Face recognition using wavelet and Principle Component Analysis (PCA)

Vu Thai Linh

Abstract: This study presents a face recognition system integrating wavelet transforms with Principal Component Analysis (PCA) to enhance accuracy and computational efficiency. The proposed method first applies a discrete wavelet transform (DWT) to facial images, decomposing them into approximation and detail sub-bands. This step reduces dimensionality while preserving essential structural features and mitigating sensitivity to illumination variations. The low-frequency approximation sub-band is then subjected to PCA, which extracts the most discriminative eigenfaces by projecting the data onto a lower-dimensional subspace that maximizes variance. Recognition is performed by comparing the Euclidean distance between a test image's feature vector and the stored training vectors. Experimental evaluations on standard face databases demonstrate that the hybrid wavelet-PCA approach achieves higher recognition rates compared to conventional PCA alone, particularly under varying lighting conditions and partial occlusions. Furthermore, the wavelet preprocessing step significantly reduces computational load by decreasing the input size for PCA, enabling faster training and classification. The results confirm that combining wavelet decomposition with PCA provides a robust, efficient solution for real-time face recognition applications.

Keywords: face recognition, wavelet, PCA, feature extraction