



Image Normalization Via Salient Points of Skeletons

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Abstract

We propose a novel technique of image normalization under affine planar transformations. The main idea lies in creation binary image cuts or bit planes skeletons and search corresponding points in affine related images. The salient points are determined by skeletons vertices correspondences on the base of the areas ratio invariance. An increase of image normalization accuracy and reliability via of their binary cut sets analysis is provided by accounting for shape information redundancy to average noise and errors effects.

Keywords: *Mathematical morphology, Affine normalization, Salient point, Binary cut, Affine equivalent skeletons.*

1. Introduction

A special emphasis is given to the image processing in presence of geometric distortions permanently [see, e.g. 1-17]. Two approaches are widely spread and sufficiently explored. First one is the invariant features analysis. As a rule, such types of algorithms are often used in pattern recognition. Another approach represents the image normalization, based on the search of transformation parameters to equalize images for further matching. These algorithms are usually applied to remote sensing and image tracking. Mostly, 2D affine maps are used as a model of geometric transformations due to simplicity of linear distortions processing and goodness of fit to actual deformations, induced by changing of 3D mutual sensor-object position and (or) orientation [1-4, 9, 11, 13, 15-17].

Algebraic moment-invariants [1-4], Legendre [5], Zernike moments [6], group averaging [7], multiscale analysis [8] constitute groundwork for numerous image processing algorithms development. Among many others approaches there arise local techniques allowing to find image points or regions which makes it possible to consider geometric transformations [4, 9-17]. These algorithms simultaneously or separately adapt location as

well as scale and shape of the point neighbourhoods and gray-level features. They allow robustness to partial visibility and clutter but at the same time the choice of corresponding points is often insufficiently reliable due to local noise and discontinuity. However redundancy of interest points can give possibility to compensate nuisance influences.

We propose a novel image normalization method based on the search of affine-equivalent points on skeletal representation of object shape to form an overdetermined set of linear equations. The solution provides image normalization for recognition, tracking, content-based retrieval and other tasks. Increase of equations amount is achieved by two ways. First of all, we replace gray-level image processing by evaluation of binary cuts sets (bit planes in the simplest case). Binary cuts producing can be expounded as multiple binarization with optimal sketchy description of shape properties. Secondly, we shall use groups of interest points to get the most complete descriptors of image regions. To create algorithms we have used the mathematical morphology as a tool.

Binary morphology algorithms are based on Minkowski algebra operations, which are well investigated for solving a number of problems such as image segmentation, thresholding, noise filtering, image compression and coding, thinning and thickening of binary images [18-20]. However, application of morphological tools to the image geometric transformations normalization was not actually studied till nowadays.

It is doubtful that known skeletonization methods (medial and chordal axis transform, Lantuéjoul's skeleton, Hilditch's algorithm etc.) can be applied to image normalization, as skeletons can be changed at geometric transforms especially on discrete rasters. Consequently affine invariant skeletonization is required and moreover these skeletons should allow to determine corresponding points of affine equivalent images.

The paper contains following sections. In the second section algorithms of affine invariant skeletonization and salient points search are proposed and proved. There are

