İkil Görüntü İşleme

Samsun – 2011

İkil X aritmetik

- İkil x aritmetik
- İkil: 0 – 1
- Aritmetik: 8 bit – 16 bit vs

İkil işlemler

- Mantıksal işlemler

$$
\begin{aligned}
&NOT && c = \overline{a} \\
&OR && c = a + b \\
&AND && c = a \bullet b \\
&XOR && c = a \oplus b = a \bullet \overline{b} + \overline{a} \bullet b \\
&SUB && c = a \setminus b = a - b = a \bullet \overline{b}
\end{aligned}
$$

- Her bir piksele uygula: $c[m,n] = a[m,n] \bullet \overline{b}[m,n]$

NOT a	
0	1
1	0
↑ input	↑ output

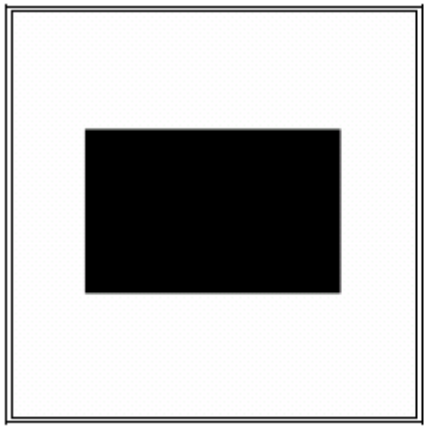
OR a \ b	0	1
0	0	1
1	1	1

AND a \ b	0	1
0	0	0
1	0	1

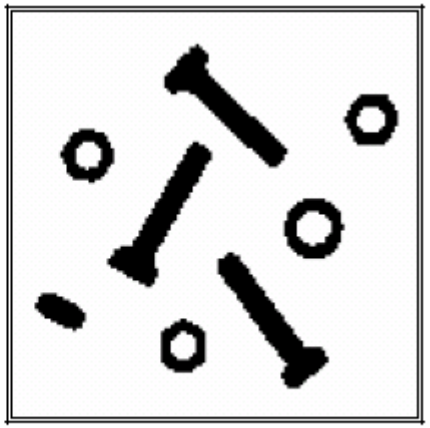
XOR a \ b	0	1
0	0	1
1	1	0

SUB a \ b	0	1
0	0	0
1	1	0

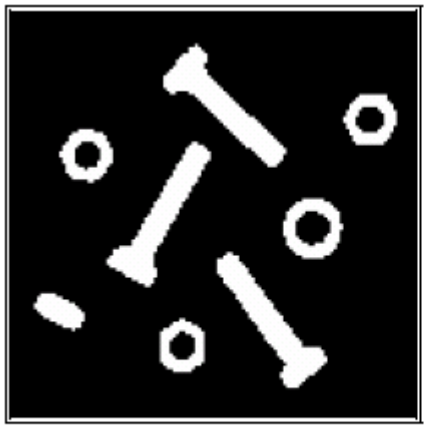
Örnek



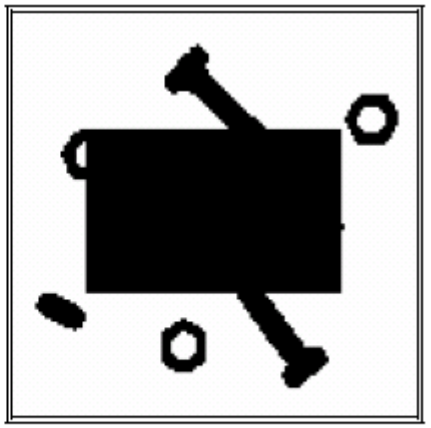
a) Image a



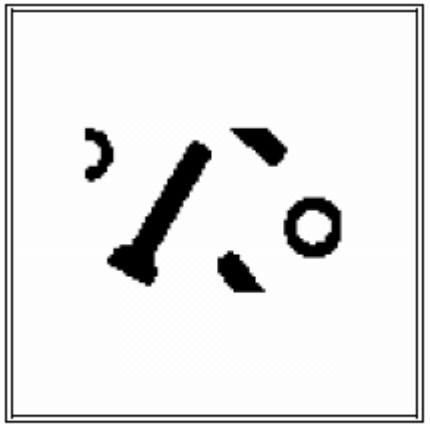
b) Image b



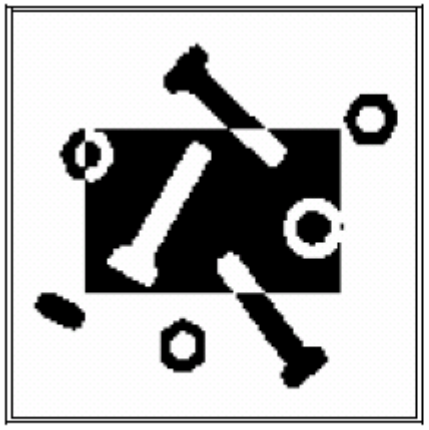
c) NOT$(b) = \overline{b}$



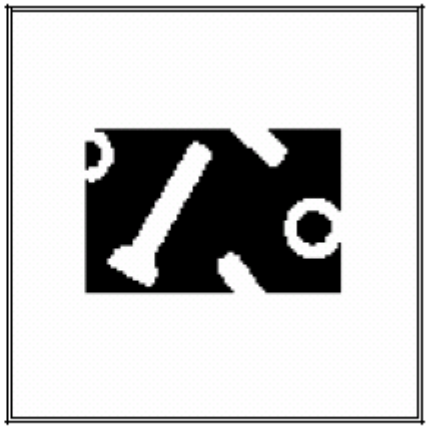
d) OR$(a,b) = a + b$



e) AND$(a,b) = a \bullet b$



f) XOR$(a,b) = a \oplus b$



g) SUB$(a,b) = a \setminus b$

Aritmetik İşlemler

Operation	*Definition*	*preferred data type*
ADD	c = a + b	integer
SUB	c = a – b	integer
MUL	c = a • b	integer or floating point
DIV	c = a / b	floating point
LOG	c = log(a)	floating point
EXP	c = exp(a)	floating point
SQRT	c = sqrt(a)	floating point
TRIG.	c = sin/cos/tan(a)	floating point
INVERT	$c = (2^B - 1) - a$	integer

Katlama tabanlı işlemler

- Tüm resmi dolaş: soldan-sağa, üstten-alta
- Pikselin komşuluğunda çalış: ör. 3x3
- Komşularının ağırlıklı toplamını hesapla
  - Komşuluk penceresi: kernel penceresi
  - Ağırlık: filtre katsayısı
- h: filtre katsayıları, a: girdi resmi, c: çıktı resmi

$$c[m,n] = a[m,n] \otimes h[m,n] = \sum_{j=-J_0}^{J_0} \sum_{k=-K_0}^{K_0} h[j,k]a[m-j,n-k]$$

Temel

- Doğrusal zamanla değişmezlik (LSI)
- Doğrusallık

$$\begin{aligned} &If \quad a_1 \to c_1 \quad and \quad a_2 \to c_2 \\ &Then \quad w_1 \bullet a_1 + w_2 \bullet a_2 \to w_1 \bullet c_1 + w_2 \bullet c_2 \end{aligned}$$

- Zamanla değişmezlik

$$\begin{aligned} &If \quad a(x,y) \to c(x,y) \\ &Then \quad a(x-x_o, y-y_o) \to c(x-x_o, y-y_o) \end{aligned}$$

- w1,w2, x0, y0: keyfi sabitler

Temel

- Birim vuruş tepkesi PSF (Point Spread Func)
- Fourier Transform(PSF) → OTF (Optical Transfer Func)

- Konumsal düzlemde katlama, frekans düzleminde çarpma
  - FT
  - Çarp
  - IFT

Doğrusal Filtreler

$$h_{rect}[j,k] = \frac{1}{25}\begin{bmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$

(a) Rectangular filter (J=K=5)

$$h_{circ}[j,k] = \frac{1}{21}\begin{bmatrix} 0 & 1 & 1 & 1 & 0 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 0 & 1 & 1 & 1 & 0 \end{bmatrix}$$

(b) Circular filter (R=2.5)

$$h_{rect}[j,k] = \frac{1}{81}\begin{bmatrix} 1 & 2 & 3 & 2 & 1 \\ 2 & 4 & 6 & 4 & 2 \\ 3 & 6 & 9 & 6 & 3 \\ 2 & 4 & 6 & 4 & 2 \\ 1 & 2 & 3 & 2 & 1 \end{bmatrix}$$

(a) Pyramidal filter (J=K=5)

$$h_{circ}[j,k] = \frac{1}{25}\begin{bmatrix} 0 & 0 & 1 & 0 & 0 \\ 0 & 2 & 2 & 2 & 0 \\ 1 & 2 & 5 & 2 & 1 \\ 0 & 2 & 2 & 2 & 0 \\ 0 & 0 & 1 & 0 & 0 \end{bmatrix}$$

(b) Cone filter (R=2.5)

Figure 27: Triangular filters for image smoothing

Gauss Filtre

$$h(x,y) = g_{2D}(x,y) = \left(\frac{1}{\sqrt{2\pi}\sigma} e^{-\left(x^2/2\sigma^2\right)} \right) \bullet \left(\frac{1}{\sqrt{2\pi}\sigma} e^{-\left(y^2/2\sigma^2\right)} \right)$$

$$= g_{1D}(x) \bullet g_{1D}(y)$$

$$g_{1D}[n] = \begin{cases} \frac{1}{\sqrt{2\pi}\sigma} e^{-\left(n^2/2\sigma^2\right)} & |n| \le N_o \\ 0 & |n| > N_o \end{cases}$$

Doğrusal olmayan filtre

- Median
- Max/min/range

Sonuçlar

a) Original **b)** Uniform 5×5 **c)** Gaussian ($\sigma = 2.5$)

d) Median 5×5 **e)** Kuwahara 5×5

Figure 30: Illustration of various linear and non-linear smoothing filters