Two-Dimensional Face Recognition Methods Comparing with a Riemannian Analysis of Iso-Geodesic Curves

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ABSTRACT

In this paper, the authors performed a comparative study of two-dimensional face recognition methods. This study was based on existing methods (PCA, LDA, 2DPCA, 2DLDA, SVM...) and 2D face surface analysis using a Riemannian geometry. The last system uses the representation of the image at gray level as a 2D surface in a 3D space where the third coordinate represent the intensity values of the pixels. The authors' approach is to represent the human face as a collection of closed curves, called facial curves, and apply tools from the analysis of the shape of curves using the Riemannian geometry. Their application has been tested on two well-known databases of face images ORL and YaleB. ORL data base was used to evaluate the performance of their method when the pose and sample size are varied, and the database YaleB was used to examine the performance of the system when the facial expressions and lighting are varied.

Keywords: Facial Curves, Facial Surfaces, Geodesic Path, ORL Database, Riemannian Geometry, YaleB Database

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1. INTRODUCTION

Traditional means of identity verification for access control: as passport, identity card, passwords or PINs can be easily falsified. The solution appears to remedy this problem is to use biometrics. Biometric recognition processes allow recognition of individuals based on physical and behavioral characteristics of the individual. Different technologies have been developed such as: digital fingerprint, iris, voice, hand and face [*C. Samir 2006*].

Face recognition is one of the most commonly used techniques in biometrics authentication applications, of access and video surveillance control. This is due to its advantageous features [*C. S. Chua 2000*]. A face recognition system requires no cooperation from the individual like putting your fingers or hands on a specific device or speaking into a microphone. Therefore, the individual has to stay or walk in front of a camera in order to be recognized by the system.

In a face recognition system, the individual is subject to a varied contrast and brightness lighting background. This three dimensional shape, when it is part of a two-dimensional surface, as is the case of an image, can lead to significant variations [*C. Samir 2009*]. The human face is an object of three dimensional natures. This object may be subject of various rotations, not only flat but also space and also subject of deformations due to different facial expressions. The shape and characteristics of this object also change over time.

Automatic recognition of human faces based on the 2D images processing is well developed this last years, and several techniques have been proposed. We find several global, local and hybrids methods: The Principal Component Analysis PCA also known under the name eigenfaces [*L. Sirovich 1987; L. Sirovich 1990; M. Turk 1991; R.Alain 2009*], two-dimensional version of PCA noted 2DPCA [*J. Yang 2004*], Linear Discriminant Analysis LDA also known under the name Fisherfaces [*P. N. Belhumeur 1997; L. Bedoui 2008*], two-dimensional version of LDA known as 2DLDA [*M. Visani 2004*], the Stochastic Approach [*M. T. Laskri 2002; P. K. Suri 2011*]. On the other hand, there are methods of 3D face recognition based on the use of three-dimensional information of the human face in the 3D space. Existing approaches that address the problem of 3D face recognition can be classified into several categories of approaches: Geometric or Local approaches 3D, Bronstein et al propose a representation based on the isometric nature of the facial surface [*A. M. Bronstein 2005; 2007*]. Samir et al use 2D and 3D facial curves for analyzing the facial surface [*C. Samir 2006; 2009*]. Holistic approaches, Heseltine et al have developed two approaches applying the representations ACP in Three-dimensional face [*T. Heseltine 2004*], Cook et al present a robust method for facial expressions based on Log Gabor models from images of deep [J.A. Cook 2006]. There are some other approaches based on face Segmentation can be found in [*P.*

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