Prof-V.M.Gadre.
Date 03-5-10

TWO APPLICATIONS (LECTURE 38)

- DATA MINING
- FACE RECOGNITION

Applications of Wavelets in Data Mining

Improve the efficiency
of Multilevel Surprise
and Trend Queries

Data Representation

as a Matrix

$$\tilde{X} = M \times N$$

(1) Efficient Storage

(2) Efficient Retrieval

(3) Can be easily modified

Singular Value Decompo-
-sition (SVD)

$$\tilde{X} = \underset{M\times r}{U}\ \underset{r\times r}{\Lambda}\ \underset{r\times N}{V}$$

$r =$ Rank of Matrix $\tilde{X}$

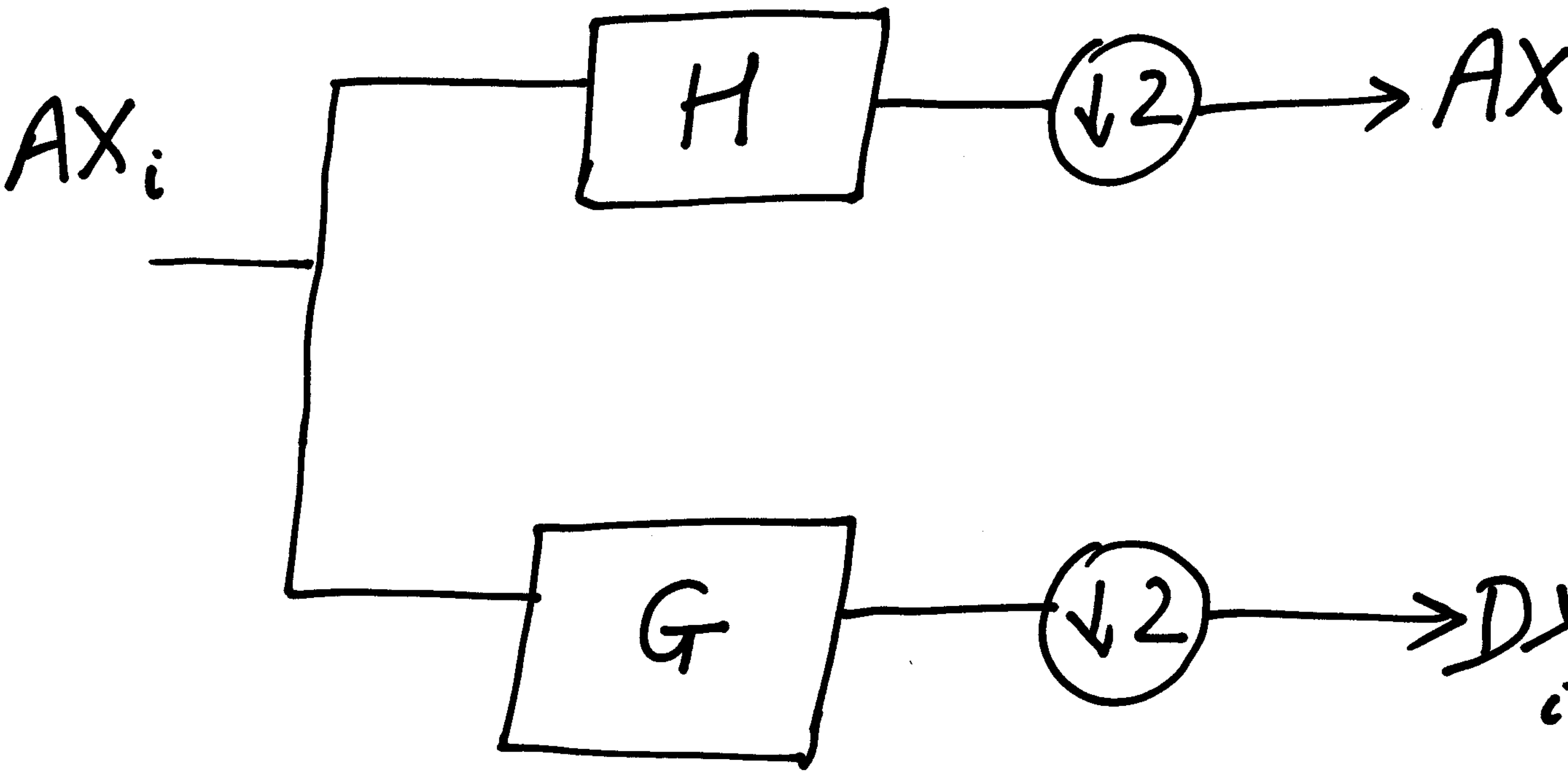
(1) Complexity of reconstruction

$N \times M$

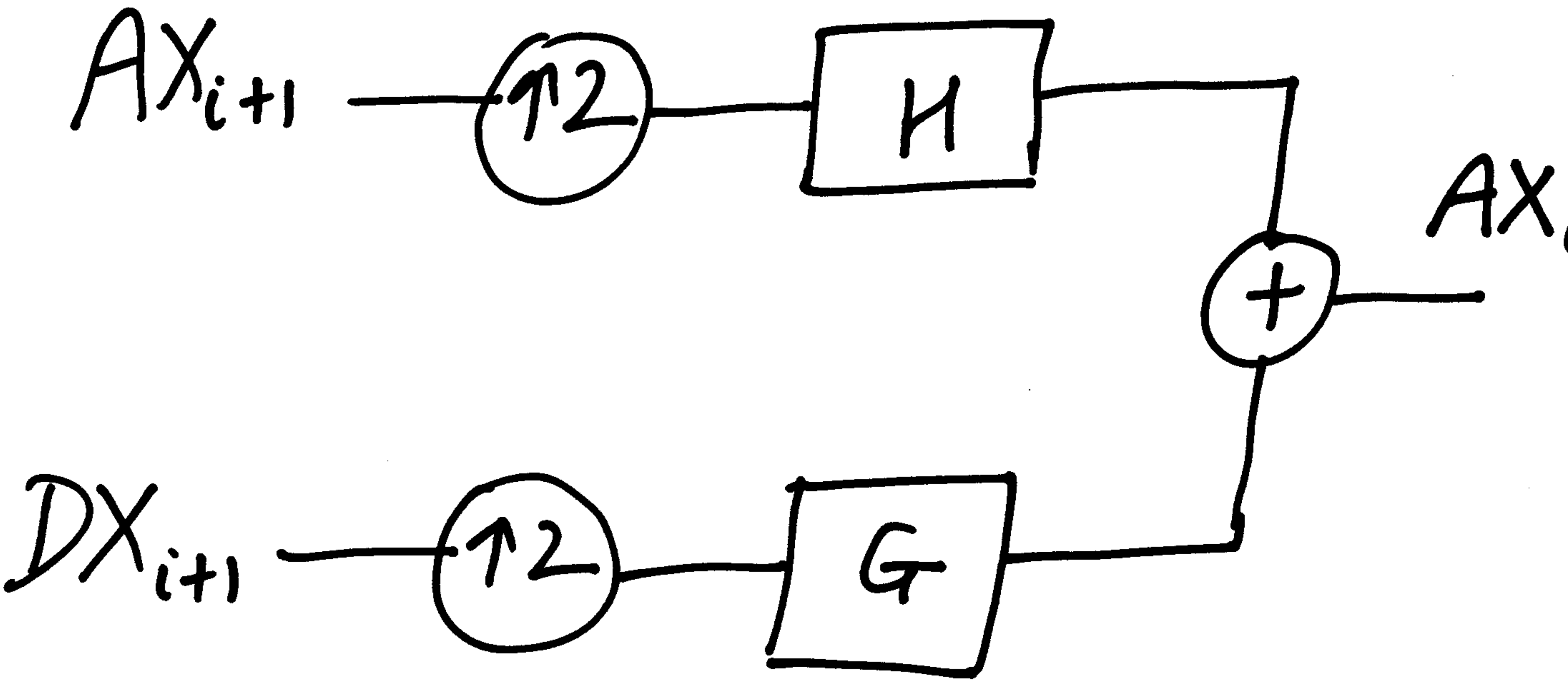
(2) $\tilde{X}$ is not updated

Recompute the whole matrix again

Split Operation



Merge Operation



Properties

(i) Perfect reconstruction

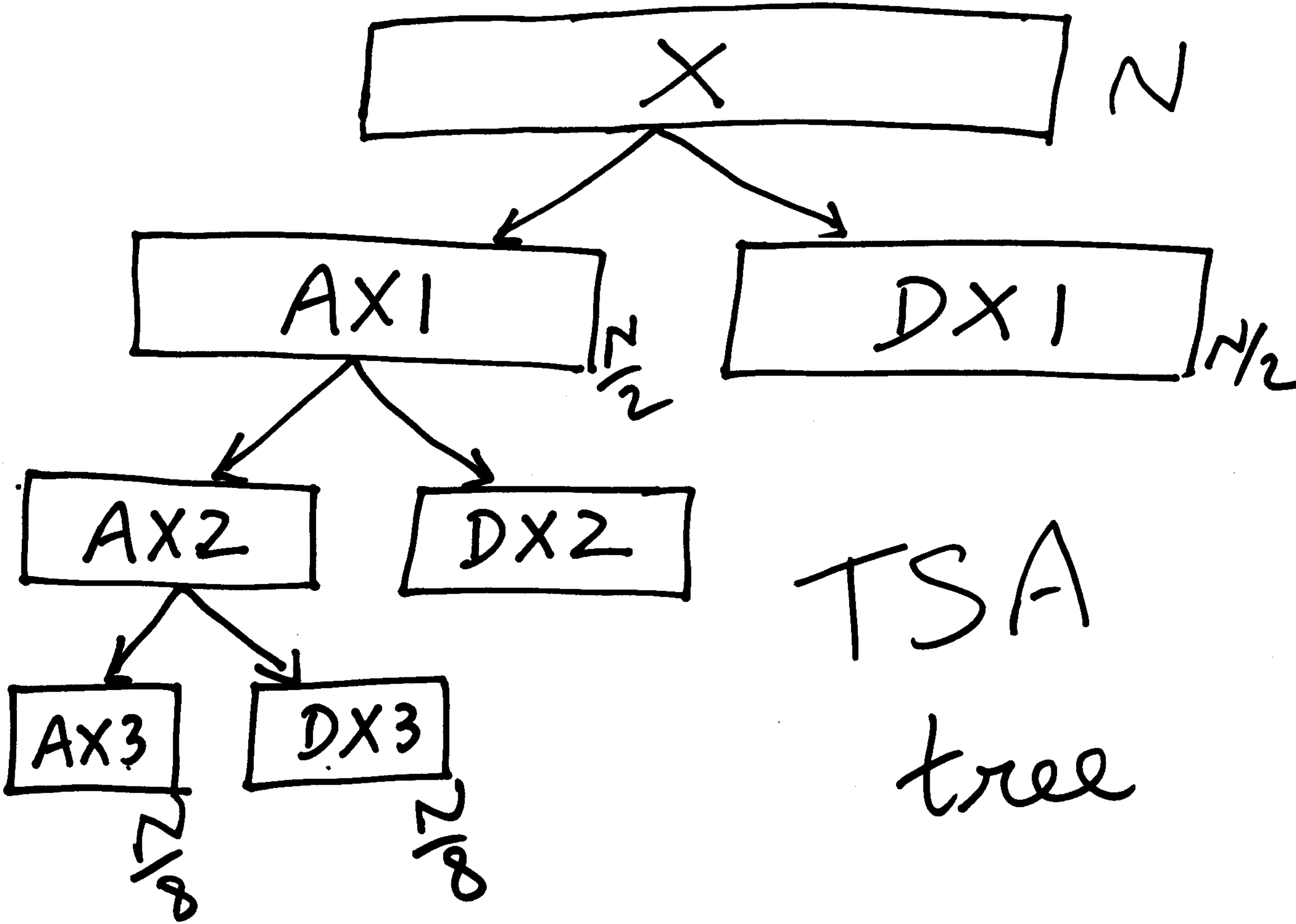
(ii) Power Complementary

(iii) Size of each node decreases

Assumptions

(i) Split and merge operations incur negligible cost

(ii) Cost due to disk I/O operation



TSA tree

Optimal TSA tree

Store only the leaf nodes

(1) Node Dropping

Exploit the Orthogonality property

$$\|X - \hat{X}\|^2 = \sum_{\substack{node \\ \in S}} \|node\|^2$$

Use a greedy algorithm

$$\frac{norm^2(node)}{size(node)}$$

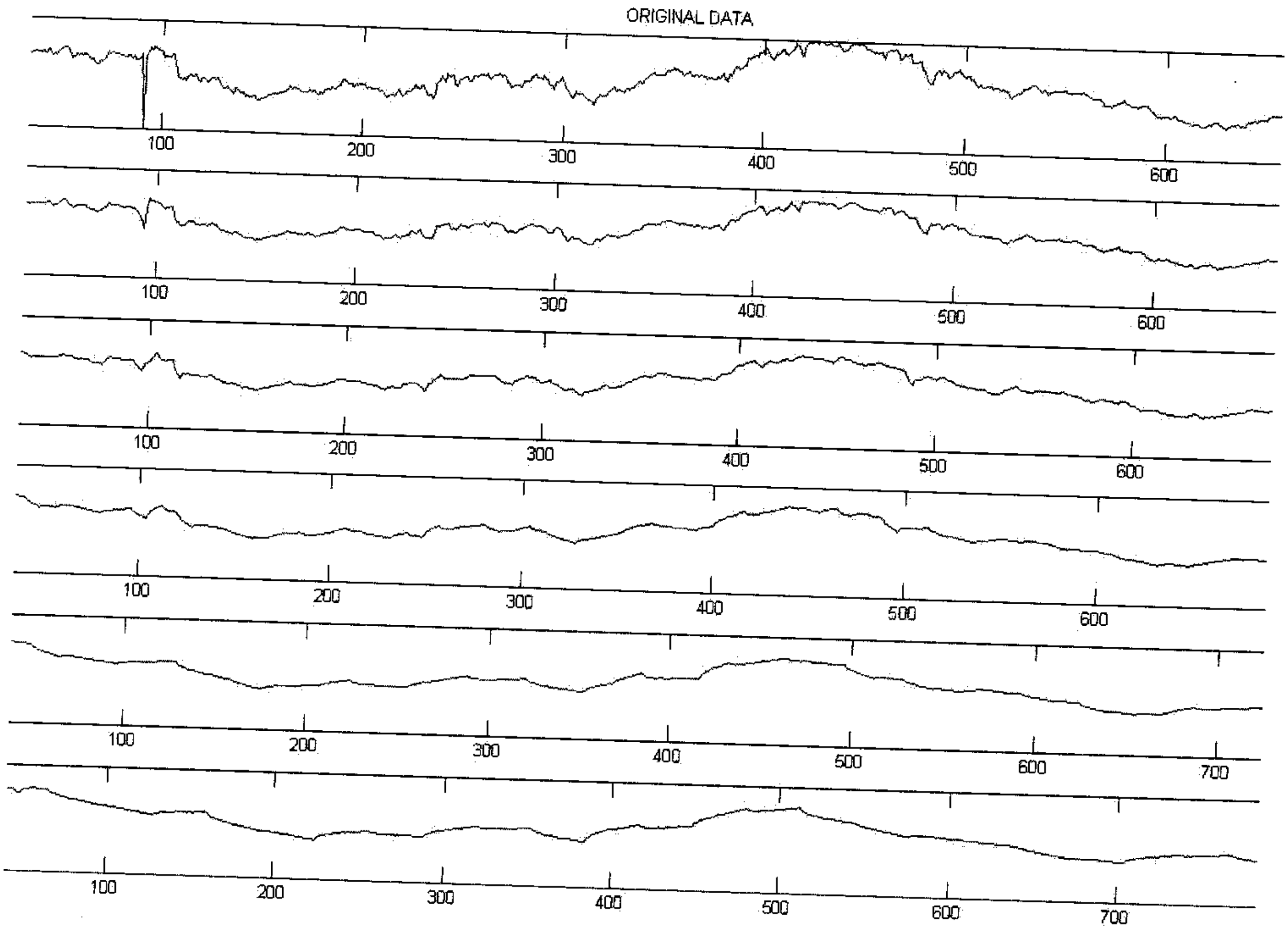
(2) Co-efficient Dropping

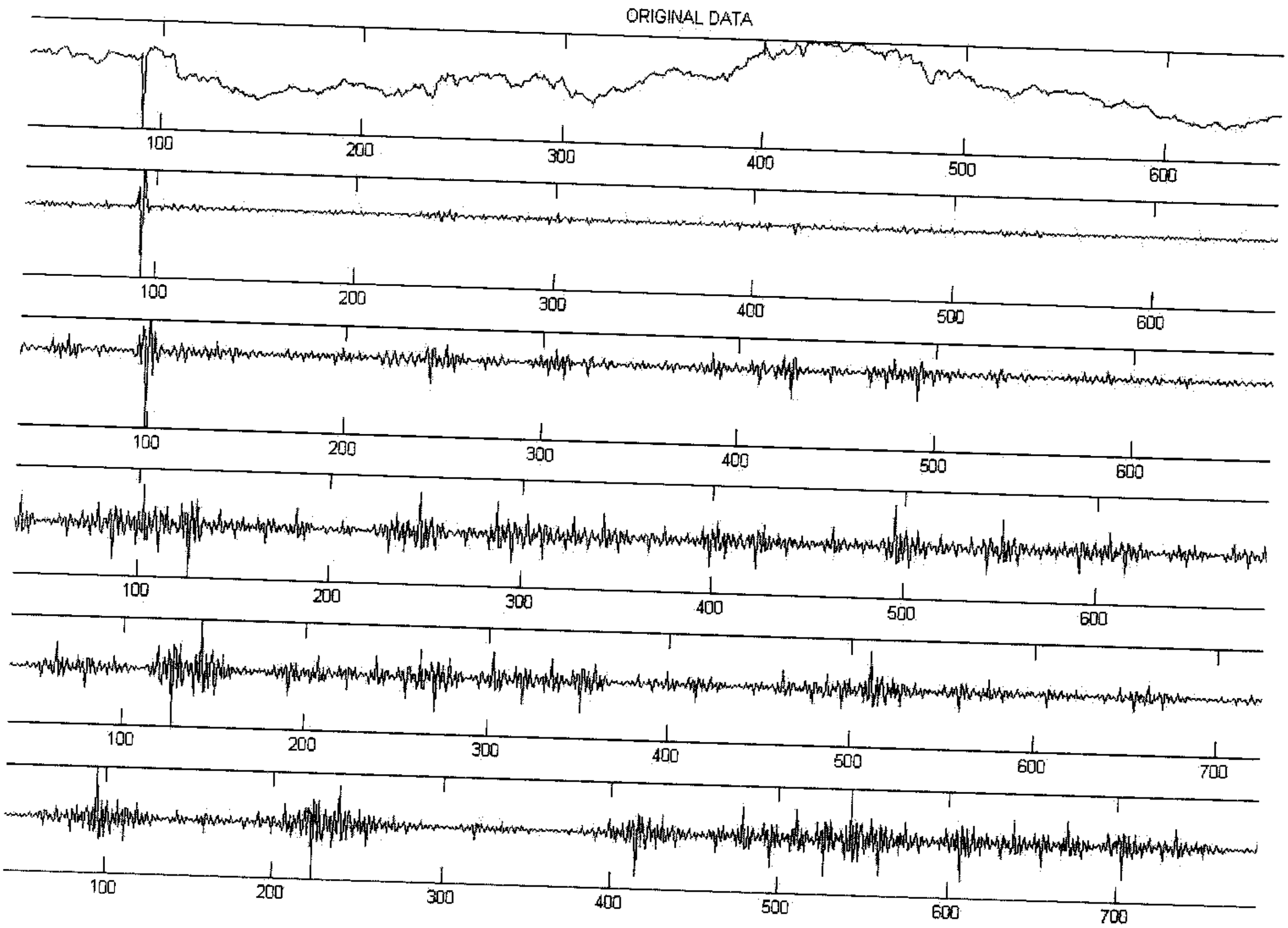
- Store co-efficients
- Store indexes

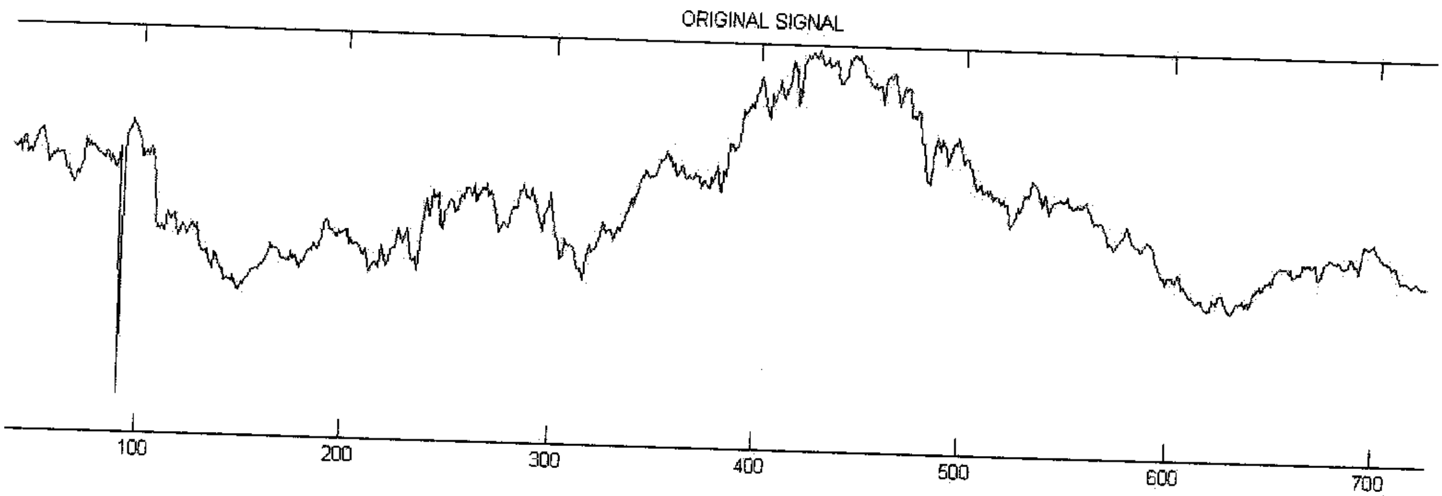
Application of Wavelets in Data Mining

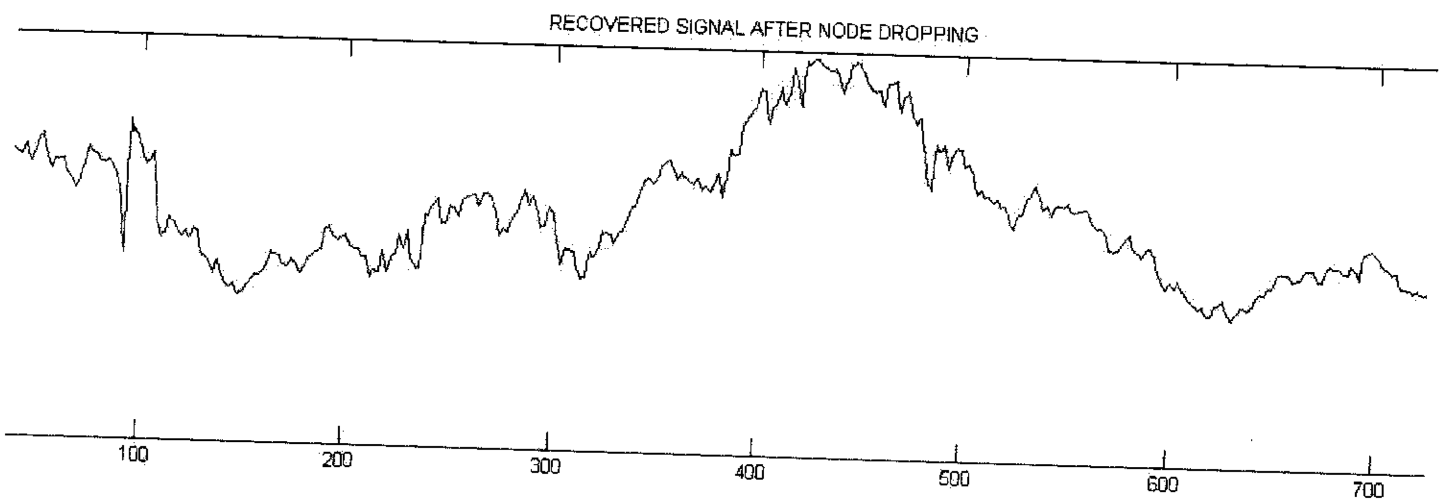
Instructor : Prof V. M. Gadre

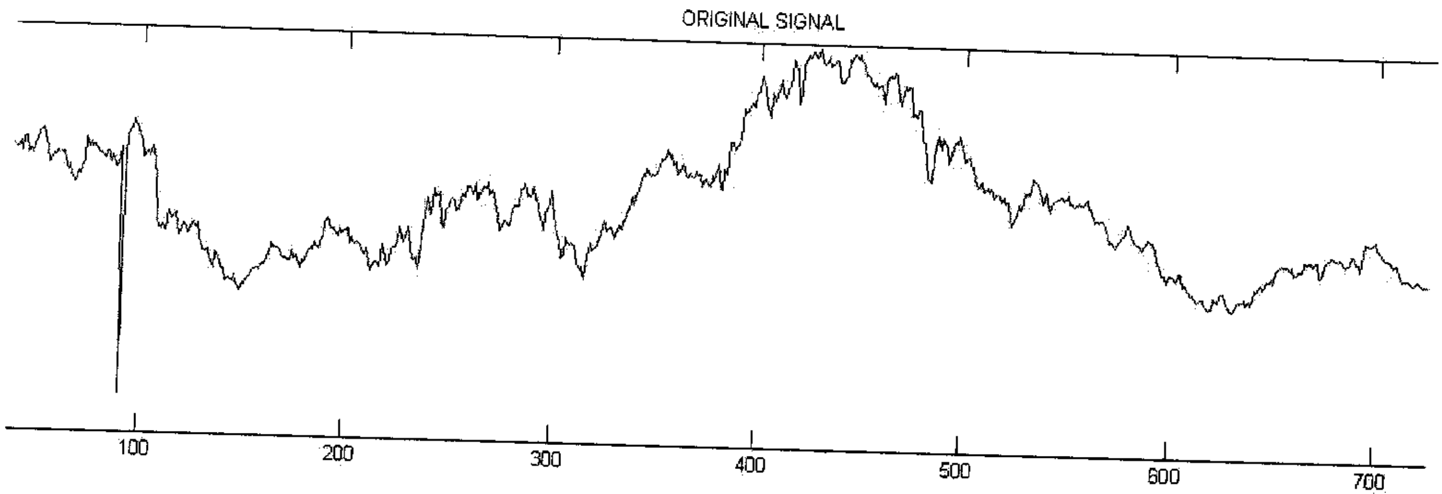
Kunal Shah (09307001)
Arka Chowdhury (09307402)

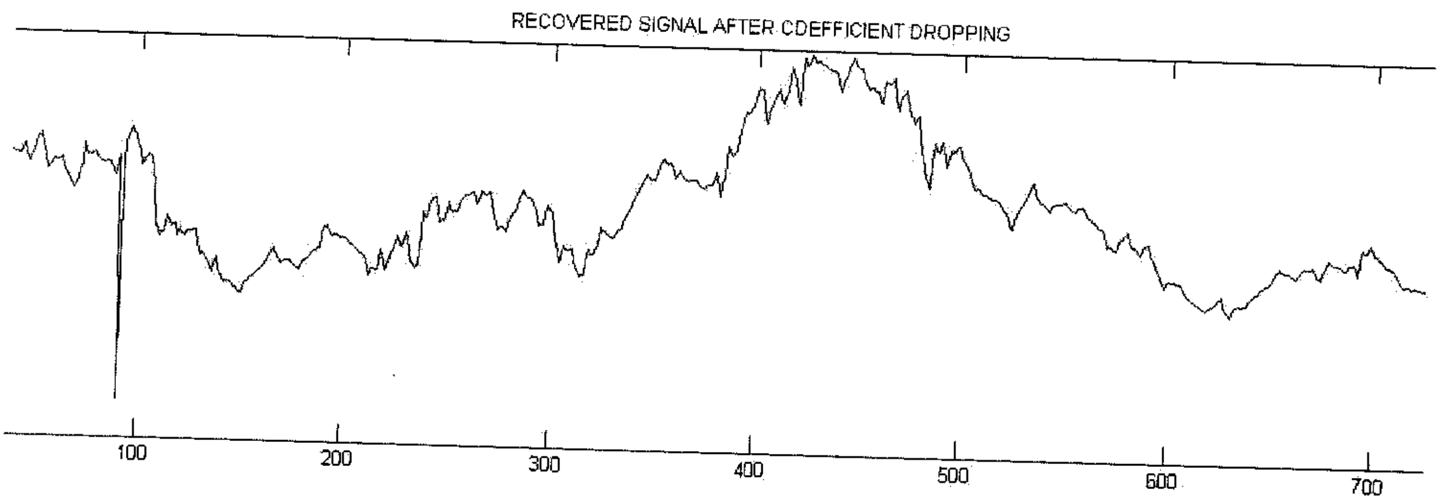

ORIGINAL DATA
100
200
300
400
500
600
700


ORIGINAL DATA
100
200
300
400
500
600
700


ORIGINAL SIGNAL
100
200
300
400
500
600
700


RECOVERED SIGNAL AFTER NODE DROPPING
100
200
300
400
500
600
700


ORIGINAL SIGNAL
100
200
300
400
500
600
700


RECOVERED SIGNAL AFTER COEFFICIENT DROPPING
100
200
300
400
500
600
700

Reference

C. Shahabi, X.Tian, W. Zhao. TSA tree: A Wavelet-based Approach to Improve the Efficiency of Multi-Level Surprise and Trend Queries on Time-Series Data. In Statistical and Scientific Database Management, pages 55 – 68, 2000.

Reference

Stock prices of SBI taken from Yahoo stock. Hyperlink:

http://finance.yahoo.com/q/hp?s=SBIN.NS&a=09 &b=27&c=2006&d=09&e=26&f=2009&g=d

FACE RECOGNITION THROUGH WAVE-PACKET ANALYSIS

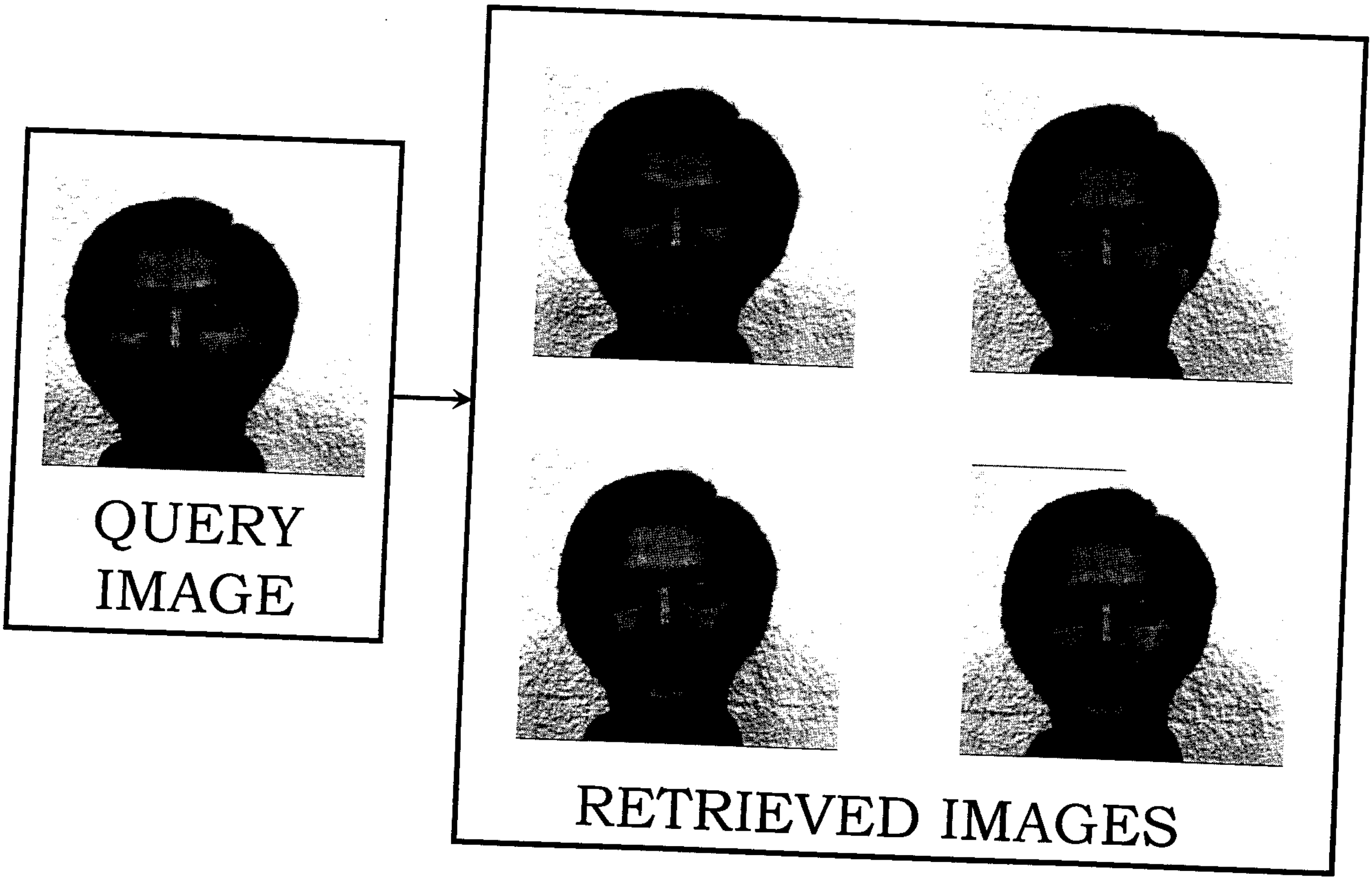
Instructor: Prof. V. M. Gadre

Presented by: Shah Ronak

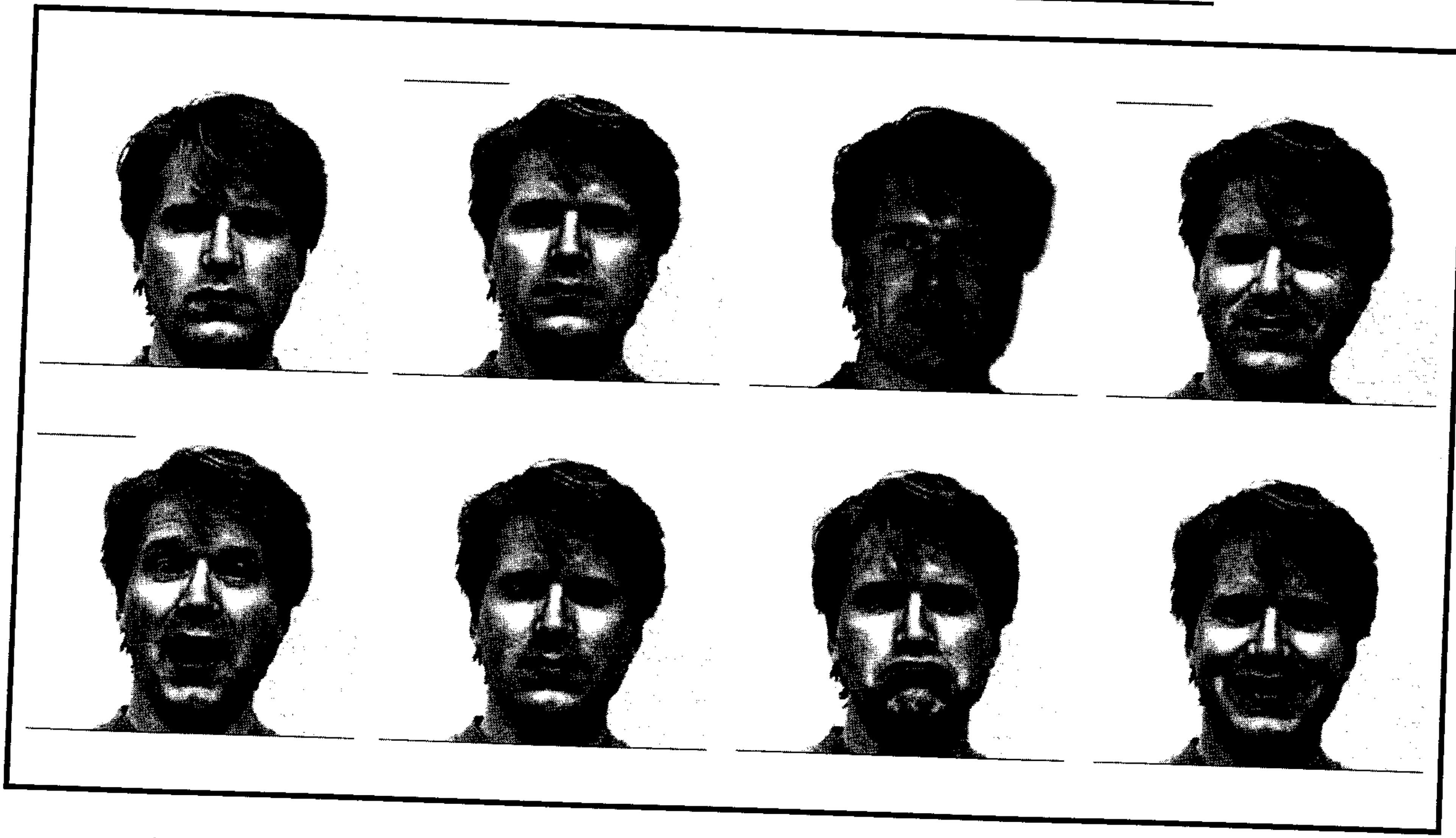
EXPERIMENTAL RESULTS

Exp	Number of Images used in Learning/ class	Total Images used in learning	Total number of query images	Number of images matched to the native class	Accuracy (±1.25%)
1	4	40	80	66	82.5%
2	6	60	80	64	80.0%
3	8	80	80	64	80.0%

TYPICAL ARCHIEVAL RESULT
(CBIR INTERFACE)



TYPICAL FACE IMAGES FOR ONE SUBJECT FROM YALE** FACE DATABASE



** can be downloaded from: http://cvc.yale.edu/projects/yalefaces/yalefaces.html For non-commercial use only

DISTANCE METRIC

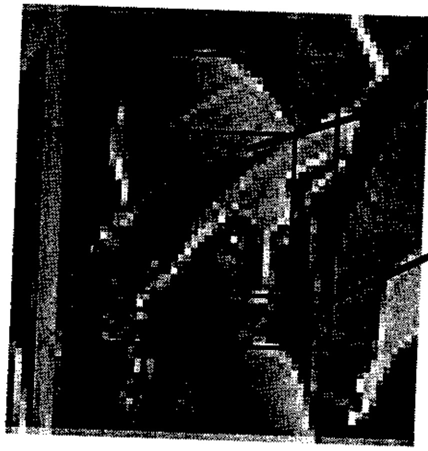
- Why not Euclidean?
- Metric based on Bhattacharyya Distance

$$D\left(V_k, V_l\right) = \sum_{f=1}^{17} D_f\left(V_k, V_l\right)$$

$$D_f\left(V_k, V_l\right) = \frac{1}{4} \frac{(\mu_{fk} - \mu_{fl})^2}{(\sigma_{fk}^2 + \sigma_{fl}^2)} + \frac{1}{2} \ln \left[\frac{\frac{1}{2}(\sigma_{fk}^2 + \sigma_{fl}^2)}{\sqrt{\sigma_{fk}^2 \sigma_{fl}^2}} \right]$$

FEATURE VECTOR EXTRACTION

Approximation Subspace (4 features)

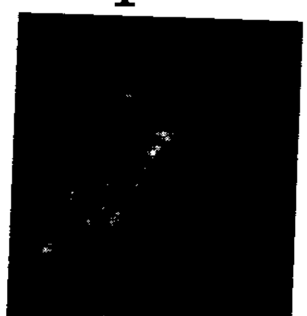


Mean (μ_1) & Variance (σ_1^2)

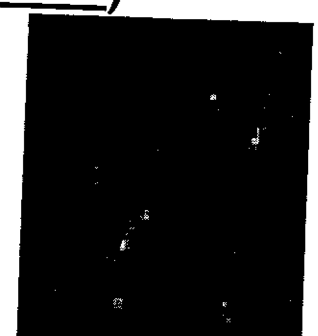
Mean (μ_2) & Variance (σ_2^2)

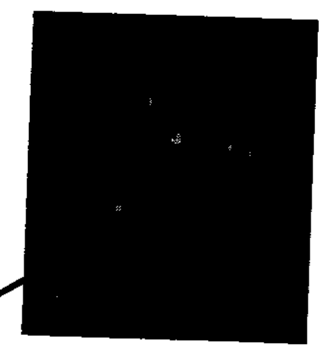
19 /Image!!

Detail Subspaces (15 features)



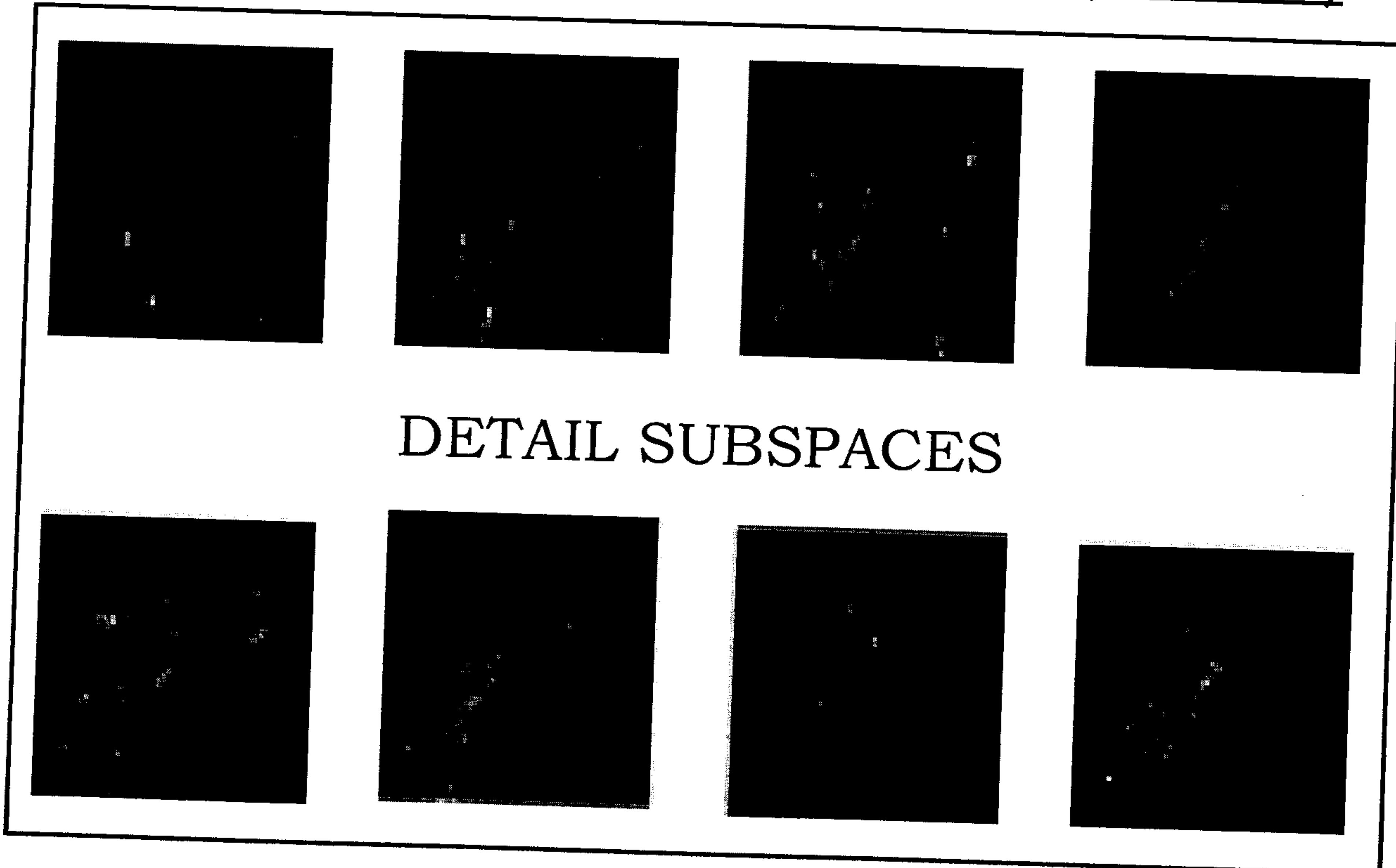
. . .



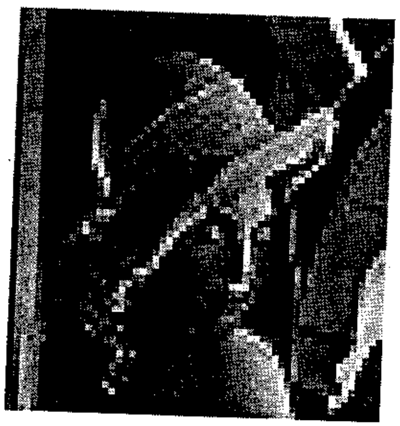


Mean (μ_i) 'zero' & hence Variance (σ_i2) only

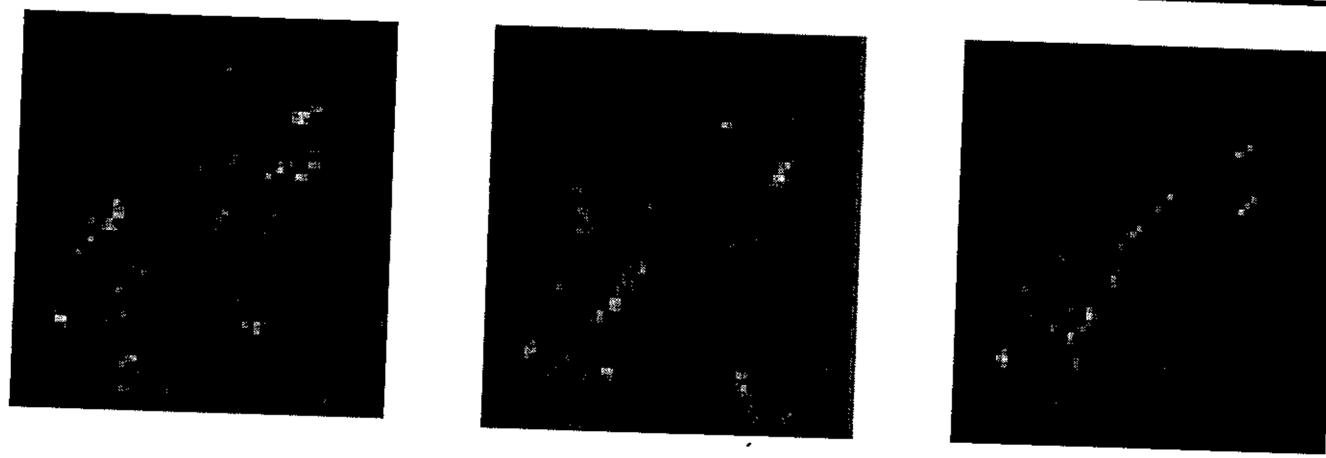
SUBSPACES OBTAINED AT SECOND LEVEL OF DECOMPOSITION (contd..)



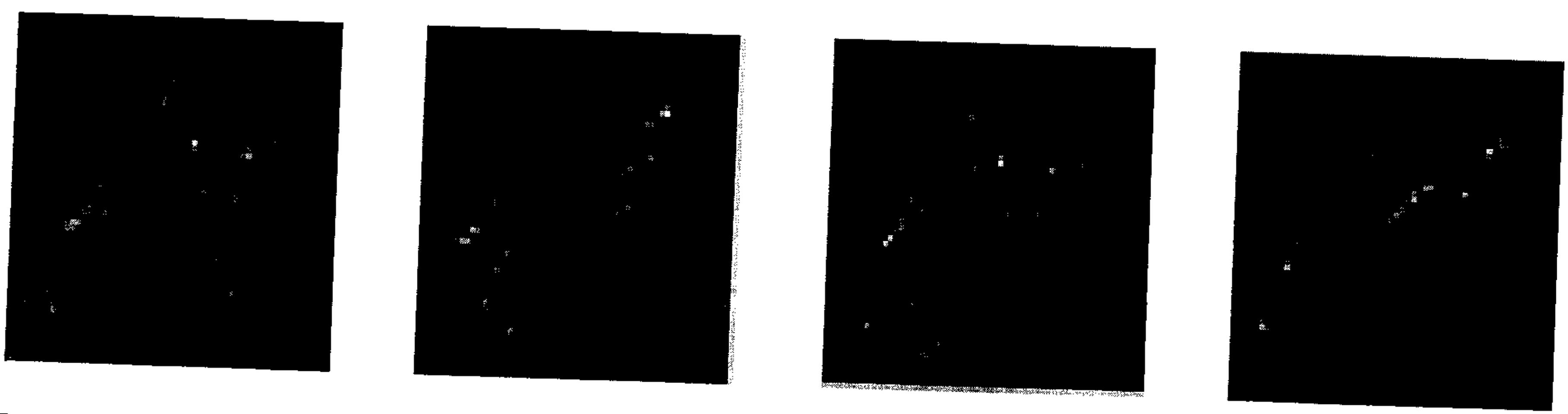
SUBSPACES OBTAINED AT SECOND LEVEL OF DECOMPOSITION



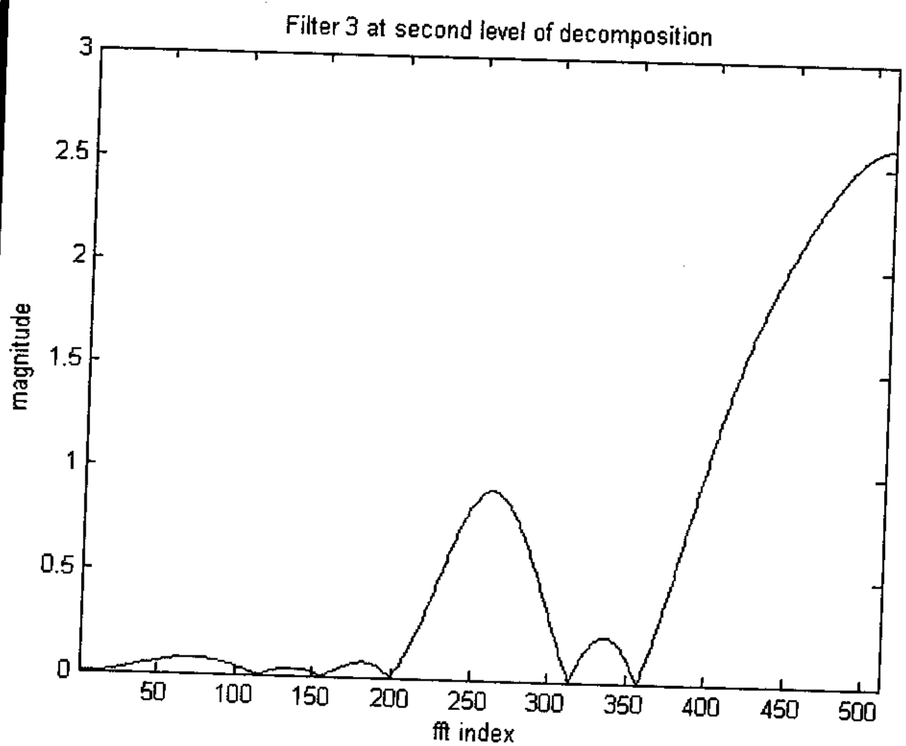
APPROX



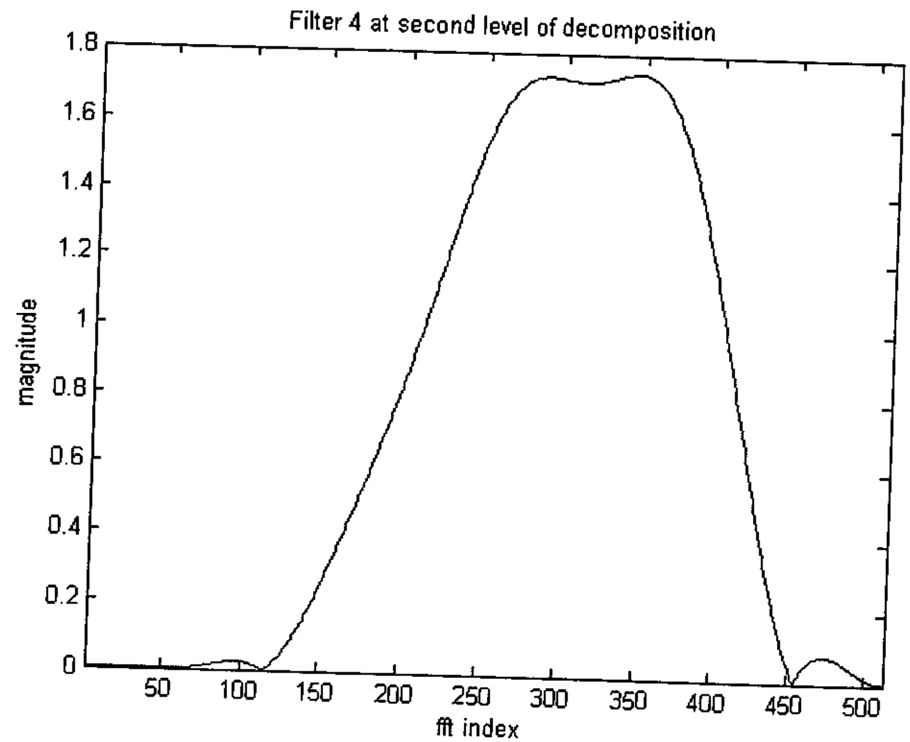
DETAIL SUBSPACES



MAGNITUDE RESPONSES AT SECOND LEVEL OF DECOMPOSITION (contd..)

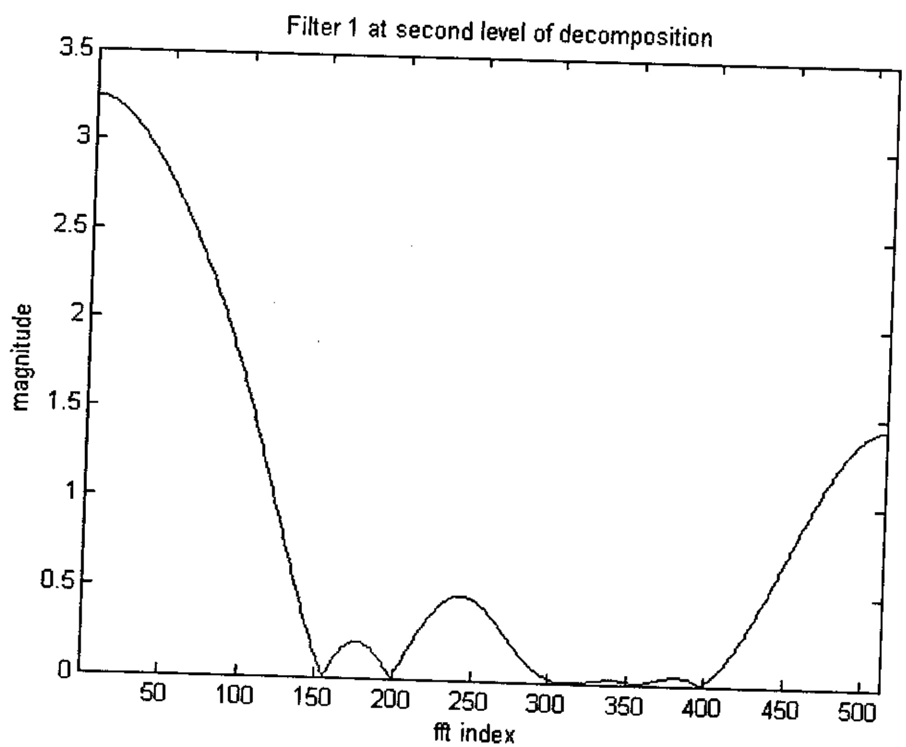


HPF Magnitude Response

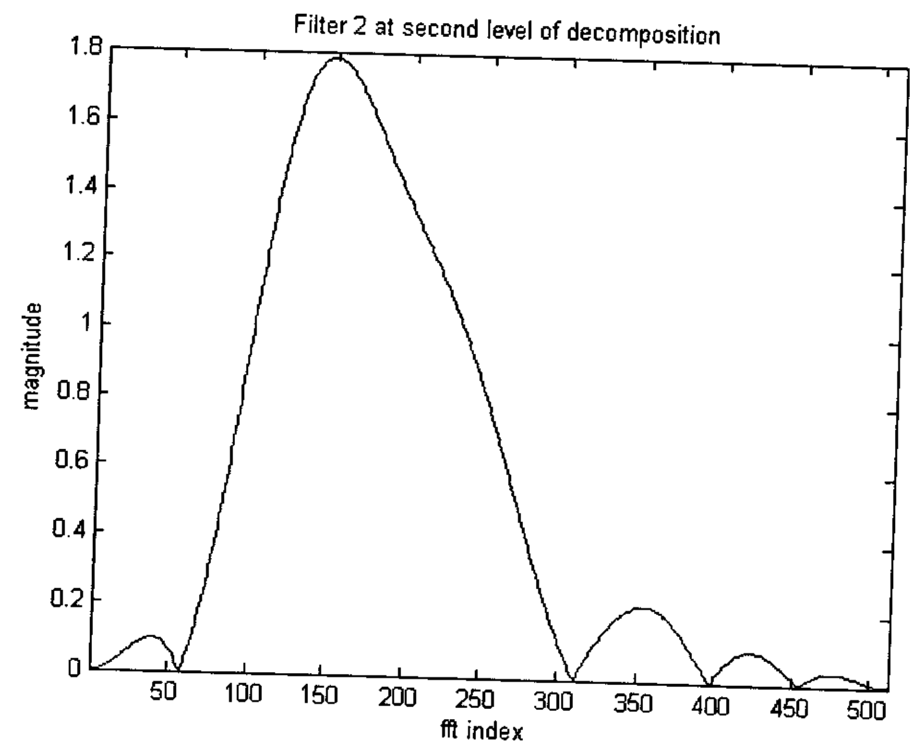


BPF Magnitude Response

MAGNITUDE RESPONSES OF FILTERS AT SECOND LEVEL OF DECOMPOSITION

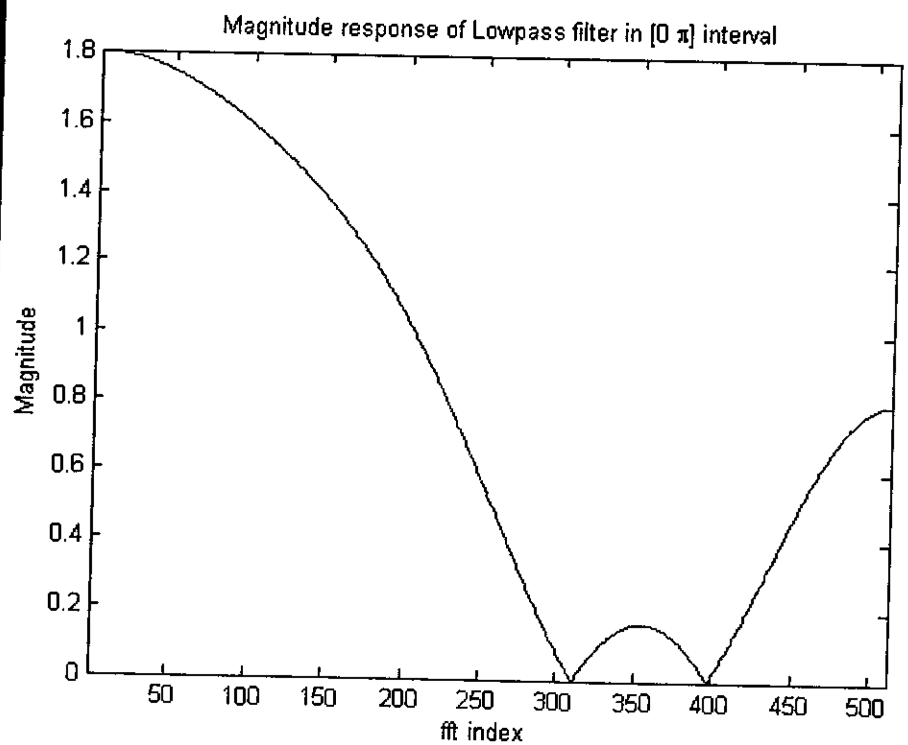


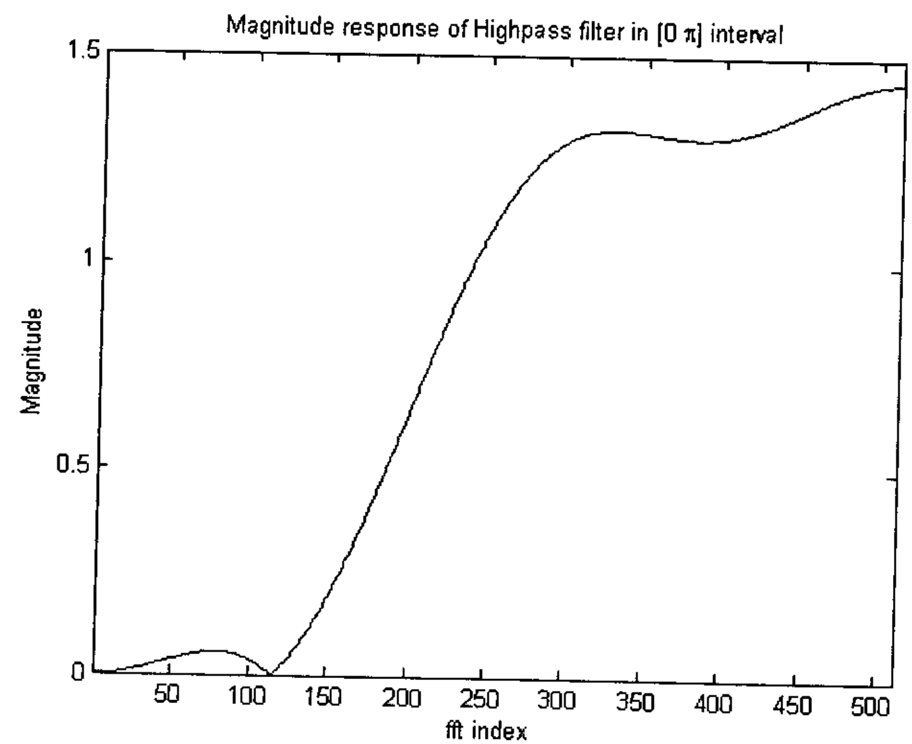
LPF Magnitude Response



BPF Magnitude Response

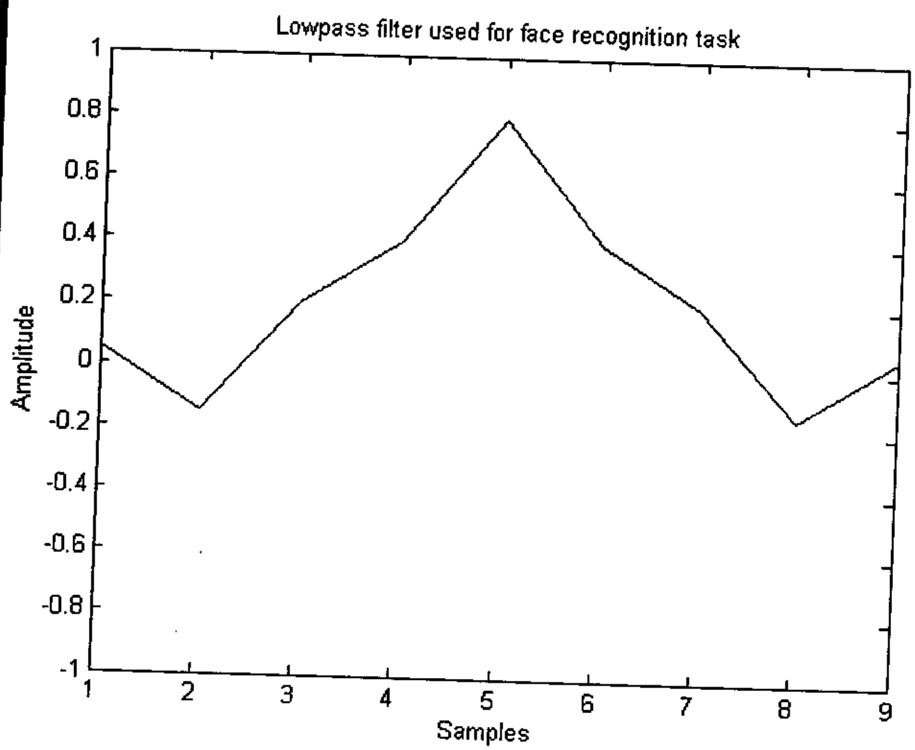
MAGNITUDE RESPONSES OF FILTERS



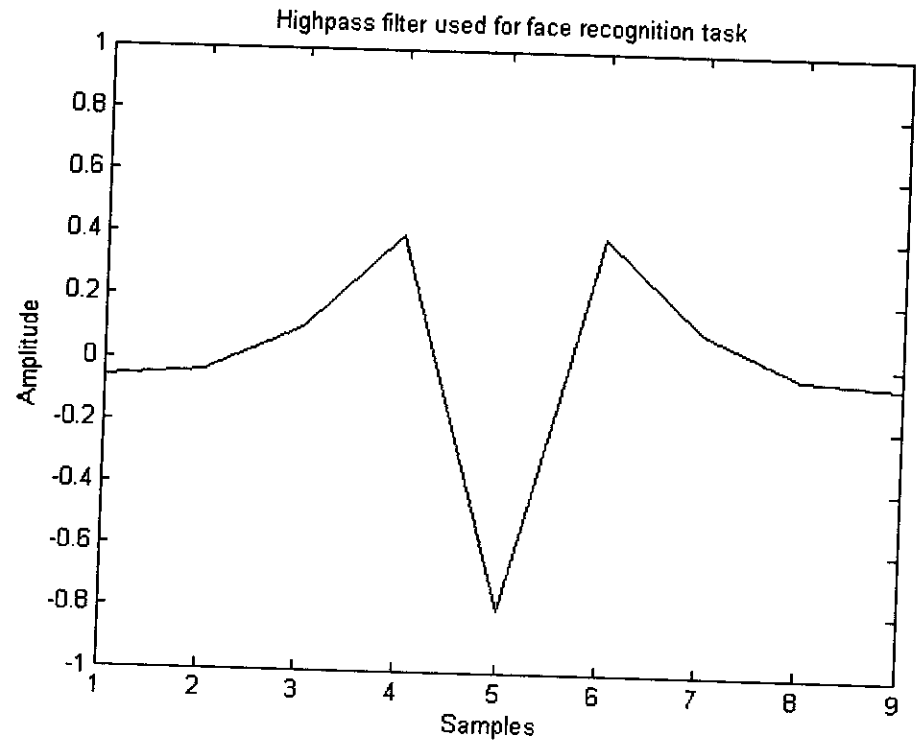


LPF Magnitude Response HPF Magnitude Response

FILTERS IN ACTION



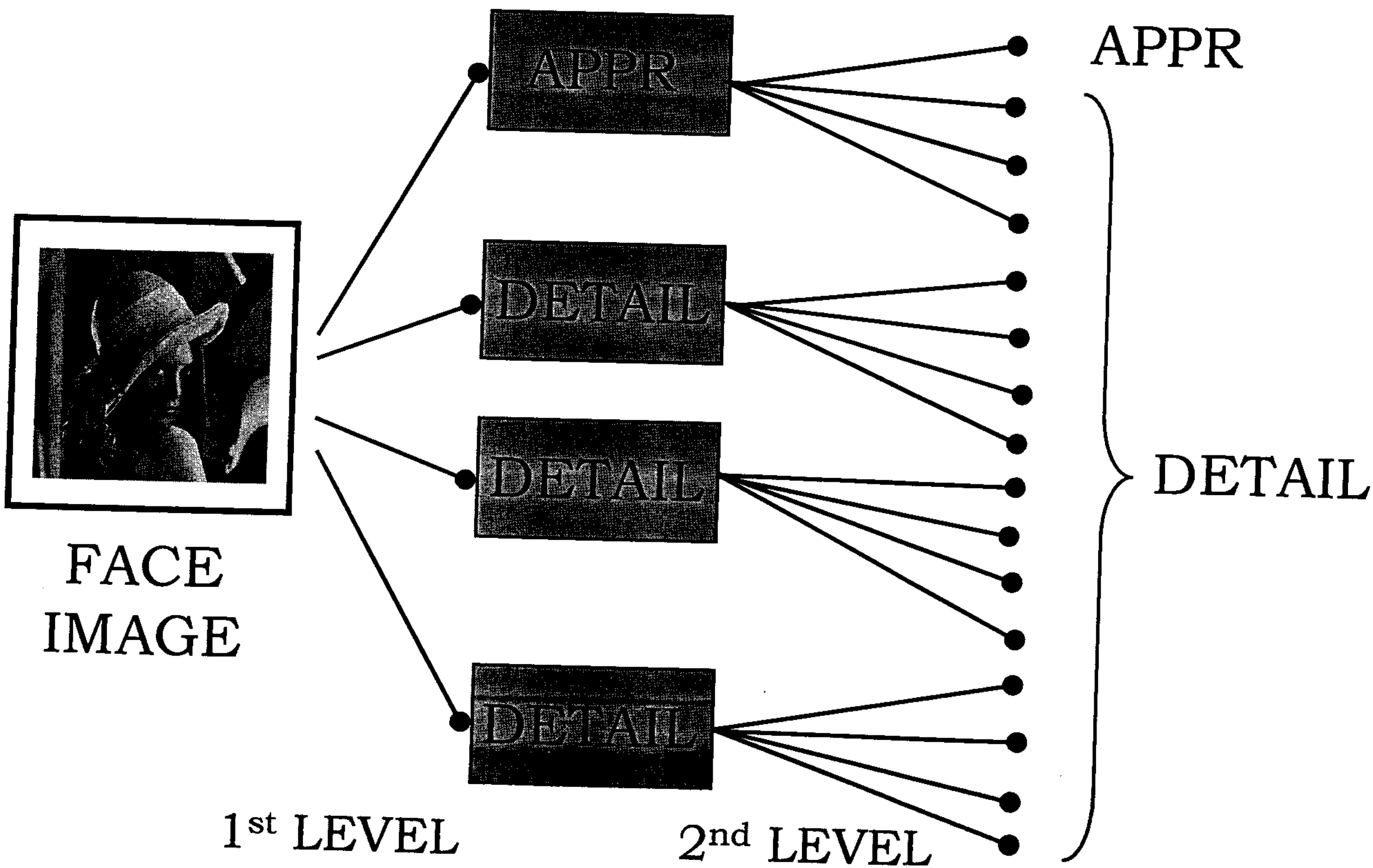
LPF Impulse Response



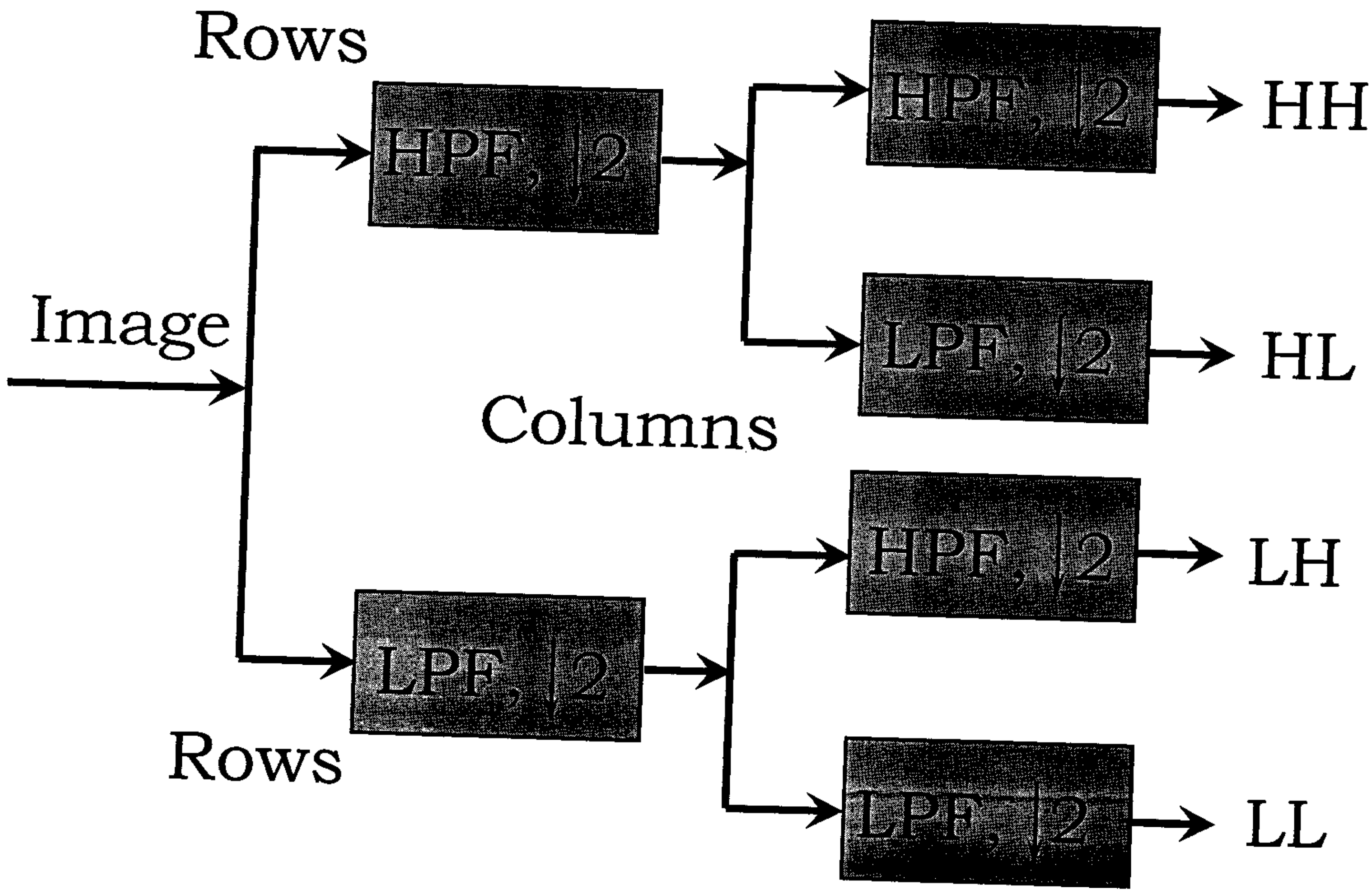
HPF Impulse Response

Filter	Impulse Responses								
LPF	0.05	-0.15	0.20	0.40	0.80	0.40	0.20	-0.15	0.05
HPF	-0.06	-0.04	0.10	0.40	-0.80	0.40	0.10	-0.04	-0.06

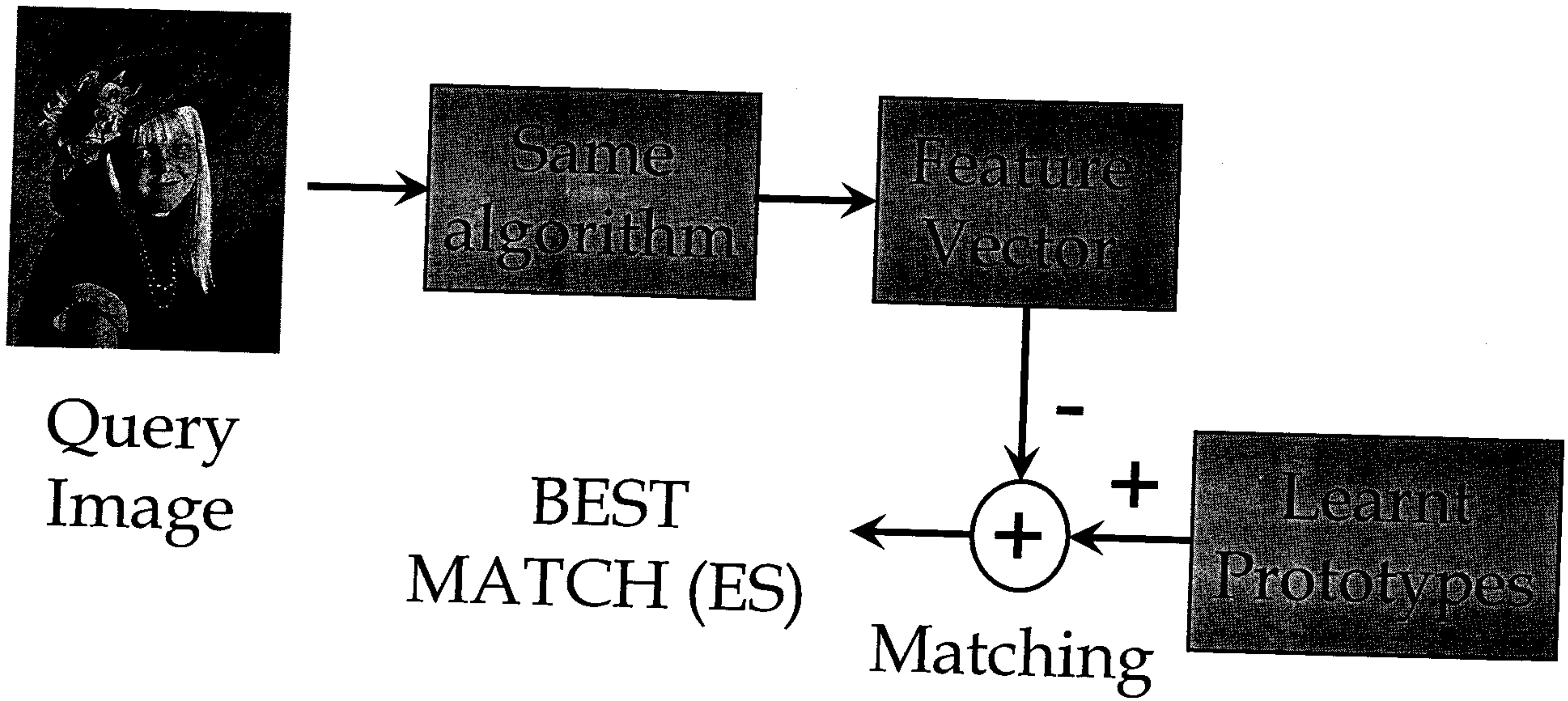
TWO-LEVEL WAVE-PACKET DECOMPOSITION



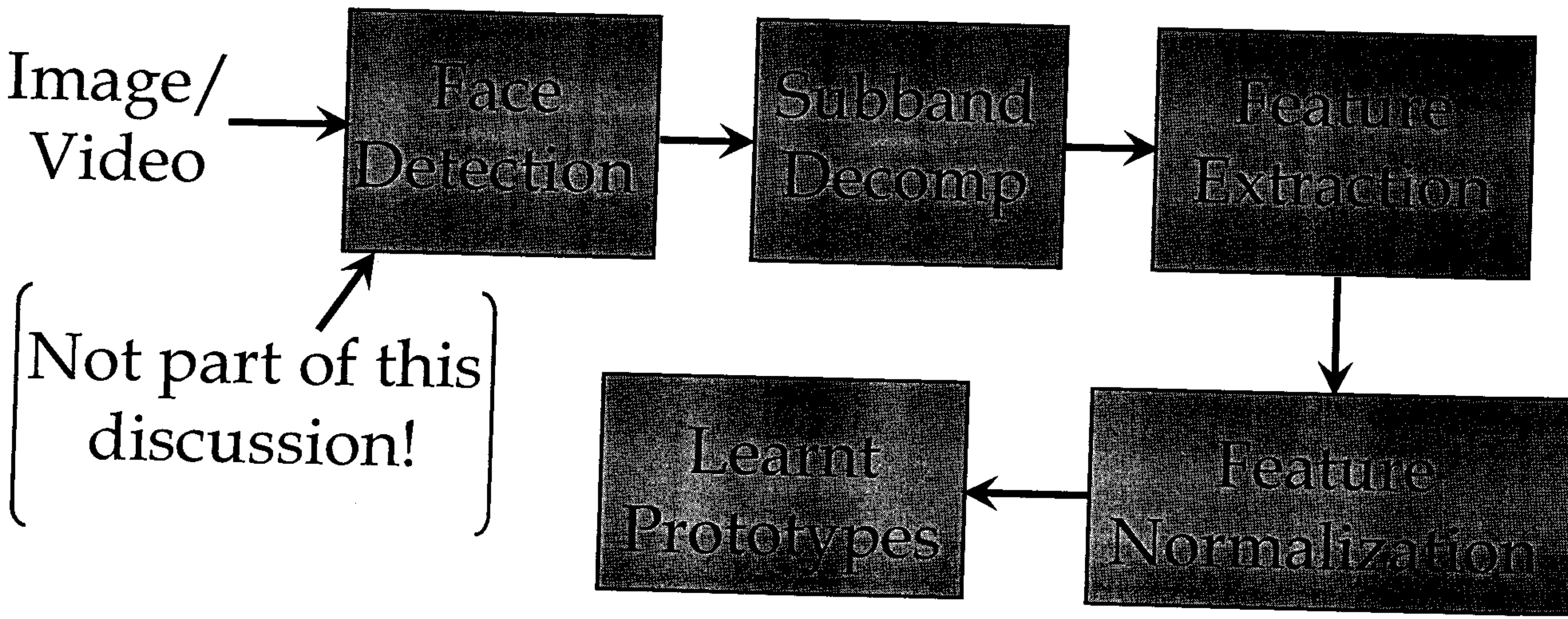
Traditional filter-bank structure For Image



BLOCK DIAGRAM (MATCHING)



BLOCK DIAGRAM
(PROTOTYPE LEARNING)



APPROACHES

- Geometric approach

- $\boxed{\text{Feature based approach}}$

Why Face Recognition? (contd..)

- Automatic character (actor) recognition

- Image and Video database managemen
for efficient archival

Why Face Recognition?

- Bio-metric Recognition?
- Surveillance

Activity Tracking & Recognition

Abnormality Detection

REFERENCES (contd..)

3) R. Brunelli, T. Poggio. Face Recognition: Features versus Templates. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 11(6): 1042-1052, 1993.

4) Raghuveer Rao, A. Bopardikar. Wavelet Transforms: Introduction to theory and applications. *Prentice Hall*, 1998.

5) W. Zhao, R. Chellappa, P. Phillips, A. Rosenfeld. Face Recognition: A literature survey. ACM Computing Surveys, 35 (4): 399-458, 2003.

REFERENCES

1) **C. Garcia, G. Zikos, G. Tziritas. A Wavelet based Framework for Face Recognition. *Fifth European conference on Computer Vision*, 84-92, 1998.**

2) P. Belhumeur, J. Hespanha, D. Kriegman. Eigenfaces versus Fisherfaces: Recognition using class specific linear projection. *IEEE transactions on Pattern Analysis and Machine Intelligence*, 19(7): 711-720, 1997.