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Invariant correlation using a binary mask applied to binary and gray images

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ABSTRACT:

More alternative ways to generate the binary ring masks are studied and a new methodology is presented when in the analysis the image come with some distortion due to rotation. This new algorithm requires low computational cost. Signature vectors of the target so like signature vectors of the object to be recognized in the problem image are obtained using a binary ring mask constructed in accordance with the real or the imaginary part of their Fourier transform analyzing two different conditions in each one. In this manner, each image target or problem image will have four unique binary ring masks. The four ways are analyzed and the best is chosen. In addition, due to any image with rotation include some distortion, the best transect is chosen in the Fourier plane in order to obtain the best signature through the different ways to obtain the binary mask. This methodology is applied to two cases: to identify different types of alphabetic letters in Arial font and to identify different fossil diatoms images. Considering the great similarity between diatom images the results obtained are excellent.

Key words: Spectral image recognition, nonlinear correlation, binary masks.

REFERENCES AND LINKS

[1] S. Solorza, J. Álvarez-Borrego, Digital system of invariant correlation to position and rotation. Optics Communication 283, (2010), pp. 3613-3630.

1. Introduction

Recently, a digital system of invariant correlation to position and rotation was presented [1]. In that methodology a binary ring mask was constructed using the real part of the Fourier transform of the reference image. Different image sets were compared, for example different alphabetical Arial font letters and different species of diatoms using these binary masks and nonlinear correlations. However, in their paper they gave a small review of different correlation systems invariants to rotation and position [1].

In this paper we studied more alternative ways to generate the binary ring masks and we present a new methodology when in the analysis the image come with some distortion due to rotation.

2. Methodology

2.a The signature of the image

The objective is identifying a specific target no matter the position or the angle of rotation presented on the same plane. In order to have an invariance rotation we used the binary mask (step 1 in Fig. 1a). So, the modulus of the Fourier transform of the image is multiplied by the binary mask to sampling the frequencies pattern of the object (steps 2 and 3 in Fig. 1a). Finally, the modulus of the Fourier transform in each ring is summed and then assigned to the corresponding ring index to obtain the signature of the image (step 4 in Fig. 1a). The first ring begins from the

center of the image in Figure 1a (step 3). Figure 1b shows the comparison of the four signatures of the image when four different ways for calculating the binary mask are used.

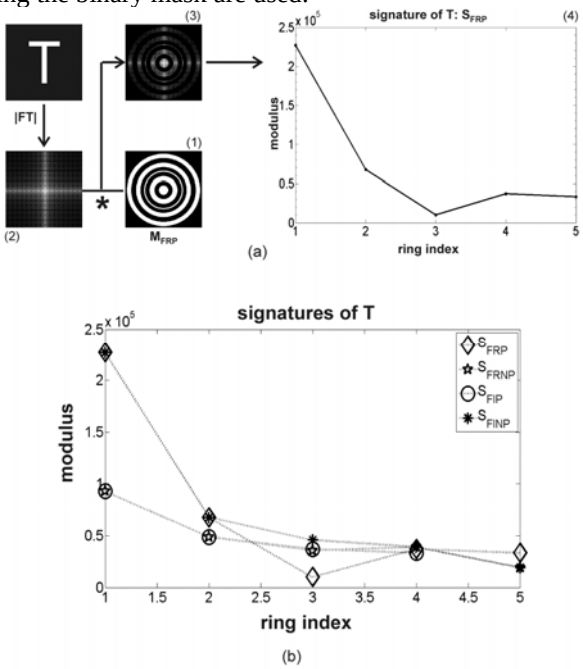

Fig. 1 Different four signatures obtained from the image T.

3. Results.

As a first step we analyze alphabet letters (binary images) and like a second step we used real images (diatoms). Anyway the method can be tested using any kind of images. If we consider the results presented in [1], we will analyze the nonlinear correlation results only. The mean value ± 2SE (two standard error) was calculated and outliers values were considered in the analysis. We can obtain a better result for the letter analysis when the real part of the Fourier transform is used. When the diatoms were analyzed good results were obtained using any of the four different ways for calculating the binary mask.

4. Conclusion.

In this deeper analysis, we find four different ways to obtain the binary mask. Binary images (letters) and gray real images (diatoms) were analyzed in order to know the best way to go in the correlation process. Nonlinear filters were used. In all the cases, composite filters f_{10} and f_{18} were used and they had the best performance with α =0.1-1.0 . In addition, using the f_{10} composite filter we have a less cost computational. In the particular examples presented in this paper, the correlation digital system shows an excellent performance, a confidence level of 95.4% or greater.

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