Digital Image Processing Laboratory 5

Eigen-Image Analysis

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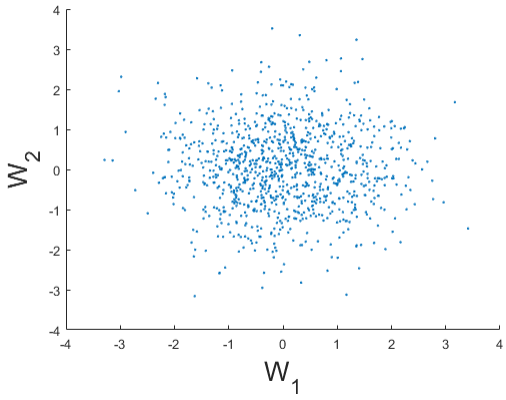
100/100

February 28, 2020

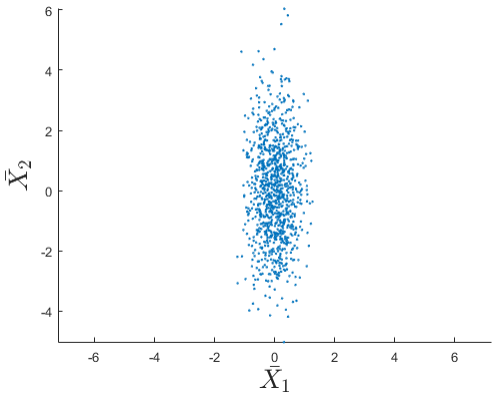
1 Multivariate Gaussian Distribution & Whitening

1.1 Generating Gaussian Random Vector

1.1.1 Scatter Plot for W

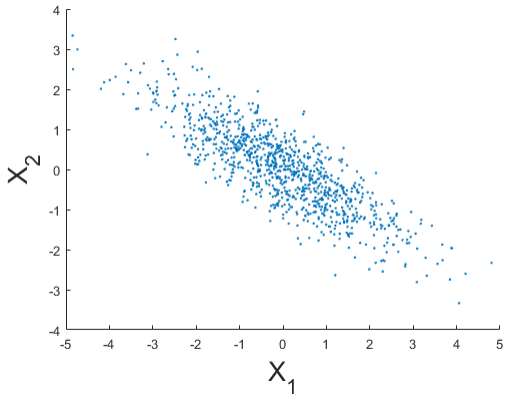


1.1.2 Scatter Plot for $\bar{X}$



1

1.1.3 Scatter Plot for X



1.2 Covariance Estimation and Whitening

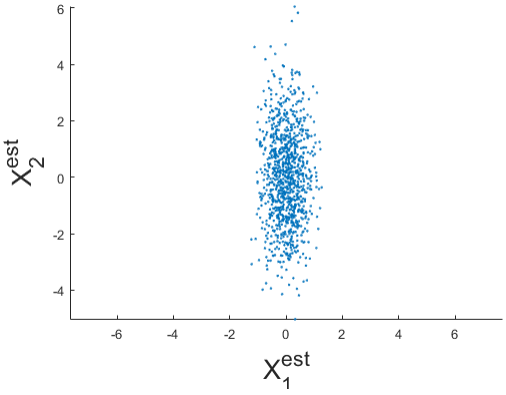
1.2.1 Theoretical Value of R_x

$$R_x = \begin{bmatrix} 2 & -1.2 \\ -1.2 & 1 \end{bmatrix}$$

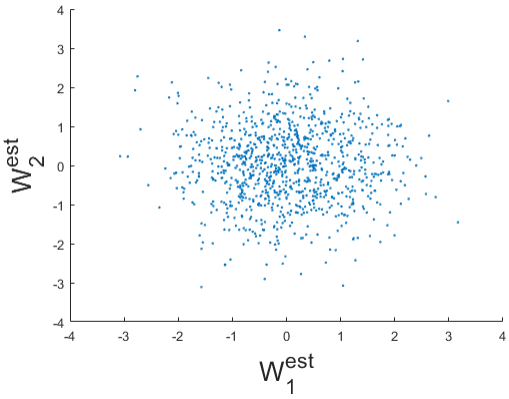
1.2.2 Estimated Value of $\bar{R}_x$

$$\bar{R}_x = \begin{bmatrix} 2.0365 & -1.2159 \\ -1.2159 & 1.0306 \end{bmatrix}$$

1.2.3 Scatter Plot for $\bar{X}$



1.2.4 Scatter Plot for W

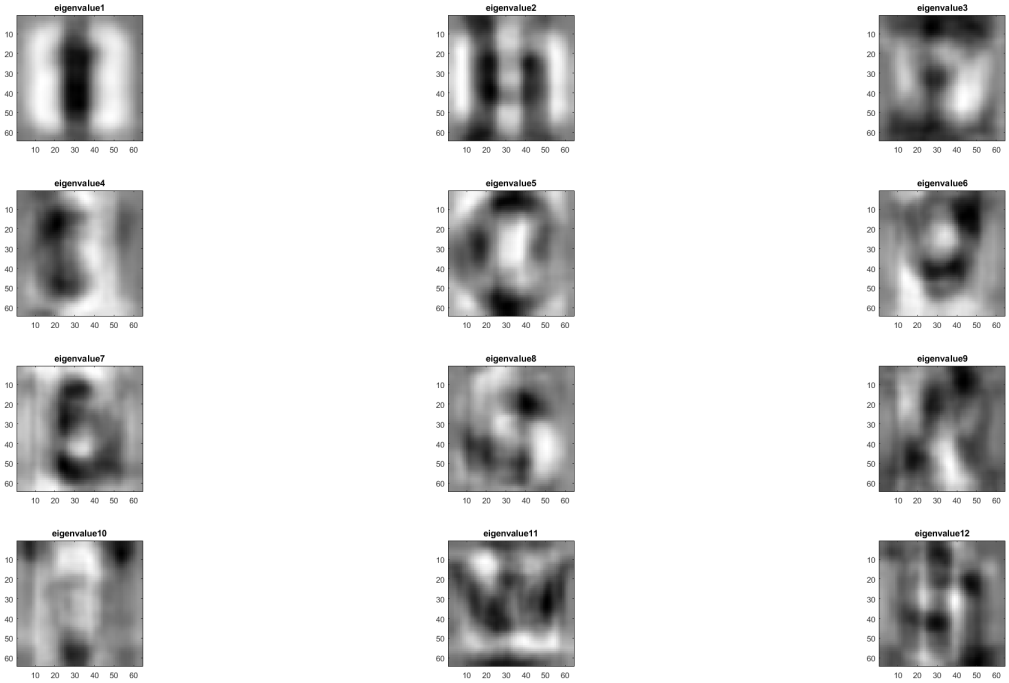


1.2.5 Estimated Value of $\bar{R}_w$

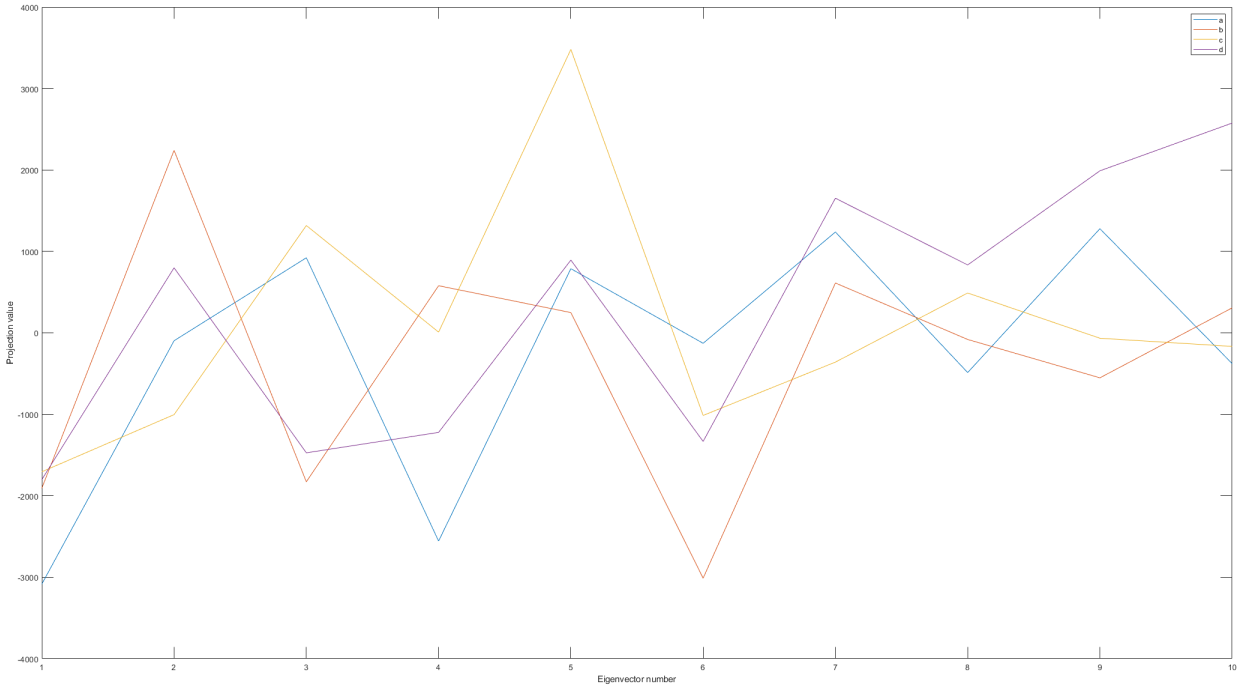
$$\bar{R}_w = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

2 Eigenimages, PCA & Data Reduction

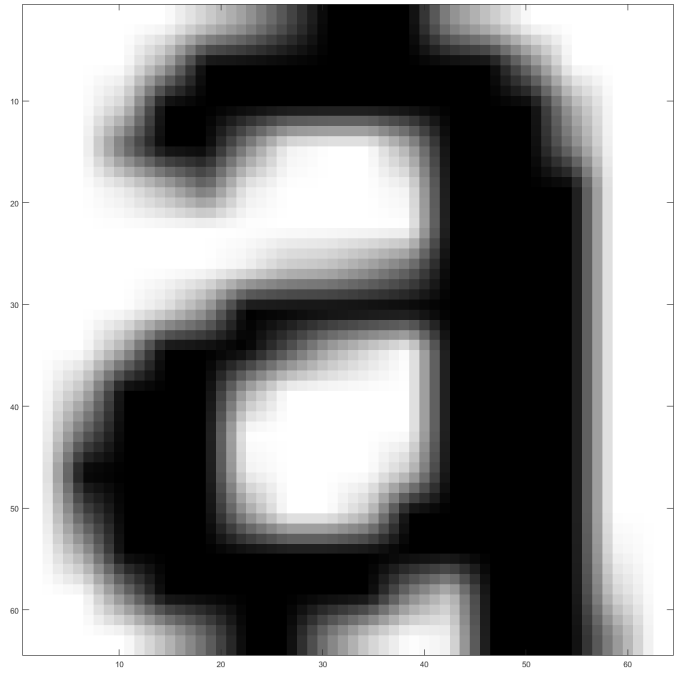
2.1 Images for first 12 Eigen values



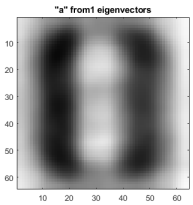
2.2 Projection Coefficients vs Eigenvector Number

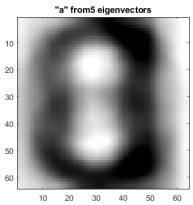


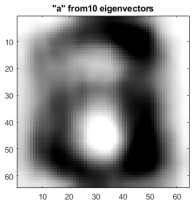
2.3 Original Image

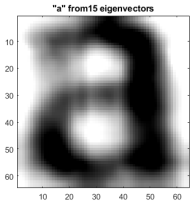


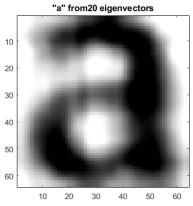
2.4 Resynthesized Images

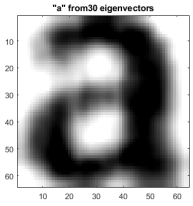












3 Image Classification

3.1 Classification errors using Eigenvectors

Actual	Mis-classified
d	a
j	y
l	i
n	v
p	e
q	a
u	a
y	v

3.2 Classification errors using $B_k = \Lambda_k$

Actual	Mis-classified
i	l
y	v

3.3 Classification errors using $B_k = R_{wc}$

Actual	Mis-classified
g	q
y	v

3.4 Classification errors using $B_k = A$

Actual	Mis-classified
f	t
y	v

3.5 Classification errors using $B_k = I$

Actual	Mis-classified
f	t
y	v
g	q

3.6 Conclusions

The classification error when using 3.2, 3.3 & 3.4 is the lowest i.e they have similar performance. However, there is a trade off between the estimation accuracy and data accuracy i.e more complex the model, the worse is the estimation and vice versa.