2006 Best Paper Award Recipients: A Message From the Editor-in-Chief

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BEST PAPER AWARDS

THE Best Paper Award honors the authors of a paper of exceptional merit dealing with a subject related to the IEEE Signal Processing Society's technical scope, irrespective of the author's age. The window of eligibility for this award has been extended to five years preceding the year of election (in this case, 2001 to 2005); judging is based on general quality, originality, subject matter, and timeliness. Three papers from the IEEE TRANSACTIONS ON SIGNAL PROCESSING have been selected by the IEEE Signal Processing Society to receive 2006 Best Paper Awards, as follows[1]:

1) **Martin Vetterli, Pina Marziliano**, and **Thierry Blu**, for the paper entitled "Sampling Signals with Finite Rate of Innovation," *IEEE Transactions on Signal Processing*, vol. 50, no. 6, pp. 1417–1428, Jun. 2003. The authors propose a novel sampling framework for a very general class of signals, called "signals with finite rate of innovation." Sampling is a cornerstone of signal processing because it allows real-life signals in the continuous domain to be acquired, represented, and processed in the discrete domain (e.g., by computers). The classical Shannon sampling theory requires the sampled signal to be bandlimited. However, many important classes of signals in applications, such as streams of Diracs, piecewise polynomials, and nonuniform splines, are not bandlimited, even though they can have finite rates of innovations. The paper shows, quite remarkably, that these nonbandlimited signals can be uniformly sampled using appropriate kernels and perfectly reconstructed.

2) **Richard J. Kozick** and **Brian M. Sadler**, for the paper entitled "Source Localization with Distributed Sensor Arrays and Partial Spatial Coherence," *IEEE Transactions on Signal Processing*, vol. 52, no. 3, pp. 601–616, Mar. 2004. Localizing aeroacoustic sources using microphone array is a classical and extremely challenging problem in signal processing. With distributed sensors, the difficulties in signal processing are compounded by the cost of fusion and intersensor communications. Fusion or local processing? This is a fundamental question in sensor processing, and its significance is much amplified recently in the context of wireless sensor networks. This paper by Kozick and Sadler considers source localization using distributed sensor clusters. An analysis based on Ziv–Zakai

bounds indicates whether fusion of sensor data is justified. The paper also shows an interesting connection between atmosphere physics and statistical signal processing. This results in much more accurate performance bounds, as compared with the optimistic AWGN and plane wave assumptions that are typically used.

3) **Eduard A. Jorswieck** and **Holger Boche**, for the paper entitled "Optimal Transmission Strategies and Impact of Correlation in Multiantenna Systems with Different Types of Channel State Information," *IEEE Transactions on Signal Processing*, vol. 52, no. 12, pp. 3440-3453, Dec. 2004. The paper discusses optimal (in the sense of ergodic capacity) transmission strategies for multiple-input single-output (MISO) systems under various types of channel state information (CSI) at the transmitter: no CSI, perfect CSI, and correlation feedback. The authors derive the optimum transmission strategy (including an algorithm for computing the power allocation) for the case where the transmitter has knowledge of the channel vector's covariance matrix and provide bounds on capacity loss due to correlations in the channels. The paper nicely brings together the different CSI scenarios and extends previous analytical results which assumed either an infinite number of transmit antennas or an infinite SNR.

YOUNG AUTHOR BEST PAPER AWARDS

The Young Author Best Paper Award honors the authors of an especially meritorious paper dealing with a subject related to the Society's technical scope and whose lead author, upon the date of submission of the paper, is less than 30 years of age. Two papers published in IEEE TRANSACTIONS ON SIGNAL PROCESSING have been selected for the 2006 award as follows:

1) **Jean-François Chamberland**, for the paper coauthored with Venugopal V. Veeravalli, entitled "Decentralized Detection in Sensor Networks," *IEEE Transactions on Signal Processing*, vol. 51, no. 2, pp. 407–416, Feb. 2003. The classical decentralized detection framework as studied in the 1980s has limited application to modern wireless sensor networks, as it does not adequately take into account important features of sensor technology and of the wireless link between the sensors and the fusion center. In their paper, the authors introduce an alternative mathematical framework that better captures the resource constraints. Each sensor transmits its data over a multiple access channel, and the sensor network is constrained by the capacity of the wireless channel over which the sensors are transmitting. The focus of the paper is on good solutions that scale well with the number of sensors; the

[1]The paper summaries that follow have been derived from the nomination statements by the respective Technical Committees.

number/density of nodes is a parameter to be optimized. Based on their evaluation criteria, it is shown that the gain offered by having more sensors often outweighs the benefits of getting detailed information from each sensor. The paper provides an excellent first step in bridging the gap between the protocol-oriented research on sensor networks and their future applications. It is also a starting point to further investigate the nature of information in context of decentralized detection and estimation in large sensor networks.

2) **Joakim Jaldén**, for the paper coauthored with Björn Ottersten entitled "On the Complexity of Sphere Decoding in Digital Communications," *IEEE Transactions on Signal Processing*, vol. 53, no. 4, pp. 1474–1484, Apr. 2005. Optimum multiuser decoding and MIMO decoding are key problems in modern wireless communications and known to be NP-hard. In practice, this implies that worst-case complexity is exponential in the problem size. The aim is to devise good approximate solutions of polynomial complexity without sacrificing performance. The sphere decoder (SD) family of detectors belongs to the latter class and has gained much popularity as an effective strategy for MIMO detection. The SD's worst-case complexity is exponential, but for moderate problem sizes and relatively high SNR, practical experience shows that it yields the optimum solution at low complexity, known to be bounded by a polynomial function. The main contribution of Jalden and Ottersten was to show that, for fixed SNR, the expected complexity is actually exponential since the sphere radius (a critical parameter in the SD algorithm) must be carefully chosen to ensure a nonzero probability of finding a point within the sphere. By deriving an exponential lower bound on the SD algorithm's expected complexity, Jalden and Ottersten showed that there exists no SNR value for which the expected complexity of the SD algorithm, for all problem sizes, can be bounded by a polynomial function; nevertheless, the rate of exponential complexity increase is SNR-dependent, and for high SNR, it is quite small.