Gabor wavelet transform applied to feature extraction of ophthalmic images

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Abstract. This work describes the feature extraction module of a system designed to measure and interpret optical refractive errors (astigmatism, axis of astigmatism, near- and short-sightedness) from Hartmann-Shack (HS) images. This module uses the Gabor wavelets transform to produce a reduced set of features from an image of the human eye that are then input to an image analysis module based on Support Vector Machines.

1. Introduction

We investigate a new approach for measuring ocular refractive errors (astigmatism, near-sightedness and short-sightedness) from images of the human eye [1]. This approach uses Support Vector Machines (SVMs) to analyse data features extracted from images of the eye acquired with a technique known as Hartmann-Shack [2] and output measures for the eye´s refractive errors. Prior to analysis and feature extraction an image processing stage takes place to identify and crop the region of interest considering domain spatial and geometrical information. Then a set of relevant image features are extracted using wavelet and Garbor Transforms. These features are finally fed into a SVM module for analysis that provides a diagnosis of refractive errors present in the ocular globe under investigation.

2. Gabor wavelet transform

The Gabor process takes as input and image and two parameters, orientation and scale, that determine the number of desired features according to the expression (orientation $\times$ scale $\times$ 2). Hence, for orientation and scale equal to 10 a vector of 200 relevant features will be extracted from the input image. Two hundred attributes have been considered in this project. Prior to delivering to the analysis module, these attributes were normalised.

The Garbor algorithm implemented was based on the ones used by Castanón [3] for Content-based Image Retrieval (CBIR), which was itself inspired on the algorithm by Daugman [4], used in a well-known application in human face recognition through the iris.

3. Final Remarks

The Gabor transform is shown appropriate for the feature extraction, because it minimizes the uncertainty of the two-dimensional articulations in the space and frequency. Those 2D filters can be adjustable in the orientation and scale. Therefore, detectors of lines and borders, and statistical calculations of micro features in a specific area are made usually to characterize the information of the texture.

The technique of Gabor has been used in several applications of images processing, for example, for the images representation by the definition of wavelets set that supplies a complete representation of the same ones and the recovery of images based on the texture. There are applications of Gabor algorithm also for the recognition of fingerprints and of human faces in video sequences.

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