



AWARD TITLE: IEEE Transaction on Image Processing Best Paper Award

PAPER TITLE: Image Quality Assessment Based on Multiscale Geometric Analysis

AUTHORS: Xinbo Gao, Wen Lu, Dacheng Tao, Xuelong Li

TRANSACTIONS: IEEE Transaction on Image Processing

PUBLICATION DATE: July, 2009

CITATION IMPACT: 45 citations

NOMINATING PERSON, COMMITTEE OR BOARD: IVMSP TC

NAME, ADDRESS, E-MAIL ADDRESS, PHONE AND FAX OF NOMINATOR:

Feng Wu, No.5 Danling Street, Haidian, Beijing 100080, China, fengwu@microsoft.com
+86-10-59173119

NAME, CURRENT ADDRESS, E-MAIL ADDRESS, PHONE, AND FAX OF AUTHORS:

Xinbo Gao, No.2, South Taibai Road, Xi'an 710071, China, xbgao@mail.xidian.edu.cn
+86-29-88202845, +86-29-88201620

Wen Lu, No. 2, South Taibai Road, Xi'an 710071, China, wenlu.xidian@gmail.com
+86-29-88201838, +86-29-88201620

Dacheng Tao, Nanyang Technological University, Singapore 639798, e-mail:
dctao@ntu.edu.sg

Xuelong Li, Birkbeck College, University of London, London WC1E 7HX, U.K, e-mail:
xuelong@dcs.bbk.ac.uk

PLEASE ATTACH A SUCCINCT STATEMENT SUPPORTING THE NOMINATION:

(Supporting statement should be limited to at most one page. Material more than one page will not be forwarded to the Awards Board)

Summary of basis for nomination

- Significance and timeliness

Image quality assessment (IQA) is of importance in the field of image processing, which is the reference and standard for optimizing the image processing algorithm or system. In the past, most of researches focus on the design of full reference IQA metric. Since it needs the original image, it is limited to some special applications. In recent years, reduced-reference (RR) IQA has been recognized as an effective and efficient way to predict the visual quality of distorted images. This paper develops a novel framework for RR-IQA to mimic the human visual system (HVS) by incorporating the merits from multi-scale geometric analysis (MGA), contrast sensitivity function (CSF), and the Weber's law of just noticeable difference (JND). In the proposed framework, MGA is utilized to decompose images and then extract features to mimic the multichannel structure of HVS. Additionally, MGA offers a series of transforms including Wavelet, Curvelet, Bandelet, Contourlet, Wavelet-based Contourlet transform, and hybrid wavelets and directional filter banks, and different transforms capture different types of image geometric information. CSF is applied to weight coefficients obtained by MGA to simulate the appearance of images to observers by taking into account many of the nonlinearities inherent in HVS. JND is finally introduced to produce a noticeable variation in sensory experience.

- General quality

The paper has all good points of an awarded paper. The topic of image quality assessment is significant and the breakthrough is obvious. The idea of the paper is novel and pioneering. The proposed techniques are presented clearly with key points explained in depth and supported by detailed mathematical analysis and solid experiments. The description is clear and carefully organized, and the discussion is very insightful.

- Contributions & originality

This paper develops a novel framework for reduced reference image quality assessment to mimic the human visual system by incorporating the merits from MGA, contrast sensitivity function, and the Weber's law of just noticeable difference. Moreover, in the past, researches in this field always focus on one of the special transform domain of MGA. While this paper tries to study the RR-IQA metric in a series of transforms domains including Wavelet, Curvelet, Bandelet, Contourlet, Wavelet-based Contourlet transform, and hybrid wavelets and directional filter banks. Through the experimental comparison, some useful conclusions are reached.

- Comparison with other studies

This paper compares the performance of the proposed framework based on different MGA transforms with standard IQA methods, i.e., PSNR, WNISM, and the mean structural similarity index (MSSIM), based on the following experiments: the consistency experiment, cross-image and cross-distortion experiment, sensitivity experiment, and the rationality experiment. The experimental results demonstrate the effectiveness and superiority of the proposed RR-IQA metric.

- Impacts

Since this paper was published, it has attracted extensive and increasing attention. It was one of the top 100 most downloaded IEEE Xplore articles from June to August, 2009. In a short period, the paper attracted many follow-up works and triggered related research, e.g., more than 45 citations till June, 2012. Overall, the paper introduces a new paradigm for reduce reference image quality assessment and is expected to significantly impact the related technology development in many years to come.