studies and a closed form solution for beamforming gain degradation is also derived. Finally, the evaluation of the power consumption of the new distributed and collaborative beamforming algorithm is given.

In the fourth paper entitled "Cooperative Diversity Performance of Selection Relaying over Correlated Shadowing", by V.K. Sakarellos, D. Skraparlis, A. Panagopoulos and J.D. Kanellopoulos [4] novel analytical expressions and numerical results on cooperative diversity performance using Selection Relaying over correlated lognormal channels for both SC and MRC techniques at the receiver, are presented. Moreover, an exact framework for comparing the performance and efficiency of the medium access protocol and relay capabilities (TDMA/half-duplex, SDMA/full-duplex) is proposed and finally, based on the analysis and novel mathematical expressions for the outage probability, the impact, of the lognormal parameters (including correlation) on the cooperative system performance and its efficiency, is investigated.

The next paper entitled "Performance of Two-hop Infrastructure based Multi-antenna Regenerative Relaying in Rayleigh Fading Channel" by H. Katiyar and R. Bhattacharjee [5] an infrastructure based multi-antenna cooperative relay network is investigated. Closed form expressions of outage probability and average error rate under Rayleigh fading are given. Finally, the effect of number of antennas installed on relay and its placement is also studied.

In the sixth paper entitled "Static hybrid amplify and forward (AF) and decode and forward (DF) relaying for cooperative systems", by H. Boujemâa [6], a new static hybrid Amplify and Forward (AF) and Decode and Forward (DF) relaying protocol for cooperative systems, is proposed. The relays close to the source amplify the received signal whereas the remaining relays transmit only if they correctly decode. Outage SNR probability, exact and asymptotic Bit Error Probability (BEP) of both all participating and opportunistic hybrid AF-DF relaying protocols are derived and compared to conventional AF and DF relaying. The proposed protocol offers better performance than AF relaying and similar performance to DF relaying with a lower computational complexity.

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In the seventh paper entitled "Free Probability based Capacity Calculation of Multiantenna Gaussian Fading Channels with Cochannel Interference", by S. Chatzinotas and B. Ottersten [7], a new generic model for a multi-antenna channel is presented incorporating additive white Gaussian noise, flat fading, path loss and cochannel interference. The asymptotic capacity limit of this channel is calculated based on an asymptotic free probability approach. Finally, numerical results are utilized to verify the accuracy of the derived closed-form expressions and evaluate the effect of the cochannel interference.

The next paper entitled "Splitting Algorithm for DMT Optimal Cooperative MAC Protocols in Wireless Mesh Networks" by E. Benoit [8], proposes a new cooperative protocol for wireless mesh networks. The protocol implements both on-demand relaying and a selection of the best relay terminal so only one terminal is relaying the source message when cooperation is needed. Two additional features are also proposed. The protocol has been designed in the context of Nakagami-m fading channels. Simulation results show that the performance of the splitting algorithm does not depend on channel statistics.

In the following paper entitled "Bandwidth Allocation in Cooperative Wireless Networks: Buffer Load Analysis and Fairness Evaluation" by T.D. Lagkas, D. Stratogiannis, G.I. Tsiropoulos, P. Angelidis [9], a novel bandwidth allocation technique for cooperative wireless networks is proposed, which is able to satisfy the increased QoS requirements of network users taking into account both traffic priority and packet buffer load. The performance of the proposed scheme is examined by analyzing the impact of buffer load on bandwidth allocation. Finally, fairness performance in resource sharing is also studied.

In the tenth paper entitled "A Single Hop Architecture Exploiting Cooperative Beamforming for Wireless Sensor Networks" by A.G. Kanatas, A. Kalis and G.P. Efthymoglou [10] a single hop architecture for a cooperative wireless sensor network is presented and the attained distributed beamforming gain performance using the theory of random arrays is analyzed. Moreover the average loss in directivity gain when the received signal from each sensor node follows a Ricean distribution is investigated. Finally, the results show that high directive gains can be achieved in practical wireless sensor networks using simple sensor nodes.

The last paper entitled "Robust Detection Analysis of Linear Cooperative Spectrum Sensing for Cognitive Radio Networks", by G. Taricco [11], robust detection is employed in order to cope with uncertainties on the channel gains and the noise power levels in a cognitive radio system based on linear cooperative spectrum sensing. A lower bound to the received symbol energy required to achieve reliable system operation is derived. Then, a symmetric CR system scenario is investigated analytically and by numerical simulations.

Closing this editorial, we would like to thank all the authors who have submitted their papers to this special issue. We would also like to thank all the reviewers for their time and efforts. Their careful reviews and valuable comments helped us select the papers as well as improve the quality of this special issue. Finally, we hope that the works published in this special issue will inspire the readers to develop new cooperative techniques for advanced wireless communication systems.

Acknowledgments

The guest editors of this Special Issue wish to thank all the contributing authors for submitting high quality papers to this special issue. We would also like to thank all reviewers for their thorough and valuable evaluation of the papers within the short stipulated time. We are also very grateful to the Editor in Chief of Physical Communication Prof. Ian F. Akyildiz and all the editorial staff.

Finally, we hope that the readers will enjoy the contributions on Cooperative Communications in this Special Issue.

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