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Editorial

Quality perception of advanced multimedia systems

It is our great pleasure to introduce a special issue focused on quality perception of advanced multimedia systems. What is "quality" and how to faithfully measure it have been attracting more and more attention from various research and industrial fields of multimedia systems. Multimedia signals usually suffer from various types of distortions during capturing, compression, transmission and post-processing processes, which inevitably degrades the quality of multimedia contents and thus reduces quality of experience of the users. How to faithfully monitor, control and improve the visual quality of advanced multimedia systems becomes an important task and has been widely studied by academia and industries.

In recent years, the research fields have witnessed several new trends, including the study of emerging multimedia applications, the usage of advanced learning tools, and the transferring from traditional to mobile application scenarios. This special issue is a collection of papers concerning subjective and objective quality evaluation and quality-related techniques for advanced multimedia systems, which echoes the above trends well.

Papers in this special issue are categorized into four groups: 1. Overview and survey papers on quality models and metrics; 2. Quality perception for emerging multimedia applications; 3. Quality perception modeling using advanced learning tools; 4. Quality perception modeling for mobile applications. Naturally, some papers may not only belong to a single group, for example a paper can use advanced learning techniques to handle emerging multimedia applications. Those papers will be introduced in all corresponding groups.

1. Overview or survey papers

This special issue has two review papers that respectively provides overview for the quality perception issues of emerging multimedia applications and free energy inspired perceptual quality models. Tang et al.'s paper entitled "*Feature comparison and analysis for new challenging research fields of image quality assessment*" conducts feature comparison and analysis on new challenging research fields including contrast-distorted, screen content, multiply-distorted, tone-mapped, depth image-based rendering and authentically distorted image quality assessment. This paper offers a good review of the quality perception research for the recent emerging multimedia applications. Zhai et al.'s paper entitled "*Free-energy principle inspired visual quality assessment: An overview*", reviews the free energy principle as an important tool for the design of perceptual quality metrics and visual saliency models, and provides a detailed comparison of related work in terms of algorithm design and performance.

2. Quality perception for emerging multimedia applications

Over the last decade, a growing number of advanced multimedia technologies or systems have entered our daily lives, for example cloud computing, stereoscopic imaging, virtual reality, etc. Such emerging multimedia applications call for new quality perception models. For example, the prevalence of cloud computing brings massive screen content and stereoscopic imaging creates many 3D contents, which the traditional quality perception models cannot handle effectively. In this special issue, two papers focus on screen content and one paper focuses on 3D content.

Yue et al.'s paper entitled "*Blind quality assessment for screen content images via convolutional neural network*" focuses on the topic of screen content image quality assessment. The screen content images are quite different from photographic natural scene images which are captured from real-world scenes. As being mostly computers generated, those screen content Image has substantially different statistical characteristics from natural scenes. For example, it tends to have more noise-free smooth areas, high-saturation color content, and extremely sharp texts and edges. Therefore, some specific quality perception models should be developed. Yue et al.'s work labels the quality of screen content images using a full-reference image quality measure, and then learns a mapping from the entire screen content image to the labeled quality score using convolutional neural network (CNN). Wu et al.'s paper entitled "*Blind quality assessment for screen content images by combining local and global features*" also focuses on screen content image quality evaluation, but with a classic feature extraction plus regression framework, instead of the CNN based solution. Both works achieve state of the art performance.

Stereoscopic or 3D images are an important media for advanced multimedia systems. Besides the perception of the 2D counterparts, 3D image perception also needs to consider need issues such as depth perception, visual discomfort, and visual fatigue. Such problems have made 3D image quality perception modeling much more complex than traditional 2D one. Zhou et al.'s paper entitled "*Eye movements and visual discomfort when viewing stereoscopic 3D content*" conducts eye tracking experiments under 3D image viewing task. They investigated the correlation between eye movement features and the overall visual discomfort of stereoscopic images and designed a discomfort prediction model. Karimi et al. in their paper "*Blind stereo image quality assessment inspired by brain sensory-motor fusion*" uses a brain model to synthesize a pair of contrast and phase images from the stereo input. Then features from the synthesis results are extract and combined using neural network towards a prediction of perceptual quality.

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3. Quality perception modeling using advanced learning tools

The trend of using advanced learning tools, such as CNNs, has prevailed in the research of perceptual quality metrics. Two papers use CNN as a tool to design quality perception models. Different from traditional quality perception models which first designs hand-crafted features such as natural scene statistics and image gradients, and then integrate these features via regression models like support vector regression and random forest, those quality perception models generally learn a mapping from the input scene to the quality perception using deep neural network such as CNN in an end-to-end manner.

The abovementioned Yue et al.'s paper entitled "*Blind quality assessment for screen content images via convolutional neural network*" follows such route and trains a mapping directly from a screen content image to quality score. Bosse et al.'s paper entitled "*Estimation of distortion sensitivity for visual quality prediction using a convolutional neural network*" is also powered by CNN. They propose a concept of distortion sensitivity as a property of the reference image. The distortion sensitivity is then calculated via CNN and is then used to weight PSNR towards a final quality score. Notably, Karimi et al.'s paper "*Blind stereo image quality assessment inspired by brain sensory-motor fusion*" also uses a stacked neural network, yet in a more traditional way, as a feature integration tool in the pooling stage.

4. Quality perception modeling for mobile applications

The research of quality perception for mobile applications has also attracted more attention recently. Two papers focus on mobile related scenarios in multimedia system. Different from the applications on traditional platforms on which the environments are well-controlled and predictable, mobile multimedia applications have to take into considerations the viewing contexts such as the display device size, ambient luminance, and motion of the device or viewer.

Xia et al.'s paper entitled "*Prediction of mobile image saliency and quality under cloud computing environment*" deals with hand-crafted feature extraction and regression based saliency estimation and quality assessment for images on mobile terminals within a cloud computing framework. Chaoub et al.'s paper entitled "*A multiple description scalable coding scheme for adaptive video streaming over next generation cellular networks*" introduces a video transmission scheme that enhances perceptual video quality at the receiver side. Multiple description coding and layered coding were used together with dynamic spectrum access to achieve the optimized visual quality.

We hope that audiences find this special issue useful, timely and informative, in addressing the important topics in quality perception of advanced multimedia systems. Finally, the Guest Editors would like to thank the EiC Dr. Ercan E. Kuruoglu and the reviewers for their support during the special issue organization.

Running order of papers:

1. "*Feature comparison and analysis for new challenging research fields of image quality assessment*"
2. "*Free-energy principle inspired visual quality assessment: An overview*"
3. "*Blind quality assessment for screen content images via convolutional neural network*"
4. "*Blind quality assessment for screen content images by combining local and global features*"
5. "*Eye movements and visual discomfort when viewing stereoscopic 3D content*"
6. "*Estimation of distortion sensitivity for visual quality prediction using a convolutional neural network*"
7. "*Prediction of mobile image saliency and quality under cloud computing environment*"
8. "*A multiple description scalable coding scheme for adaptive video streaming over next generation cellular networks*"
9. "*Blind stereo image quality assessment inspired by brain sensory-motor fusion*"

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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