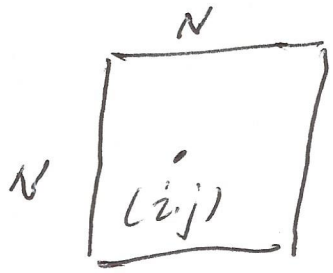
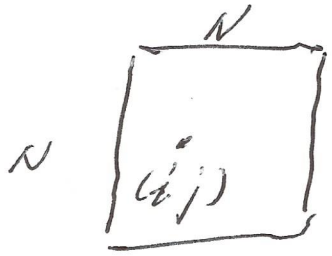
General Problem Formulation.

learning the relationship between two image patches.



gray-scale image patches.



Ex①. Residual images
differences between
HR & interpolated LR.

Ex②. Segmentation map
binary values — 0 or 1

$$Y(i,j) \xrightarrow{SVR} R(i,j)$$

$$Y(i,j) \xrightarrow{SVM} B(i,j)$$

The decision rule (SVM or SVR) depends on the following factors. ① → context information
② → attributes

Context adaptive decision rule.

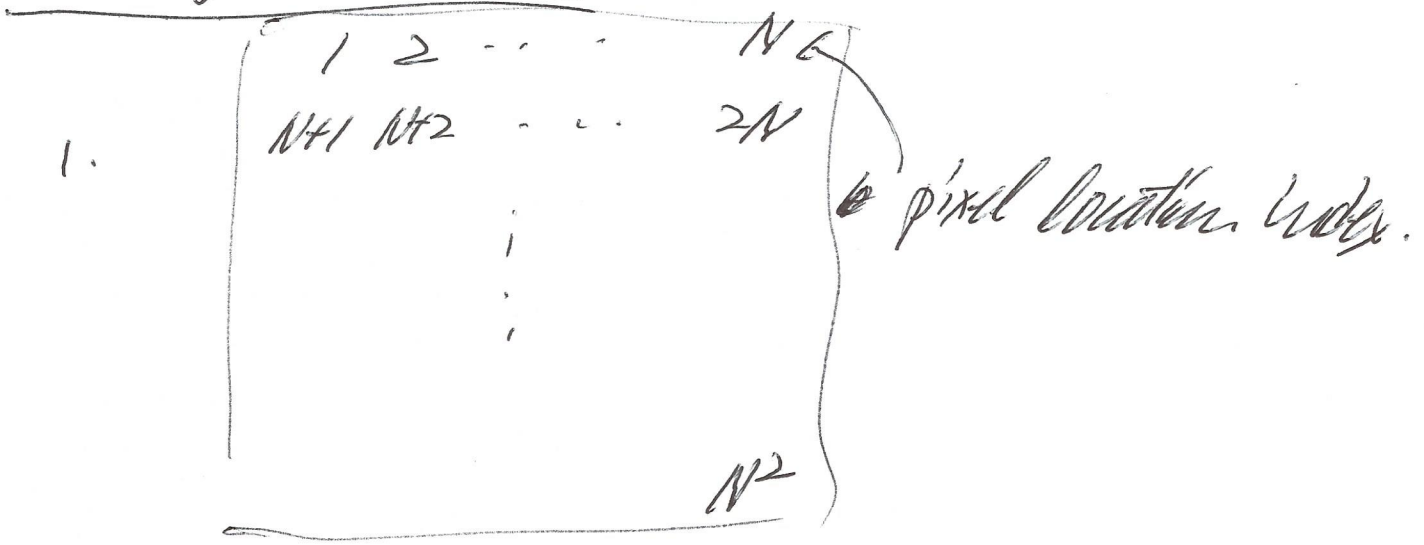
CASUM, CASVR.

Context information.

1. pixel location in the patch

2. pattern of the patch.

1-stage approach. (if N is small)



2. clustering of patches into K clusters.

SUM/SVR trained for the same cluster.

and pixels in the same location

multi-stage approach (If N is large)

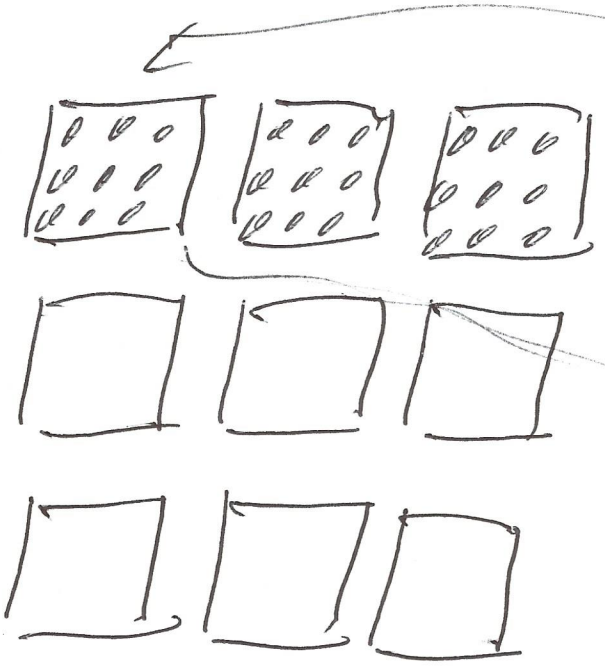
9. 16. 25. 27. 32

3^2 4^2 5^2 3^3, 2^5

↓ ↓ ↘

2 stage 3-stage 5-stage

Use N=9 as example.



X_1 X_2 X_3

X_4 X_0 X_5

X_6 X_7 X_8

B_1 B_2 B_3

B_4 B_0 B_5

B_6 B_7 B_8

2-level position index.

$(X_i, B_j) \rightarrow (i \; j)$

$0 \le i \le 8$ $0 \le j \le 8$.

2-level clustering. →

1st stage
Feature vector.

$$\Delta \underline{x} = \begin{pmatrix} \Delta x_1 \\ \vdots \\ \Delta x_8 \end{pmatrix} \qquad \Delta x_i = x_i - x_0 \quad i = 1 \cdots 8$$

Use $\Delta \underline{x}$ to cluster 3×3 image patches.

$\Rightarrow$ K_1 clusters

2nd stage.

$$b_j = \frac{1}{9} \sum_{i=0}^{8} x_{ji} \rightarrow \text{mean of each 3×3 patches}$$

$$\Delta \underline{b} = \begin{pmatrix} \Delta b_1 \\ \vdots \\ \Delta b_8 \end{pmatrix} \qquad \Delta b_i = b_i - b_0 \quad i = 1 \cdots 8$$

Use $\Delta \underline{b}$ to cluster 3×3 image patches at the 2nd stage.

$\Rightarrow$ K_2 clusters.

Conditional decision.

Under the same 2nd stage cluster. k_2

Under the same 1st stage cluster. k_1

Under the same 2nd stage block index b_j

" 1st stage index x_i

SVM Predictor

(attributes $|X = x_i, B = b_j, K_1 = k_1, K_2 = k_2$)

← 0 or 1

Predictor ↓

bank coefficients. from both 1st & 2nd stage)

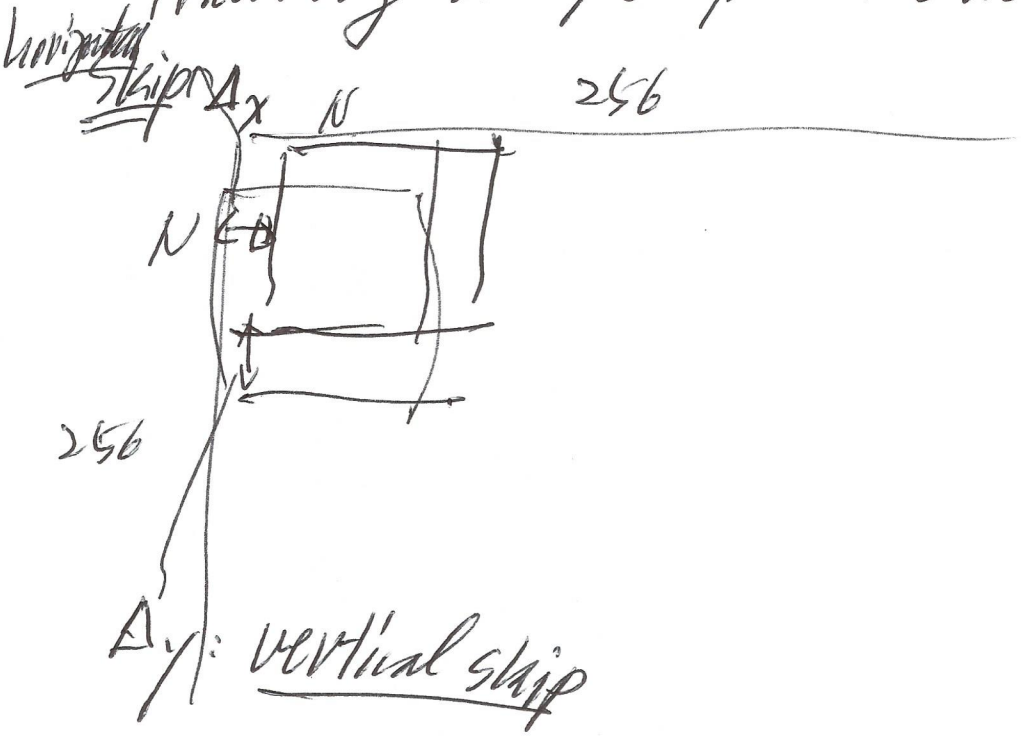
concentrated

Training. SVM predictor.

SVR predictor

(- — -) ← continuous range.

Training sample patch collection



If $\Delta x = 1$ $N = 9$, $256 - 9 = 248$ columns

$\Delta y = 1$, $N = 9$ $256 - 8 = 248$ rows.

total patch # = 248×248

= 61,504 samples.

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testing: non overlapping → 1 pixel. 1 decision

or

overlapping → 1 pixel. multiple decision averaged or voted