Introduction to the Issue on Perception Inspired Video Processing

VIDEO services are demanding a significant and rapidly increasing fraction of Internet traffic. The ability of traditional approaches to video processing to cope with this data glut are being stretched to the limit, hence new approaches to video processing are necessary to keep up with current and predicted exponential increases in the creation and consumption of video. The knowledge accrued by more than a century of largely unexplored findings from Vision Science research, along with recent breakthroughs in brain imaging, neural computational modeling, and models of users' Quality of Experience (QoE), provides a verdant ground for developing efficient, perceptually optimized video processing paradigms. The papers in this special issue report recent advances and new directions in applying human perception for optimizing video processing. Due to the broad nature of applications of video processing, the papers in this issue cover a wide range of topics including quality of video, neural correlates, 3D video, classification, segmentation, and compression.

A. Neural Responses to Video

Understanding neural responses to visual data will enable a better understanding of how the human visual system processes videos. This understanding is essential for developing next-generation video processing systems that deliver the highest visual quality. This issue includes two papers that study neural responses to video. The paper by Rosenthal *et al.* entitled "Evoked Neural Responses to Events in Video" reports on neural responses to events in video, while neural responses to varying video quality is reported by Arndt *et al.* in "Using Electroencephalography to Measure Perceived Video Quality." With electroencephalographic (EEG) instruments becoming more accessible, we can expect very active research in this direction within the next few years.

B. Video Quality

Quality assessment is an important area of video processing, and research in this areas focuses on developing models and tools for quantifying video quality. Quality assessment is especially challenging in cases of image retargeting where the target images are transformed using content-aware methods to fit the device display. The paper "Objective Quality Assessment for Image Retargeting Based on Perceptual Geometric Distortion and Information Loss" by Hsu *et al.* introduces an objective metric based on perceptual principles. Maintaining mobile video quality is also a challenging problem. Observing that the quality of video experienced by users on mobile devices depends on the device, content, and the environment, Xue and Chen introduce methods for maximizing mobile video quality in their paper entitled "Mobile Video Perception: New Insights and Adaptation Strategies."

C. 3D Video

There is continued interest in 3D video services, and technology in this area continues to improve. Two papers in this issue address 3D video by focusing on the important topics of compression and 3D quality of experience. Asymmetric coding is used in 3D video compression systems to reduce the bandwidth requirements by encoding one of the views at a lower quality than the other. In the paper "Visual Attention Model Aided Non-Uniform Asymmetric Coding of Stereoscopic Video," Ekmekcioglu *et al.* propose content aware methods to improve asymmetric coding using attentional cues. One of the common complaints when watching 3D videos is visual discomfort. In the paper "3D Visual Discomfort Prediction: Vergence, Foveation, and the Physiological Optics of Accommodation," Park *et al.* analyze the physiological aspects of stereo perception and present a method for visual discomfort prediction based on perceptual features.

D. Applications of Human Visual Perception

This issue includes several papers that focus on applying models/principles of human visual perception to video processing problems. The slowness principle in visual perception describes how the brain extracts slow changing representational features from fast changing input stimuli captured by the retina. Theriault *et al.* apply this principle in a video classification problem presented in their paper "Perceptual Principles for Video Classification with Slow Feature Analysis." In "A Retina-Based Perceptually Lossless Limit and a Gaussian Foveation Scheme with Loss Control," Targino da Costa *et al.* use models of retinal image projection and receptor distribution to develop a model for perceptually lossless image compression.

Another challenging problem in video processing is object segmentation. In "Coherency Based Spatio-Temporal Saliency Detection for Video Object Segmentation," Mahapatra *et al.* present methods for salient object detection and segmentation. Heinrich *et al.* present a motion estimation method for frame rate conversion in "Perception-Oriented Methodology for Robust Motion Estimation Design."

Optimizing High Efficiency Video Coding (HEVC) is an important problem that has received great interest in the research community. Services such as video telephony present interesting challenges and opportunities to apply new coding optimizations. Xu *et al.* exploit face perception for HEVC optimization in their paper "Region-of-Interest Based Conversational HEVC Coding with Hierarchical Perception Model

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of Face." In "Gamut Mapping in Cinematography through Perceptually-based Contrast Modification," Zamir *et al.* exploit contrast sensitivity for faithful color reproduction in cinematography.

We hope this special issue is able to highlight some of the many ways that models of human visual perception can be applied to video processing applications. This is just the beginning of the next phase of video processing research that we foresee will have to consider perception, cognition, and emotion to solve current as well as new problems. The guest editors would like to sincerely thank the many reviewers that provided valuable input in shaping this special issue.

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