No-reference wavelet-based blur metric for image quality assessment

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I. Introduction

With extensive technological advancements in electronic imaging today, high image quality is becoming an imperative necessity in the modern imaging systems. An important part of quality assurance are techniques for measuring the level of image distortion, *e.g.* noise or blur.

II. Method

The average cone ratio (ACR) [1] estimates local edge regularity in the wavelet domain. In our work, the advantageous properties of ACR: high sensitivity to edge distortions and strong insensitivity to noise, are used for blur estimation. In particular, we propose the center of gravity of the ACR histogram (CACR) as a measure of image blurriness. The new CACR method is applicable as both a full-reference or a no-reference blur metric.

In addition, we propose a method for image classification based on *edge* content similarity.

III. Results

Our results demonstrate consistent performance of the proposed metric for a variety of natural images, in a wide range of both Gaussian and out of focus blurriness, and over a wide range of noise. An absolute error in blur radius estimated with CACR was less than $r = 1$ pixel in as much as 80 to 90% of the test images. Moreover, Table 1 indicates a significant benefit of CACR metric compared to common image distortion metrics [2]: PSNR, and kurtosis.

Table 1. Performance of 3 image distortion metrics: PSNR, kurtosis and CACR. The calculations are done for 8 image databases (DB), each with blur radius $r = \{0.25, ..., 10\}$, using the Spearman rank order correlation coefficients (SROCC).

	SROCC		
DB name	PSNR	Kurt	CACR
Coast&Beach	0.5518	0.0850	0.9346
Forest	0.4967	0.0185	0.9830
Highway	0.6421	0.0902	0.9685
City Center	0.7053	0.0920	0.9722
Mountain	0.5742	0.0178	0.9677
Open Country	0.5027	0.0240	0.9693
Tall Building	0.6039	0.0100	0.9499

IV. Conclusions

The results of our work indicate high accuracy of the proposed CACR blur metric over a wide range of both blurriness (out of focus or Gaussian) and noise in the image. This suggest a promising potential for using the CACR for image quality assessment.

References

[1] A. Pizurica, W. Philips, I. Lemahieu, and M. Acheroy, *A joint inter- and intrascale statistical model for bayesian wavelet based image denoising,* IEEE Trans. Image Proc, 11, 2002.

[2] D. Li, R. Mersereau, and S. Simske, *Blur identification based on kurtosis minimization,* in IEEE Internat. Conf. Img. Proc. (ICIP), vols 1-5, 2005.

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