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A generalized quality assessment method for natural and screen content images

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Abstract

A generalized objective quality assessment method is proposed for natural images and screen content images. Since natural images and screen content images have different statistical properties, the modelling of a generalized quality assessment method that works for both types of images is complicated because some properties of natural images and screen content images are conflicting to one another. The proposed method assesses the perceptual quality of an image based on edge magnitude and direction. In this method, an image is first separated into regions with high and low gradients. Gradient is used due to the small perceptual span of the human visual system for textual content. For high gradient regions, small kernel size of Prewitt operators is used to obtain the gradient magnitude and direction. Correspondingly, bigger kernel size of Prewitt operators is utilized for low gradient regions. Visual quality indices are computed from both regions and pooled to obtain the final quality index. From the performance comparison, it is shown that the proposed method could assess the perceived quality of natural images and screen content images with high accuracy.

1 | INTRODUCTION

The use of screen content images (SCIs) are widespread in recent years. Many activities in our daily lives involved the use of SCIs. Some examples are remote computing, screen sharing and cloud computing and gaming [1–4]. Since these activities involve the transmitting, receiving and compression of SCIs, the quality of SCIs is essential to be maintained throughout these activities for better quality of experience of the end users. Quality assessment (QA) of an SCI is generally more complex than natural image (NI) as SCI consists of a mixture of texts, graphical contents and NIs. Theoretically, these different types of content have to be assessed separately as they have different image properties.

Most of the existing image QA methods are devised and tested on NIs only. This is due to the ubiquity of NIs displayable by digital gadgets since the past two decades. In most of the existing applications, NIs are being displayed and perceived by humans. Therefore, assessing the quality of NIs is important for improving and sustaining the quality of experience and service of the end users. Some of the popular methods are structural similarity (SSIM) [5], multiscale SSIM (MSSIM) [6], information weighted SSIM (IWSSIM) [7], feature similarity (FSIM) [8], gradient magnitude similarity deviation (GMSD) [9], visual saliency-based index (VSI) [10] and visual information fidelity (VIF) [11]. They are specifically designed for NIs and have good performance in assessing the quality of NIs. SSIM assesses image quality by considering the similarity of luminance, contrast and structure of the images. MSSIM is an extension of SSIM by incorporating multiscale information. IWSSIM is another extension of the SSIM by introducing a new weighting method based on the content information. FSIM incorporates the similarities of phase congruency and gradient magnitude. It also has an extension for colour images. Based on the gradient magnitude, GMSD is one of the best performing QA methods for NIs with low computational complexity. Instead of computing the final index as the average of similarity indices, the standard deviation is used in GMSD. VSI utilizes visual saliency maps for measuring quality distortions and works as a weighting function for computing the final quality index. Another good performing method is VIF. It involves the use of natural scene statistics (NSS) and utilizes steerable pyramid decomposition