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SERIALLY-CONNECTED DUAL 2D PCA FOR EFFICIENT FACE REPRESENTATION AND FACE RECOGNITION

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Abstract. *Subspace learning methods such as Principal Component Analysis (PCA) are widely used for face recognition. In PCA based face recognition, the 2D facial image should be initially unfolded to a long 1D vector. Such unfolding process will introduce several problems: (1) the feature vector is in high dimensional vector space resulting in huge computation cost and bad performance on generalization; (2) loss of spatial information. Recently a new method called 2-dimensional principal component analysis (2DPCA) has been proposed to overcome the above problems. 2DPCA calculates the bases in the column-mode subspace of the 2D image instead of finding the basis in the long unfolding vector subspace. Therefore, the 2D data can be directly used in the training without the unfolding vector preprocessing. 2DPCA not only makes the calculation of the bases efficiently but also can represent the 2D data accurately, however its drawback is that it needs more coefficients to represent the 2D data than PCA because 2DPCA is an unilateral projection (right multiplication) scheme. In this paper, we propose a novel method named serially-connected dual 2DPCA (SCD-2DPCA), which is a bilateral projection scheme for efficient face representation and face recognition. In SCD-2DPCA, a row-preserved 2DPCA is first applied to reduce the column dimension of a 2D image and a column-preserved 2DPCA is applied to reduce the row dimension. SCD-2DPCA can compress the image along both row and column directions, so it is more efficient for face representation than 2DPCA.*

Keywords: Face recognition, 2-dimensional principal component analysis (2DPCA), Generalized 2-dimensional principal component analysis (G2DPCA), Serially-connected 2-dimensional principal component analysis (SCD-2DPCA), Efficient representation

1. **Introduction.** Face recognition has received more and more attention with a wide range of applications such as access control, forensic identification and human computer interface. Although numerous face recognition algorithms have been proposed in the past two decades with the state of the art reported in the survey of [1,2], it still remains as a difficult problem far from well solved. This is due to the fact that faces exhibit significant variations in appearance due to illumination, expression, pose and aging factors. The typical approach in handling these variations is to use large and representative training sample set. However, the training samples are very limited in many real applications of face recognition. So it is important to find an efficient representation approach for face images in order to handle the variations from limited samples.