

## 4.4.1. Radiometric Correction

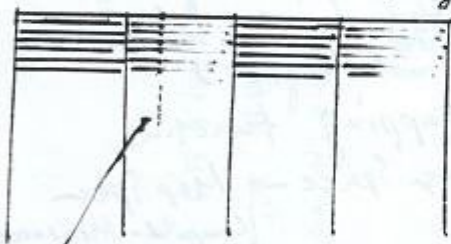
### \* Image Noises

#### 1. Striping

(1) Cross-Track Scanning  
→ Horizontal Striping



(2) Along-Track Scanning (CCD Array)  
→ Vertical Striping



Bad CCD element

SPOT 1-3

Pan: 1500 element Array x 4

→ Slight differences in neighboring array

→ 4 big stripes

#### 2. Dropped Lines

→ Horizontal Dark Segments (data lost)



## Geometric Corrections:

Rectification: Image  $\rightarrow$  Map

Registration: Image  $\rightarrow$  Image

Step 1: Find Ground Control Points

CGCP's

Find Features Points

Step 2: Find Mapping Functions

Image  $\rightarrow$  Map

Image 1  $\leftrightarrow$  Image 2

Step 3: Resampling  $\rightarrow$  Grey-values

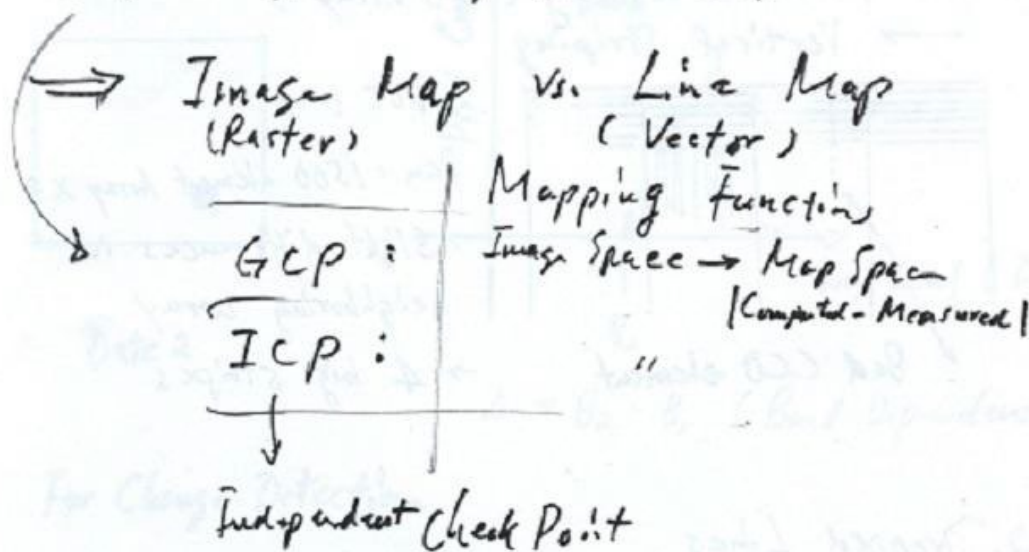
NH, BI, CC (16 points)

(1 point)

(4 points)

(16 points)

Step 4: Accuracy Assessment



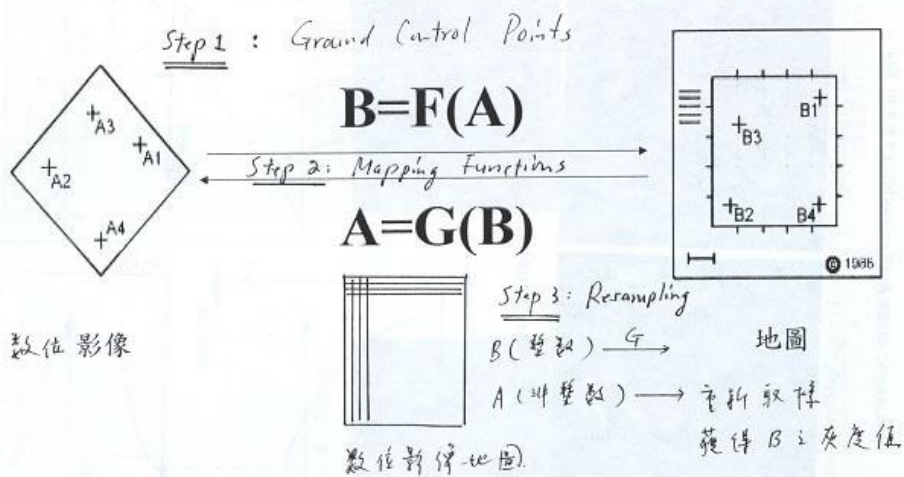


圖4.4：坐標轉換示意圖



$$y = \frac{x - x_{min}}{x_{max} - x_{min}} \times 255$$

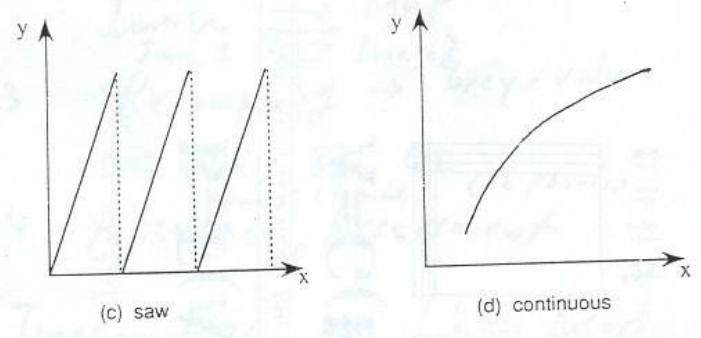
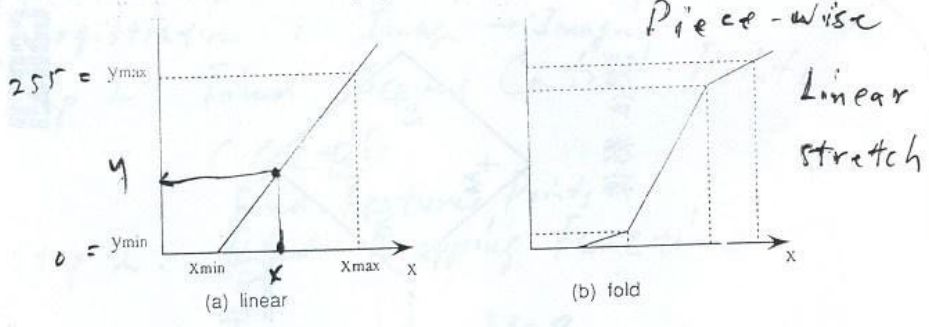


Fig 10.2.1 Typical Density Conversion

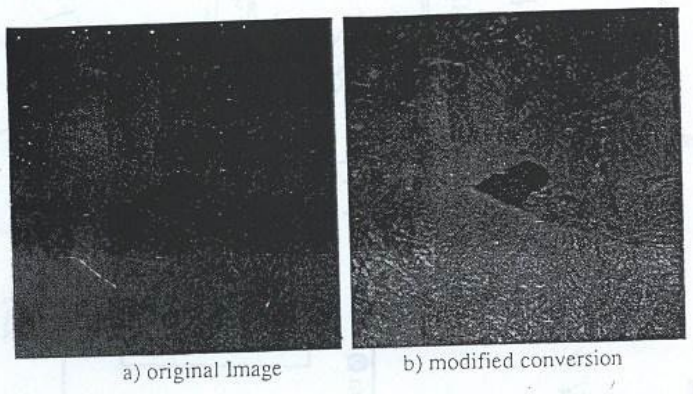
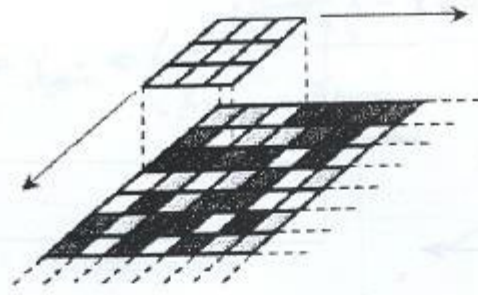


Fig 10.2.2 Examples of gray scale conversion



filtering procedure

$W_{1,1}$	$W_{2,1}$	$W_{3,1}$
$W_{1,2}$	$W_{2,2}$	$W_{3,2}$
$W_{1,3}$	$W_{2,3}$	$W_{3,3}$

X

$DN_{i-1,j-1}$	$DN_{i,j-1}$	$DN_{i+1,j-1}$
$DN_{i-1,j}$	$DN_{i,j}$	$DN_{i+1,j}$
$DN_{i-1,j+1}$	$DN_{i,j+1}$	$DN_{i+1,j+1}$

$$\hat{DN}(i,j) = \sum_{m=1}^3 \sum_{n=1}^3 W(m,n) \times DN(i+m-2, j+n-2)$$

For High Pass Filtering

$$\sum_{m=1}^3 \sum_{n=1}^3 W(m,n) = 0$$

For Low Pass Filtering

$$\sum_{m=1}^3 \sum_{n=1}^3 W(m,n) = 1$$



4.5.5

Fig.10.9.1 Examples of spatial filters of  $3 \times 3$  window

SPATIAL FILTERS	$3 \times 3$ OPERATOR	EFFECTS
Sobel	$ A  +  B $ or $\sqrt{A^2+B^2}$ where, $A = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$ $B = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$	gradient (finite differences)
Prenet	$ A  +  B $ or $\sqrt{A^2+B^2}$ where, $A = \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix}$ $B = \begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}$	gradient (finite differences)
Laplacian	$\begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix}$ or $\begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$	differential
smoothing	$\begin{bmatrix} 1/9 & 1/9 & 1/9 \\ 1/9 & 1/9 & 1/9 \\ 1/9 & 1/9 & 1/9 \end{bmatrix}$ or $\begin{bmatrix} 0 & 1/5 & 0 \\ 1/5 & 1/5 & 1/5 \\ 0 & 1/5 & 0 \end{bmatrix}$	
median	Replaced with median of $3 \times 3$ window	smoothed image
high-pass	$\begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix}$ or $\begin{bmatrix} -1/9 & -1/9 & -1/9 \\ -1/9 & 8/9 & -1/9 \\ -1/9 & -1/9 & -1/9 \end{bmatrix}$	edge-enhancement
sharpening	$\begin{bmatrix} 1/9 & -8/9 & 1/9 \\ -8/9 & 28/9 & -8/9 \\ 1/9 & -8/9 & 1/9 \end{bmatrix}$	clear image

High Pass

High Pass

Low Pass

"

High Pass



a) original image

b) Sobel

c) laplacian



d) smoothing

e) median

f) high pass

Figure 10.9.2 Image enhancement with use of  $3 \times 3$  operators

