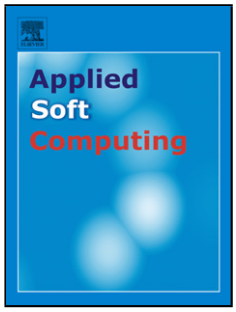

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PII: S1568-4946(17)30170-9
DOI: http://dx.doi.org/doi:10.1016/j.asoc.2017.03.046
Reference: ASOC 4131

To appear in: *Applied Soft Computing*

Received date: 19-7-2016
Revised date: 21-3-2017
Accepted date: 30-3-2017

Please cite this article as: M. Hassaballah, A. Ghareeb, A Framework for Objective Image Quality Measures Based on Intuitionistic Fuzzy Sets, <*![CDATA[Applied Soft Computing Journal]]*> (2017), http://dx.doi.org/10.1016/j.asoc.2017.03.046

Available online at www.sciencedirect.com

ScienceDirect

Applied Soft Computing 00 (2017) 1–24

Applied Soft Computing

A Framework for Objective Image Quality Measures Based on Intuitionistic Fuzzy Sets

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Abstract

Measuring the distance or similarity objectively between images is an essential and a challenging problem in various image processing and pattern recognition applications. As it is very difficult to find a certain measure that can be successfully applied to all kinds of images comparisons-related problems in the same time, it is appropriate to look for new approaches for measuring the similarity. Several similarity measures tested on numerical cases are developed in the literature based on Intuitionistic Fuzzy Sets (IFSs) without evaluation on real data. This paper introduces a framework for using the similarity measures on IFSs in image processing field, specifically for image comparison. First, some existing similarity measures are discussed and highlighted their properties. Then, modelling digital images using IFSs is explained. Moreover, the paper introduces an intuitionistic fuzzy based image quality index measure. Second, for improving the perceived visual quality of these IFS-based similarity measures, construction of neighborhood-based similarity is proposed, which takes into consideration homogeneity of images. Finally, the proposed framework is verified on real world natural images under various types of image distortions. Experimental results confirm the effectiveness of the proposed framework in measuring the similarity between images.

Keywords: Image processing, Image comparison, Image similarity, Similarity measures, Intuitionistic fuzzy sets.

1. Introduction

In computer vision and image processing applications, measuring the similarity between images plays an important role. A visual task (e.g., object tracking, image classification) relies frequently on evaluation of similarity between objects within images [1–3]. Content-based image retrieval systems often look up in a database of images for all images that are close to a given query image based on some similarity measures and retrieve the most relevant ones as the result of this query. Thus, the performance of the retrieval system may depend on defining a appropriate similarity measure [4–6]. On the other hand, it is well known that images may be subject to several types of distortions during its acquisition, storage, transmission or compression [7], which in turns deteriorate the visual quality of these images. In this case, there is a must for efficient similarity measures for image processing/analysis tasks. For instance, similarity measures are utilized for evaluating compression algorithms as well as comparing image restoration methods. Also, similarity measures are helpful for the comparison of algorithms dedicated to noise reduction [8–10].

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