International Journal of Innovative Computing, Information and Control
Volume **5**, Number **11(B)**, November **2009** ISSN 1349-4198
pp. **4145–4154**

APPLICATION OF PRINCIPAL COMPONENT ANALYSIS TO A RADIAL-BASIS FUNCTION COMMITTEE MACHINE FOR FACE RECOGNITION

Chuan-Yu Chang and Hung-Rung Hsu

Department of Computer Science and Information Engineering
National Yunlin University of Science & Technology
No. 123, Sec. 3, University Rd, Douliou, Yunlin, Taiwan
chuanyu@yuntech.edu.tw

Received October 2008; revised February 2009

Abstract. *Face recognition is an important issue in security systems, film processing, identification-card recognition, and criminal identification systems. Challenges in face recognition include illumination variation, pose variation, facial expression, aging, hair and glasses. In this paper, an AdaBoost committee machine is applied to improve face recognition accuracy. The commit machine consists of several classifiers of radial basis function neural networks (RBFNN). To speed up the training process and increase the generalization of RBFNNs, the principal component analysis (PCA) technique is applied to select adequate centers for the RBFNN classifiers and a novel weight updating mechanism is adopted to update the connection weights between the hidden neurons and output neurons. Experimental results show that the proposed method has a high recognition rate and requires a short training time.*

Keywords: Principal component analysis, Radial-basis function neural networks, Face recognition, AdaBoost

1. **Introduction.** In recent years, image analysis techniques had been successfully applied to many applications, such as wafer defect inspection [1], image watermarking [2], compression [3,4], face detection [5] and face recognition [6-18]. Face recognition has become the most popular research subject in image analysis and understanding. Face recognition is critical for identification card recognition, security systems and criminal identification systems [8]. Challenges in face recognition include illumination, pose, facial expression, aging, hair and glasses [6,7,10,18].

Generally speaking, face recognition approaches can be divided into feature-based, template-based, statistics-based and neural network-based categories [8,10]. Feature-based approaches use the geometrical relationships of invariant salient features of the face, such as eyes, eyebrows, mouth, nose and chin [8]. The recognition rate of feature-based techniques highly depends on the detected features [10]. Unfortunately, variations in illumination and facial expression seriously affect the detection accuracy of invariant salient features [7]. Template-based approaches are based on similarity measurements between a template and the tested feature sets, which can be calculated without the pairing of invariant salient features. The drawback of the template-based method is that the recognition results highly depend on the variation of scale, pose and shape [6,8]. Principal component analysis (PCA) and linear discriminant analysis (LDA) are well-known statistics-based approaches, which are often applied to the pre-processing stage of face recognition. In general, PCA is used to determine an optimal linear transformation matrix. The input data is projected from the original n-dimensional feature vector space onto an m-dimensional eigenvector space through the matrix [19]. Linear discriminant