ABSTRACT

In face recognition tasks, the relation between the dimensionality of the sample space and the training set size is an important factor since it affects the recognition performance. This relation is described by two terms (i) Small Sample Size (SSS) and (ii) Large Sample Size (LSS). In SSS, the dimension of the sample space is larger than the number of samples in the training set and in LSS; the number of samples in the training set is larger than the dimension of the sample space. Kernel Discriminative Common Vector (KDCV) and Kernel Common Vector (KCV) are the most effective nonlinear methods for recognition of face images varying in facial expressions and illuminative conditions. Moreover, KDCV method is suitable only in the case of SSS and KCV method is suitable for SSS and LSS cases. In KDCV method, the Between-class scatter matrix, \( S_b \) followed the assumption that each class is equally spaced with all other classes in the transformed space i.e., the overlapping between the class subspaces and the closeness among the class subspaces are not considered in this method. In KCV method classes are modeled as separate subspaces in the transformed space. Thus a class subspace may interfere with other class subspaces. This shows the importance of consideration of between class scatter matrix in the discriminant criterion. However, the Between-class scatter matrix is
not considered in KCV method. Moreover the KDCV and KCV methods fail to recognize a given test sample in the case of mislabels in the training set.

In this work, the limitations of KDCV and KCV methods are overcome by modifying the Between-class scatter matrix, $S_b$ and Within-class scatter matrix, $S_w$ in KDCV method and by introducing Between-class scatter matrix $S_b$ in KCV method. This increases the recognition accuracy of KDCV and KCV methods. The Difference subspace and Gram Schmidt orthogonalization procedure is followed to obtain the discriminative common vector of classes which reduces the computational complexity and effectively deals with SSS problem. The inclusion of pair wise class discriminant information in Between-class scatter matrix also improves the recognition accuracy. Thus the modified KDCV and KCV methods are named as Improved Kernel Discriminative Common Vector (IKDCV) method and Improved Kernel Common Vector (IKCV) method respectively. The procedure of IKCV method for LSS is also given in this work. Thus IKCV method is suitable for SSS and LSS cases. Moreover the failure of recognition of a given test sample in the case of mislabel in the training set is solved by integrating the AdaBoost.M2 algorithm with IKDCV and IKCV methods. Experimental results show that the proposed IKDCV and IKCV methods are superior to KDCV and KCV methods respectively in terms of recognition accuracy and computational efficiency.