



Trinity College Dublin

Coláiste na Tríonóide, Baile Átha Cliath

The University of Dublin

A Comparative Study of Dimension Reduction Techniques- PCA, ICA, LDA and NMF in Facial Recognition using SVM Classifier

CS7IS2

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Dimensionality Reduction/Prediction

1. **PCA:** Eigenfaces generated captures global features like brightness, avg. eigenfaces and that each next eigenface has less information and more noise
 2. **ICA:** Eigenfaces generated captures localized features like nose, eye selectors
 3. **NMF:** Produced sparsely information rich eigenfaces as per its inherent property due to sparsely positively populated decomposed matrices
 4. **LDA:** Scatter between classes is greater in fisherfaces than in eigenfaces
- SVM Classifier:** Widely used and works on the idea of separating members of different class using decision planes.

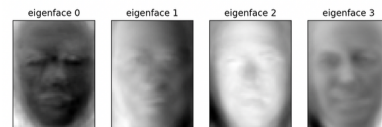


Figure 1: Eigenfaces for PCA

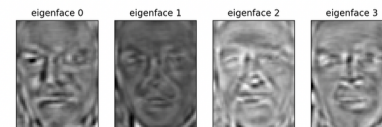


Figure 2: Eigenfaces for ICA

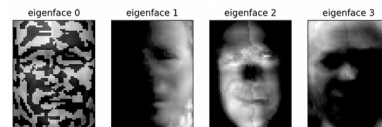


Figure 3: Eigenfaces for NMF

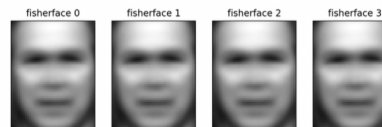


Figure 4: Fisherfaces for LDA

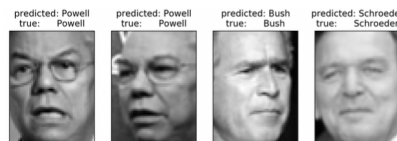


Figure 5: Prediction for PCA

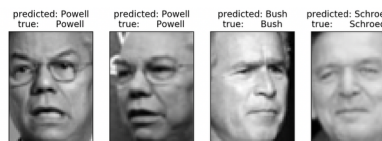


Figure 6: Prediction for ICA

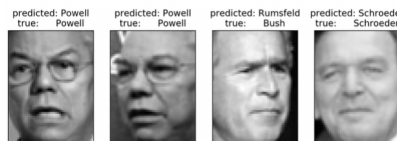


Figure 7: Prediction for NMF

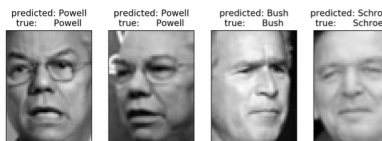


Figure 8: Prediction for LDA

Results/Observations

- NMF is the worst in terms of accuracy of prediction and training time
- PCA performs the best with prediction accuracy of 90%
- LDA performs the best for 200 fisherfaces taking around 1.54 seconds
- For LDA, time taken to train the model kept on decreasing with increasing number of fisherfaces

Based on the trade-off between accuracy of prediction and the time it took for the model to be trained on the generated eigenfaces/fisherfaces, LDA performed best for 150 fisherfaces and had accuracy of 89% and training time of 2.78 seconds.

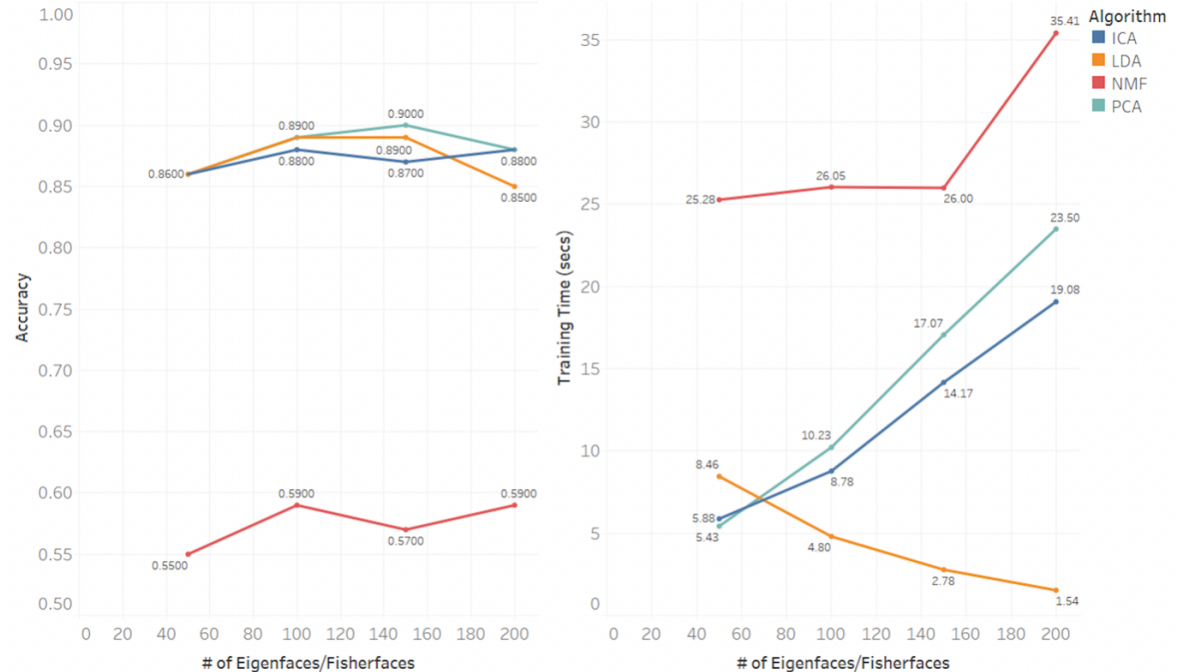


Figure 9: Performance and Training Time of SVM classifier when trained on varying number of eigenfaces/fisherfaces