Proceedings of the World Congress on Electrical Engineering and Computer Systems and Science (EECSS 2015)
Barcelona, Spain – July 13 - 14, 2015
Paper No. 306

No-Reference Image Quality Metric for Image Fusion

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Extended Abstract

Recently, multi-exposure and/or multi-focus image fusion techniques are interested by many researchers for improving the performance of traditional image enhancement techniques. While traditional techniques enhance a single input image, image fusion techniques use multiple input images of different exposures or focuses for visualizing an enhanced image. Although these techniques usually demand more computing time, they are rapidly adopted in the digital imaging industry because of their much better performances for most high quality images.

Subjective ratings have been used for evaluating the quality of fused images but they are expensive and time consuming. Therefore, several objective metrics have been used instead. They include Q_0, VIF, $Q^{AB/F}$, M_F^{XY}, and $Q(X,Y,F)$. Q_0 and VIF (Li and Kang, 2012) assess the quality of fused image compared to the ground truth reference image. In image fusion, the averaged image of input images or the best exposed or focused image among the input images has been used as the possible reference image. However, it is claimed that these reference images are not the optimal image that the image fusion algorithm is aiming. $Q^{AB/F}$, M_F^{XY}, and $Q(X,Y,F)$ (Zhou et al., 2014) evaluate the fusion performance using a normalized weighted sum of an edge-based metric, a mutual information-based metric, and a structural similarity-based metric, respectively, between the fused image and each of individual input images. It is also claimed that individual input images are not the optimal reference image.

This abstract proposes that no-reference (NR) image quality assessment (IQA) metrics can be a good candidate. NR IQA provides the absolute quality metric from the processed image itself without any reference. Therefore, NR IQA metrics are very useful in practical applications where the ground truth reference image is not available such as the case of image fusion. Recent researches show that the attributes affecting human perception on image quality are overall brightness, contrast, sharpness, details, naturalness, and colourfulness (Yeganeh and Wang, 2013). Based on this result, the hybrid NR IQA for image fusion is proposed as follows:

$$Q = \lambda_{DR} DR + \lambda_{SML} SML + \lambda_{ZC} ZC + \lambda_{MC} MC + \lambda_{CF} CF \ . \tag{1}$$

where, *DR*, *SML*, *ZC*, *MC*, and *CF* are the measurement reflecting the attribute of overall brightness and contrast, sharpness, details, naturalness, and colourfulness, respectively, and λ's are the weight of corresponding measurement. Many possible candidates for each measure exist. Based on the previously proposed NR IQA for each attribute, the dynamic range of an image, the sum-modified Lapalcian, the number of horizontal and vertical zero crossing pixels, the number of horizontal and vertical monotone-changing pixels, and Hasler and Suesstrunk's colourfulness measure are proposed for the measure of *DR*, *SML*, *ZC*, *MC*, and *CF*, respectively.

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