MP2: Vision Based Person Identification (Face Recognition)

ECE417 – Multimedia Signal Processing
Spring2015
Goal

• Person identification system
• Feature extraction
  – Raw pixel
  – PCA
  – Random projection
• Classification
  – Use K-nearest neighbor for classification
Data

- 80 different face images
  - 4 different people, 20 images for each person
- Format: [Person][Instance].jpg
- Example:
Read Images in MATLAB

- Read image files in MATLAB: `imread`
- Work with grayscale images: `rgb2gray`
- Work with `double` type
- Example:
  ```
  Img = double(rgb2gray(imread(‘A1.jpg’)));
  ```
Experiments

- Feature Extraction
  - Raw pixel
  - PCA
  - Random projection

- Classification
  - Nearest neighbor
  - 5-Nearest neighbor
Feature – Raw Pixel

• Each 90x70 image
• 1. Use “reshape” function to convert it into a 6300x1 vector
  – Ex: Fea=reshape( Img, [6300, 1] );
• 2. Resize image to 45x35, 22x17
  – Ex: Img=imresize( Img, [45, 35] );
• 3. Pick a pair of N1 and N2 so that N1xN2 is roughly equal to the choice of N in PCA. (the ratio between N1 and N2 is unchanged)
Feature - PCA

• Implement PCA (not using built-in PCA function)
• Choose N principal components such that 95% of the total energy is kept
• Project 6300x1 image vector onto the PCA subspace, resulting in a Nx1 vector as a feature
Implement PCA (I)

• 1. Subtract mean w.r.t. each pixel
  – MATLAB function: mean, repmat/bsxfun

• 2. Compute the scatter matrix
  – $S=XX'^*X$, where $X$ the zero-mean 6300x80 matrix, $S$ is 80x80

• 3. Compute eigenvalue of the scatter matrix
  – MATLAB function: eig
  – $[V, D]=eig(A)$, $V$ is the matrix of eigenvectors, diag($D$) are eigenvalues
Implement PCA (II)

• 4. Sort eigenvalues from high to low
  
  – [sorted_values, ori_index]=sort(diag(D), ‘descend’);

• 5. Find N principal components to keep K% of the total energy

• 6. Projection data on selected eigenvectors
Feature – Random Projection

- Use `randn` to generate a projection matrix of size 6300xN
- Project each 6300x1 image onto the random subspace, resulting in a Nx1 vector as a feature
- Select N to be the same as in PCA case
Experiment

- Use nearest neighbor, 5-nearest neighbor for classification

- Validation number:
  - Raw features 6300x1 + nearest neighbor: 88.75% accuracy
  - PCA (95% energy) + nearest neighbor: 96.25% accuracy