Introduction to the Special Issue on Wireless Communication

THE RAPID growth of wireless communication and access, together with the success of the Internet, has brought a new era of mobile/wireless multimedia applications and services. Enormous recent developments have been undertaken by both academia and industry. The convergence of Internet, wireless, and multimedia has created a new paradigm of research and development that enables multimedia content to move seamlessly between the Internet and mobile wireless networks. With the benefit of the increase in bandwidth in wireless networks, new access capabilities including mobile visual phones and video streaming are pervading people's everyday life. Such capabilities, along with current readily accessible e-mails and mobile web services, provide us an enhanced ability to access to Internet content anytime, anywhere, and from any device.

Transport of multimedia content over mobile wireless networks is very challenging because the mobile wireless channels are usually severely impaired due to multi-path fading, shadowing, inter-symbol interference, and noise disturbances. The channel error rate varies with the time varying channel environments. This imposes some necessary tradeoff between robust video quality of service (QoS) and adaptive wireless network resource utilization. Therefore, wireless video faces many challenges in both coding techniques and transmission mechanisms.

This Special Issue disseminates a collection of recent advances in research and development in this challenging yet exciting area. The innovations reported in this special issue represent t he state -of-art in wireless video coding and transmission technologies.

We received over 50 high-quality papers for this Special Issue, spanning nearly all topics in wireless video. Because of the page limitation, we had to turn away many fine quality manuscripts. After an extensive review process, we selected 15 Transactions Papers and two Transactions Letters. The Transactions Papers are organized into five sections: 1) advanced scalable video source coding; 2) low power coding and transmission techniques; 3) error control mechanisms including error resilience, error correction, and error concealment; 4) networked video, including rate control and streaming; and 5) encryption for wireless video.

For transmission of video over wireless networks, scalable video has a great advantage due to its easy adaptation to the varying wireless network condition. Among the various schemes, MPEG-4 is considered the video-coding standard for wireless video conferencing and streaming, as is evidenced by the "Streaming Video Profile" defined in MPEG-4 that includes fine granularity scalability (FGS) as a new tool. This Special Issue opens with the section on scalable video-coding techniques for wireless networks. The paper "Adaptive motion-compensation FGS (AMC-FGS) for wireless video" by M. van der Schaar and H. Radha introduces a novel scalable video coding framework and corresponding compression methods for wireless video streaming. The second paper, "A robust fine granularity scalability using trellis-based predictive leak" by H.-C. Huang, C.-N. Wang, and T. Chiang, proposes novel techniques to further improve the temporal prediction schemes at the enhancement layer so that the coding efficiency and error resilience are superior to the existing FGS, while the FGS is preserved. The last paper, "Three-dimensional subband coding techniques for wireless video communications" by H. Man, R. L. de Queiroz, and M. J. T. Smith presents a new 3-D subband coding framework that is able to achieve a good balance between high compression performance and channel error resilience.

Power is a key issue in wireless video as it limits the life-span of the battery in mobile devices. In wireless video coding and transmission, designing a low-power video coding and transmission algorithm without loss of significant video quality is very challenging. The second section of the Special Issue covers three papers in this area. The first paper "Power-minimized bit allocation for video communication over wireless channels" by Q. Zhang, Z. Ji, W. Zhu, and Y.-Q. Zhang, investigates the relationships among rate, distortion, and power consumption when considering mobile applications. Based on those relations, the authors propose a power-minimized bit-allocation scheme which jointly considers the processing power for source coding and channel coding, as well as the transmission power. The second paper, "Joint source coding and transmission power management for energy efficient wireless video communications" by Y. Eisenberg, C. E. Luna, T. N. Pappas, R. Berry, and A. K. Katsaggelos, proposes a framework for jointly considering error resilience and concealment techniques, at the source coding level, as well as transmission power management at the physical layer, with the goal to limit the amount of distortion in the received video sequence while minimizing transmission energy. The last paper in this section, "Joint error control and power allocation for video transmission over CDMA networks with multiuser detection" by S. Zhao, Z. Xiong, and X. Wang, considers error control and power allocation. in conjunction with multiuser detection, for transmitting wireless video over CDMA networks.

Wireless networks typically suffer from both random bit errors and packet losses during the transport of video content. Since compressed video becomes more sensitive to transport impairments, various error-control strategies have been investigated, aiming to improve the quality of video at the receiving end. These strategies can be classified into three main categories: error resilience, error protection, and error concealment. The third section addresses various approaches in error control and error robustness. The first paper, "Error-resilient video coding using multiple description motion compensation" by Y. Wang and S. Lin, proposes a new approach for multiple description video coding using motion compensated prediction. The second paper, "Error-resilient video transcoding for robust internetwork

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communications using GPRS" by S. Dogan, A. Cellatoglu, M. Uyguroglu, A. H. Sadka, and A. M. Kondoz, proposes an error-resilient video transcoding residing in a video proxy that provides the necessary output transmission rates with the required amount of robustness. The third paper, "Feedback and error protection strategies for wireless progressive video transmission" by T. Stockhammer, H. Jenkač, and C. Weiβ, studies the error-protection problem by using feedback to transfer information to the video encoder as well as to the error protection system. The final paper, "Model-based error concealment for wireless video" by D. S. Turaga and T. Chen, describes a novel model-based scheme for error concealment of networked video.

The fourth section of the Special Issue covers topics related to networked video, particularly source rate control, joint source and channel rate control, and video streaming related technologies. The first paper, "Stochastic rate-control of video coders for wireless channels" by J. Cabrera, A. Ortega, and J. I. Ronda, introduces a new approach for dealing with the transmission of real-time video over wireless channels based on *a priori* stochastic models for both source and channel. The second paper, "Joint source channel rate-distortion analysis for adaptive mode selection and rate control in wireless video coding" by Z. He, J. Cai, and C. W. Chen, first develops a rate-distortion (R-D) model for DCT-based video coding incorporating a macroblock (MB) intra refresh rate, and then presents a theoretical analysis of the picture distortion caused by channel errors and the subsequent inter-frame propagation. The third paper, "Multicast and unicast real-time video streaming over wireless LANs" by A. Majumdar, D.G. Sachs, I. Kozintsev, K. Ramchandran, and M. Yeung, addresses the problem of real-time video streaming over wireless LANs for both unicast and multicast transmission. The last paper, "Optimal nonlinear sampling for video streaming at low bit rates" by X. S. Zhou and S.-P. Liou, adopts the streaming of nonlinearly sampled video frames, i.e., key-frame slideshow, synchronized with the audio stream.

Security and data integrity are becoming an extremely important issue in mobile video applications. The paper "A format-compliant configurable encryption framework for access control of video" by J. G. Wen, M. Severa, W. Zeng, M. H. Luttrell, and W. Jin, presents a framework for access control of standard-compliant video bitstreams for entertainment purposes.

The last section of this Special Issue consists of two Transactions Letters. The paper "Wireless video transport using conditional retransmission and low-delay interleaving" by S. Aramvith, C.-W. Lin, S. Roy, and M.-T. Sun, proposes a scheme to improve the video quality using a low-delay interleaving scheme and a conditional retransmission strategy. The second paper, "Matching pursuits multiple description coding for wireless video" by X. Tang and A. Zakhor, presents a multiple description video-coding scheme based on a three-loop predictive structure.

The team of Guest Editors of this Special Issue would like to thank all of the authors for submitting their excellent work to this Special Issue. The Guest Editors are deeply indebted to the reviewers for providing their expert views on all of the submitted papers. Many of them have been asked to work on very tight schedules to expedite the review process. Their contributions have greatly improved the quality of the papers in this Special Issue.

Finally, we would also like to thank Dr. Ya-Qin Zhang, Past Editor-in-Chief, for his encouragement and support for this Special Issue, Dr. Weiping Li, Past Editor-in-Chief, for approving the proposal of this Special Issue and his continued support throughout the entire process, Dr. Thomas Sikora, Editor-in-Chief, for his support and guidance in the publication of this special issue, and the IEEE staff, Jill Cianflone, for her kind help on handling all details in the publication of this Special Issue.

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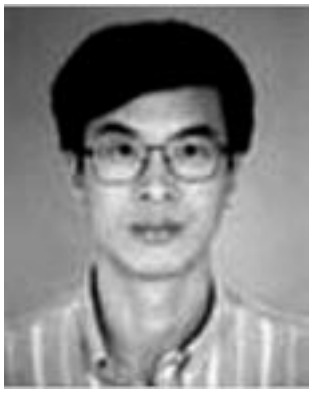
Dr. Reibman was the Technical Program Chair for the Sixth International Workshop on Packet Video in 1994 and Technical Co-Chair for the First IEEE Workshop on Multimedia Signal Processing in 1997, and is the Technical Co-Chair of the IEEE International Conference on Image Processing in 2002. She is also a member of the IEEE Signal Processing Society's Technical Committee on Image and Multidimensional Signal Processing. In 1998, she won the IEEE Communications Society Leonard G. Abraham Prize Paper Award.



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Dr. Zhu served as Guest Editor for the Special Issue on Streaming Video in IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY (CSVT). He has been an Organizer, TPC Member, and Session Chair for numerous conferences, such as ISCAS, ICIP, PV, ICC, GlobeCom, WCNC, 3G and Beyond, and ITCom. He received the Best Paper Award in 2001 from the IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY. He is a member of the IEEE Circuits and Systems Society's Technical Committee on Video Signal Processing and Communications and Technical Committee on Multimedia Systems, a member of the IEEE Communications Society's Multimedia Communication Committee, and a member of Eta Kappa Nu.