2D Ear Classification based on Unsupervised Clustering

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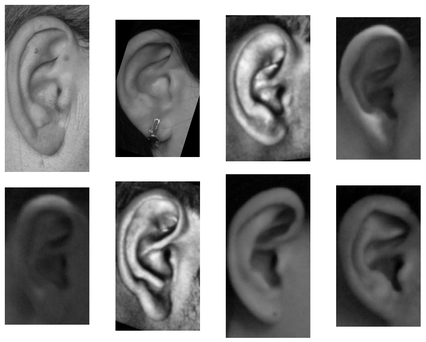
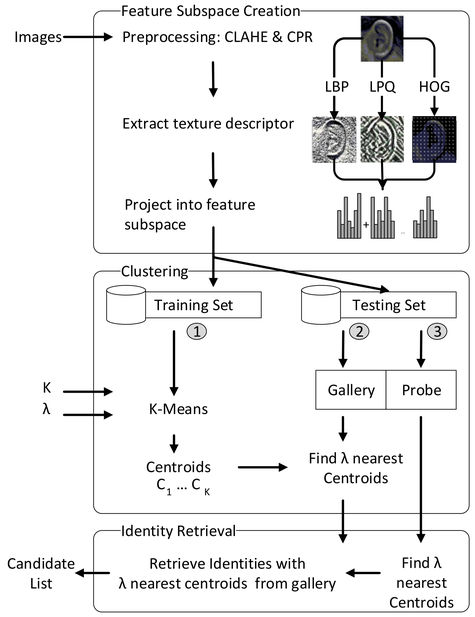
Motivation



How can we categorize these ear images?

Experimental Setup



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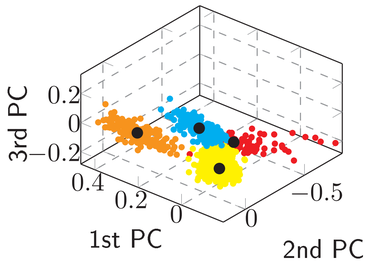
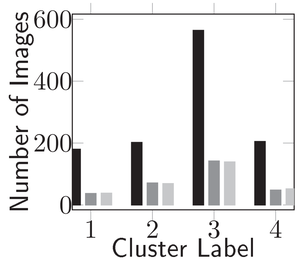
Single Cluster Search

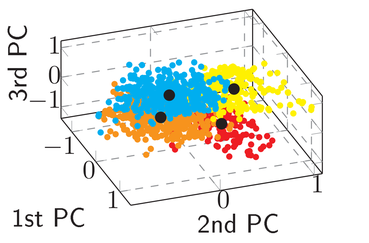
- Classification of ears using texture feature is possible. Solutions with $K = 4$ are promising.
- The LPQ texture descriptor gives the best performance, closely followed by uLBP.
- The HOG feature space does not yield a good classification performance. We obtain empty clusters and a densely populated feature space.

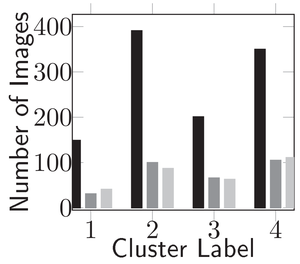
Projected feature subspaces with centroids and distributions of images per cluster in each partition. The tables show detailed performance for selected values of K.
Row 1: LPQ with radius 3 and 20×20 windows with 15 pixels overlap.
Row 2: HOG with 8×8 pixels block size and 9 orientation bins.





K	$(PSE//PEN)$
2	0.77 // 65.81
3	4.75 // 38.65
4	**3.11 // 32.08**
5	3.77 // 32.64
6	8.68 // 27.34
10	30.43 // 13.4
20	32.52 // 12.84

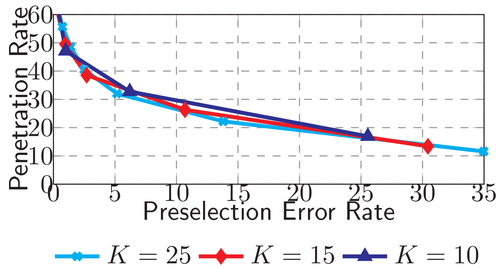




K	$(PSE//PEN)$
2	**6.46 // 49.88**
3	16.87 // 37.81
4	19.75 // 29.55
5	25.33 // 21.41
6	28.52 // 18.73
10	33.63 // 11.35
20	48.8 // 6.23

Multicluster Search

- A multi-cluster search strategy improves the performance. When searching $\lambda = 3$ clusters in LPQ radius 3 and 20×20 windows with 15 pixels overlap, we obtain 0.99% PSE at 47.1% PEN.
- High values for K increase number of choices for an optimal trade-off between PSE and PEN.



Performance Metrics

Preselection Error Rate (*PSE*) The probability that the probe identity is not in the categories that are considered for search.

Penetration Error Rate (*PEN*) The percentages of images in the database that was considered for the search.

Examples

Closest ears for each centroid with LPQ radius 3 and 20×20 windows with 15 pixels overlap and $K = 4$.

Conclusions

Unsupervised classification of 2D ear images using texture descriptors is possible.

- Solutions with four clusters are a good choice for single cluster search when using the LPQ texture descriptor.
- A multi cluster search strategy further improves the classification performance.
- Fusion of candidate lists corresponding to two different feature subspaces using the union or intersection operator does not improve the classification performance.