

機器視覺與實習

20250514

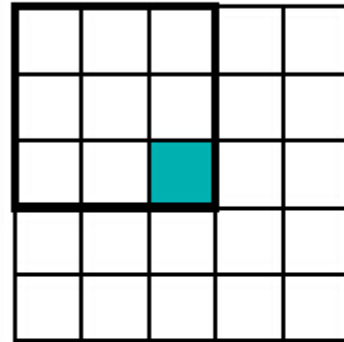
邊緣保留模糊濾波器 (Edge-Preserving Blurring Filters)

- kuwahara濾波器，能在平滑圖像的同時保留圖像有意義的邊緣資訊。

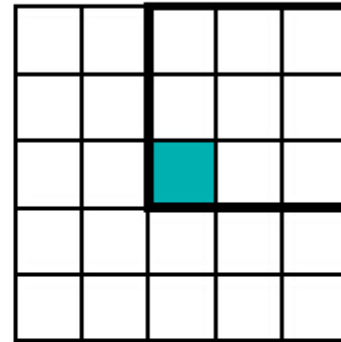


$$\sigma_a = \sqrt{\frac{1}{(N-1)} \sum (i(x,y) - \mu_a)^2}$$

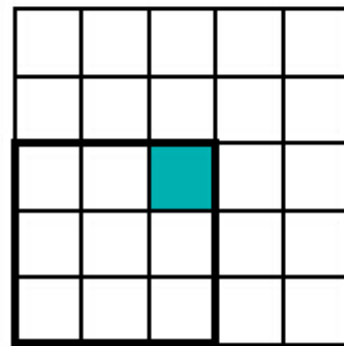
area 1



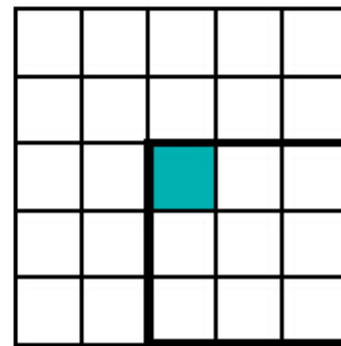
area 2



area 3



area 4



- 上圖是一個3x3的kuwahara filter，目標像素的值由這4個黑框包括著4個area確定，area1~area4 這4個區域中像素點的方差最小的區域是我們的目的地區域，方差的計算公式已由上面的公式給出，確定目的地區域之後，目標像素的值等於目的地區域中像素點的平均值。



Fig1 .Subregionstructures for Kuwahara filters



Fig2. Subregion structures for Tomita-Tsuji's filters

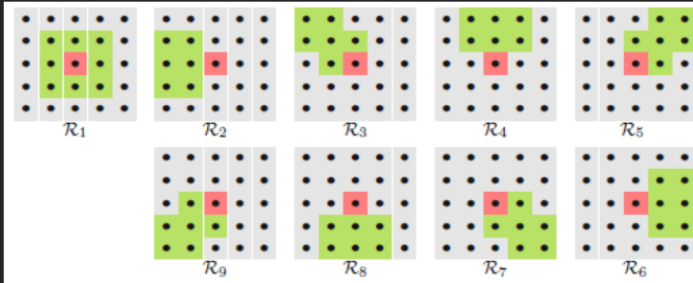


Fig3. Subregion structures for Nagao-Matsuyama's filters

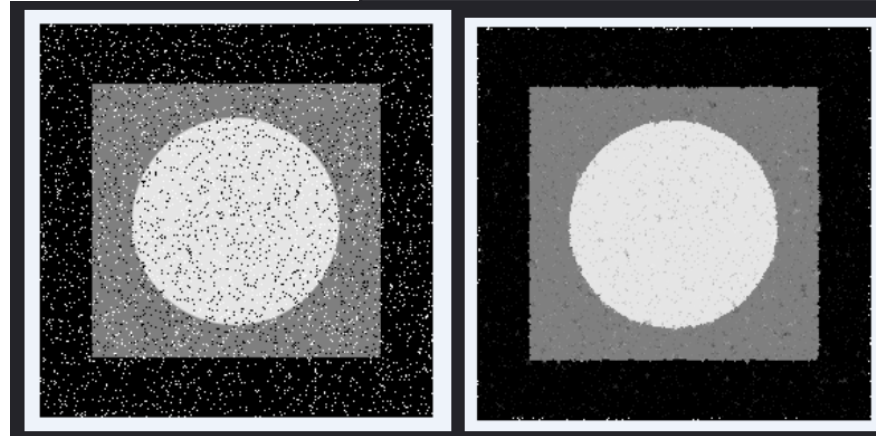
```

1: KUWAHARAFILTER( $I, r$ )
   Input:  $I$ , a grayscale image of size  $M \times N$ ;  $r$ , filter radius ( $r \geq 1$ ).
   Returns a new (filtered) image of size  $M \times N$ .

2:  $\bar{\mathcal{R}} \leftarrow [-r, r] \times [-r, r]$   $\triangleright$  comp. filter region of size  $(2r+1) \times (2r+1)$ 
3: for  $k = 1$  to  $K$  do  $\triangleright$  define  $K$  subregions  $\mathcal{R}_1, \dots, \mathcal{R}_K$ 
4:    $\mathcal{R}_k \leftarrow \{p_{k,1}, \dots, p_{k,n_k}\}$ , with  $p_{k,j} \in \bar{\mathcal{R}}$ 
5:  $(M, N) \leftarrow \text{SIZE}(I)$ 
6:  $I' \leftarrow \text{DUPLICATE}(I)$ 
7: for all image coordinates  $(u, v) \in M \times N$  do
8:    $\sigma_{\min}^2 \leftarrow \infty$ ,  $\mu_{\min} \leftarrow 0$ 
9:   for  $k = 1$  to  $K$  do
10:     $(\sigma^2, \mu) \leftarrow \text{EVALSUBREGION}(I, \mathcal{R}_k, u, v)$ 
11:    if  $\sigma^2 < \sigma_{\min}^2$  then
12:       $\sigma_{\min}^2 \leftarrow \sigma^2$ 
13:       $\mu_{\min} \leftarrow \mu$ 
14:     $I'(u, v) \leftarrow \mu_{\min}$ 
15: return  $I'$ .

16: EVALSUBREGION( $I, \mathcal{R}, u, v$ )
17:    $n \leftarrow \text{Size}(\mathcal{R})$ 
18:    $S_1 \leftarrow 0$ ,  $S_2 \leftarrow 0$ 
19:   for all  $(i, j) \in \mathcal{R}$  do
20:      $a \leftarrow I(u+i, v+j)$ 
21:      $S_1 \leftarrow S_1 + a$   $\triangleright$  Eqn. (5.4)
22:      $S_2 \leftarrow S_2 + a^2$   $\triangleright$  Eqn. (5.5)
23:    $\sigma^2 \leftarrow (S_2 - S_1^2/n)/n$   $\triangleright$  variance of subregion  $\mathcal{R}$ , see Eqn. (5.1)
24:    $\mu \leftarrow S_1/n$   $\triangleright$  mean of subregion  $\mathcal{R}$ , see Eqn. (5.3)
25:   return  $(\sigma^2, \mu)$ .

```



抖動影像(Dithering)



原圖

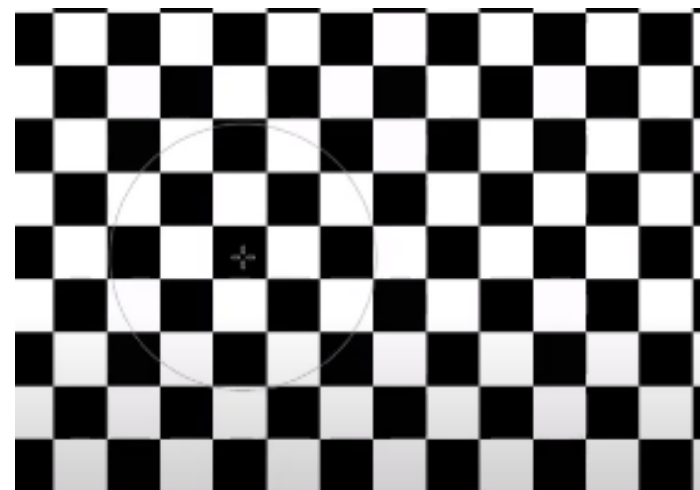


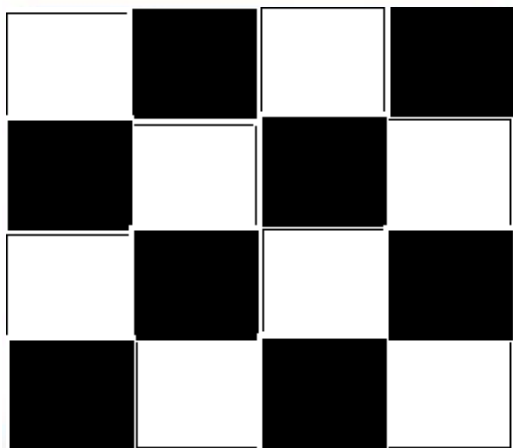
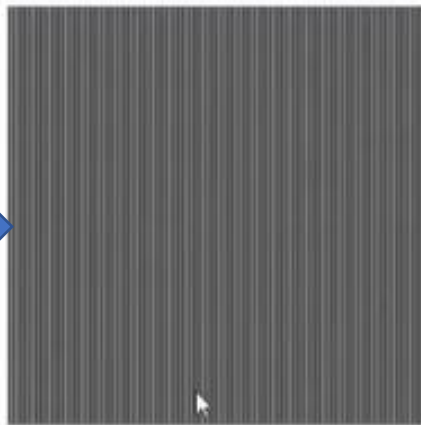
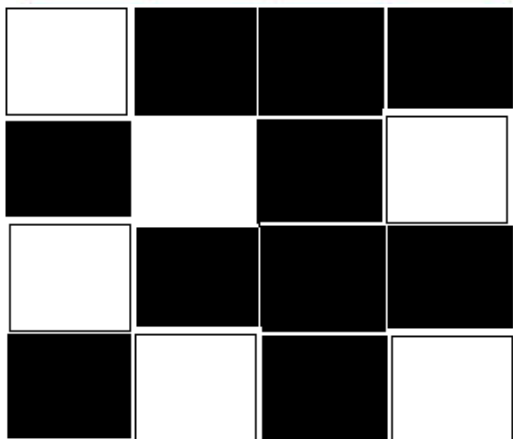
二值化

Zoom in 圖像

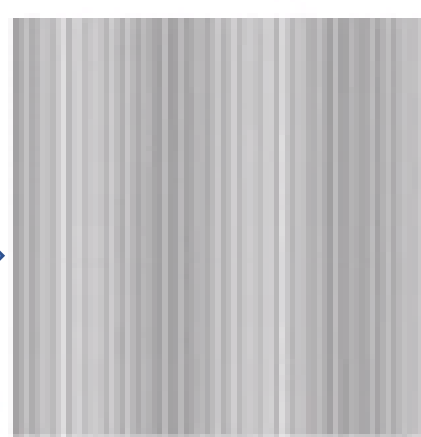
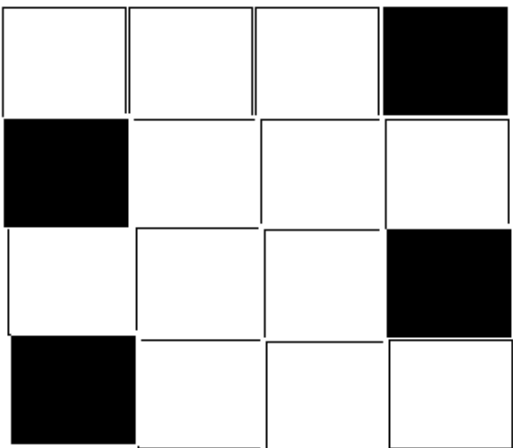


Zoom in 圖像



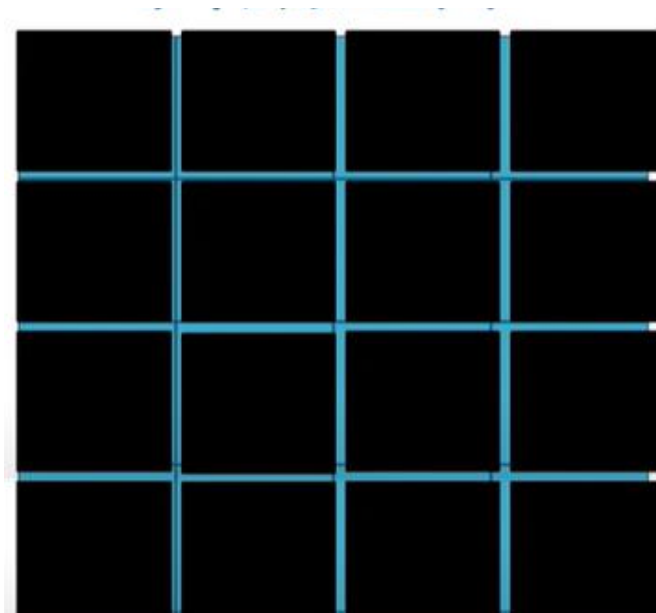


將黑白圖樣擴增至500*500維度

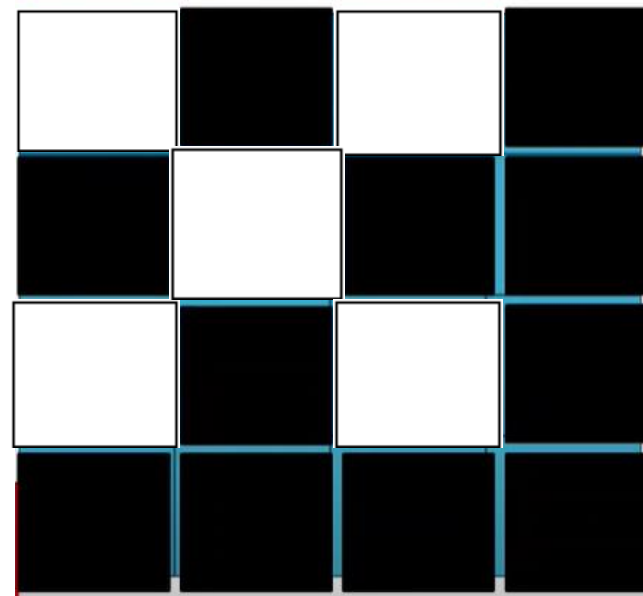


抖動矩陣

0	128	32	160
192	64	224	96
48	176	16	144
240	112	208	80



比較結果:像素值皆小於抖動矩陣值



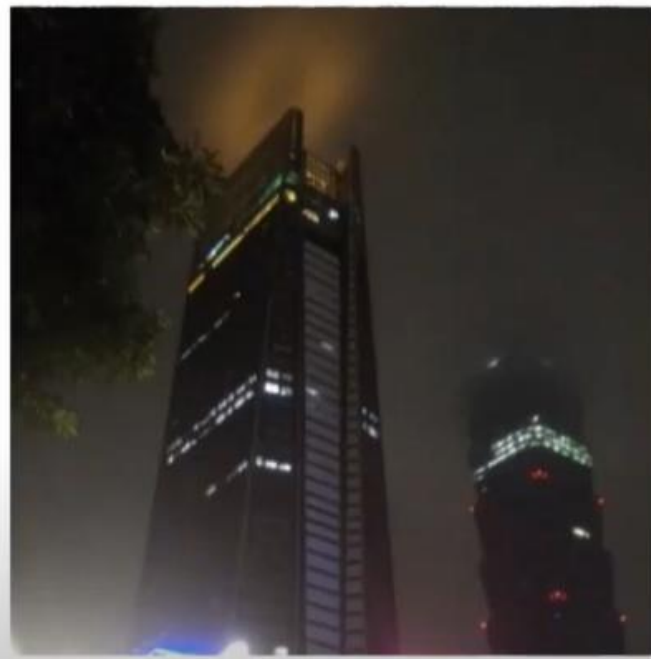
比較結果:像素值部分大於抖動矩陣值

若長寬不是4倍數的解決方式?

- 去除多餘差異不大。



320 X 320



319 X 319

程式流程

- (1)讀入影像
- (2)將長寬轉成4的倍數
- (3)形成抖動矩陣
- (4)擴張成抖動陣列
- (5)比較原影像與抖動陣列
- (6)輸出比較後的影像



原圖



二值化



抖動結果