A New Histogram-Based Descriptor for Images Retrieval from Databases

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Abstract. In this paper, we propose a new approach for designing histogram-based descriptors. For demonstration purpose, we generate a descriptor based on the histogram of differential-turning angle scale space (d-TASS) function and its derived data. We then compare the proposed histogram-based descriptor with the traditional histogram descriptors in terms of retrieval performance from image databases. Experiments on three shapes databases demonstrate the efficiency and the effectiveness of the new technique: the proposed technique of histogram-based descriptor outperforms the traditional one. These experiments showed also that the proposed histogram-based descriptor using d-TASS function and the derived features performs well compared with the state-of-the-art. When applied to texture images retrieval, the proposed approach yields higher performance than the traditional histogram-based descriptors. From these results, we believe that the proposed histogram-based descriptor should perform efficiently for medical images retrieval so we will focus on this aspect in the future work.

Keywords: pattern recognition, image description, image retrieval, texture image, differential-turning angle scale space, turning angle scale space, bull's eye performance.

1 Introduction

With the extraordinary growth of image databases due to the development of digital systems, automatic image retrieval within large databases becomes necessary. To make them more efficient and more easy to use, retrieval systems must be based preferably on images content.

In the present study, we use the d-TASS (differential-Turning Angle Scale Space) function and two related measurements to generate their corresponding histograms from which the shape descriptor is built. The d-TASS function introduced in [4] and [5] is known to yield characteristic properties and to be invariant under translation, rotation and scale change.

The rest of the paper is organized as follows: after a brief description of the d-TASS construction and the definition of the related features, in section 2, the

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proposed descriptor is presented in section 3. Section 4 presents some experimental results and compares the proposed and the traditional histogram-based descriptor generation. We also present some comparison of the proposed approach and some existing techniques of the state of the art. Finally, section 5 gives some discussions and concludes the paper.

2 Description of the Features

As presented in [5], the input contour is defined by a set of *N* points ordered counter clockwise in the plane. Given a starting point P_0, the points are numbered from P_0 to P_{N-1}. The vector $\vec{V}_n$ originating at P_n and oriented towards P_{n+1} makes an angle θ_n with the x-axis. This angle is called the turning angle. Figure 1 illustrates the principle. From this angle, we define the differential turning angle (d-TA) function φ_n:

$$\varphi_n = \theta_n - \theta_{n-1} \tag{1}$$

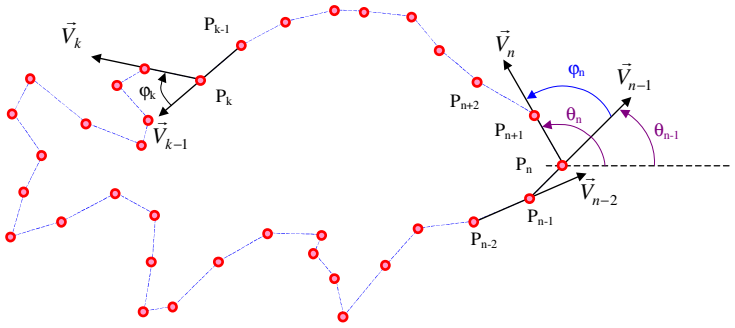

Fig. 1. Illustration of the differential-turning angle

The d-TA function yields an expression of the curvature of the contour thus its zero-crossing corresponds to that obtained from curvature analysis [12, 13].

2.1 Generation of the d-TASS Function

By definition, the d-TASS function is generated, by progressively smoothening the contour with a Gaussian filter [4, 5, 6]. Given a Gaussian kernel with a standard deviation σ_0, a progressive filtering is performed by iterating the operation so that the filtering scale $\sigma_s = \sigma_0 \sqrt{s}$ is reached after s iterations. In this study, a Gaussian kernel of size 3 (g=[0.25, 0.50, 0.25]) corresponding to $\sigma_0 = \sqrt{2/\pi}$ is used. After each iteration, the d-TA function is computed. Thus, given a range of scales (a range of iterations), one obtains the d-TASS function.