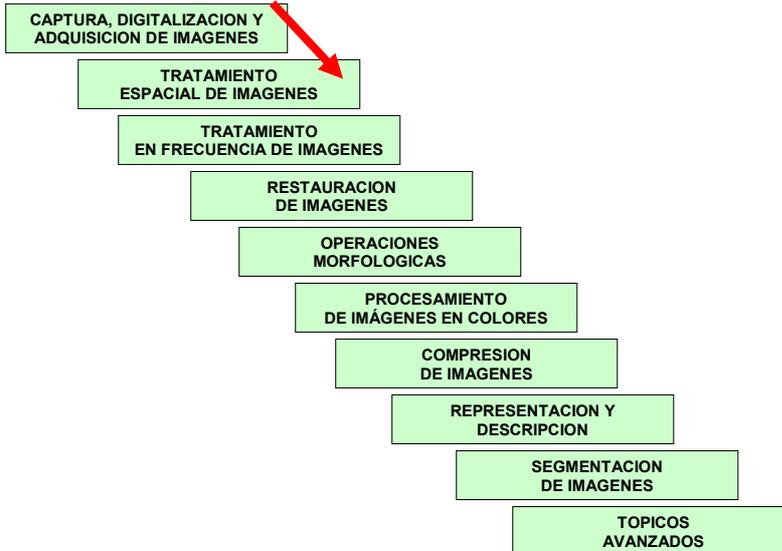


Procesamiento Digital de Imágenes

Pablo Roncagliolo B.
Nº 5



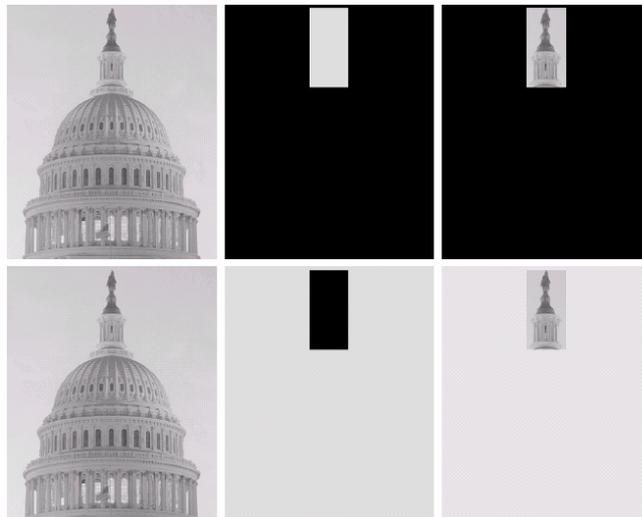
Orden de las clases...



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Operaciones Lógicas



a b c
d e f

FIGURE 3.27
(a) Original image. (b) AND image mask. (c) Result of the AND operation on images (a) and (b). (d) Original image. (e) OR image mask. (f) Result of operation OR on images (d) and (e).

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Imágenes: Gonzalez&Wood

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Ej. Operaciones Lógicas

```
function m013;
% m013
% aplica mascara segun mouse
clf;
A=double(imread('_im_lenna_256.jpg'));
[nf nc]=size(A);

% visualiza sin Toolbox de Imagenes
colormap(gray(256));
subplot(2,2,1);image(A);disp('Presione dos click para definir mascara...');

[c1 f1]=ginput(1) % ojo ginput funciona con x,y
[c2 f2]=ginput(1)
f1=round(f1);f2=round(f2);c1=round(c1);c2=round(c2);
mask=zeros(nf,nc);

for f=f1:f2
    for c=c1:c2
        mask(f,c)=1;
    end;
end;
subplot(2,2,2);imshow(mask,[1]);title('Mask');disp('presione una tecla...');pause
B=A.*mask;
subplot(2,2,3);imshow(B,[1]);title('A and Mask');disp('presione una tecla...');pause
B=A.*(1-mask);
subplot(2,2,4);imshow(B,[1]);title('A and not Mask');
```

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Imágenes: Gonzalez&Wood

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Planos de Bits

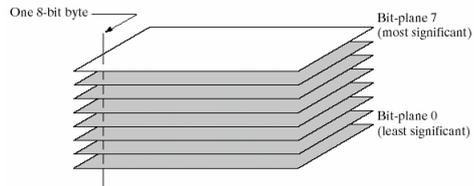


FIGURE 3.12
Bit-plane
representation of
an 8-bit image.

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Planos de Bits

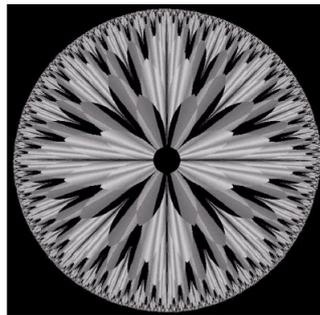
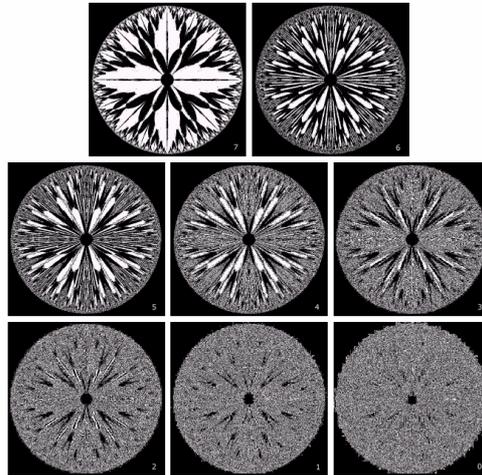


FIGURE 3.13 An 8-bit fractal image. (A fractal is an image generated from mathematical expressions). (Courtesy of Ms. Melissa D. Binde, Swarthmore College, Swarthmore, PA.)

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Planos de Bits



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FIGURE 3.14 The eight bit planes of the image in Fig. 3.13. The number at the bottom, right of each image identifies the bit plane.

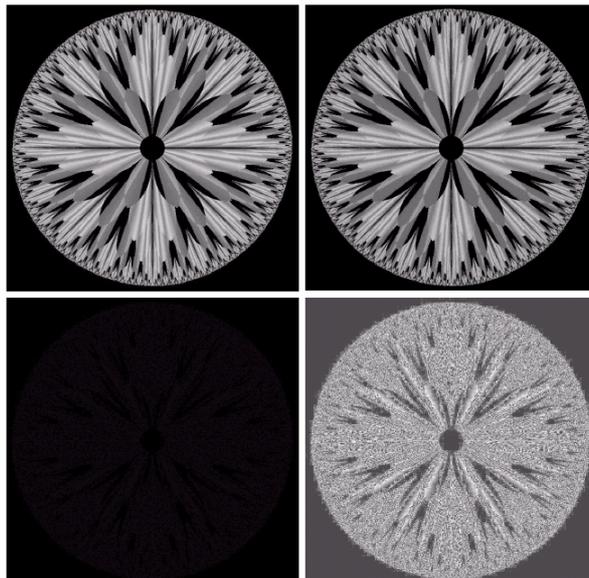
7

Planos de Bits



a b
c d

FIGURE 3.28
(a) Original fractal image.
(b) Result of setting the four lower-order bit planes to zero.
(c) Difference between (a) and (b).
(d) Histogram-equalized difference image. (Original image courtesy of Ms. Melissa D. Binde, Swarthmore College, Swarthmore, PA).



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Ej1. Planos de Bits



```
function B=m011(bit);
%planos de bits
A=imread('_im_lenna_256.jpg');
[nf nc]=size(A);
A=double(A);

%visualiza sin Toolbox de Imagenes
colormap(gray(256));
image(A);
disp('Presione una tecla para mostrar planos de bits...');pause

B=0*A;

pb=2^(bit-1)
for f=1:nf
    for c=1:nc
        aux=bitand(A(f,c),pb);
        B(f,c)=bitget(aux,bit);
    end;%for
end;%for

image(B*255);
```

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Imágenes: Gonzalez&Wood

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Ej2. Planos de Bits



```
%m012
%visualización progresiva en planos de bits
clear
A=imread('_im_lenna_256.jpg');
[nf nc]=size(A);
A=double(A);

%visualiza sin Toolbox de Imagenes
colormap(gray(256));
image(A);
disp('Presione una tecla para mostrar planos de bits...');pause

C=zeros(nf,nc);

for bit=8:-1:1
    pb=2^(bit-1)
    for f=1:nf
        for c=1:nc
            aux=bitand(A(f,c),pb);
            B(f,c)=bitget(aux,bit);
            C(f,c)=bitor(C(f,c),aux);
        end;
    end;
    image(C);
    pause(1);
end;
```

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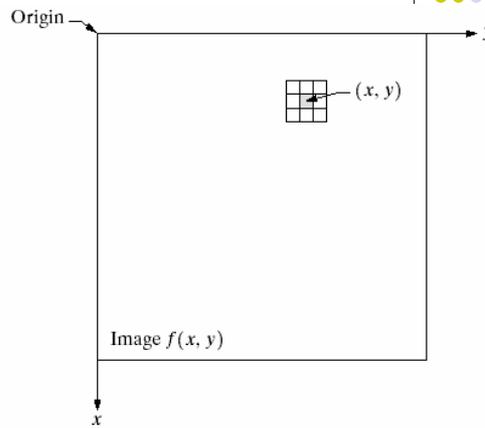
Imágenes: Gonzalez&Wood

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Tratamiento de Imágenes: Dominio espacial



FIGURE 3.1 A
3 × 3
neighborhood
about a point
(x, y) in an image.



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Imágenes: Gonzalez&Wood

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Tratamiento de Imágenes: Dominio espacial: FILTROS

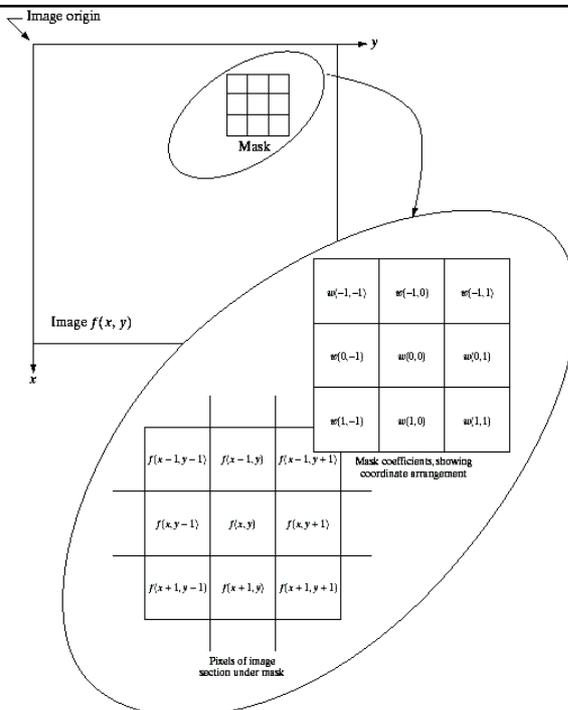


FIGURE 3.32 The mechanics of spatial filtering. The magnified drawing shows a 3 × 3 mask and the image section directly under it; the image section is shown displaced out from under the mask for ease of readability.

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Tratamiento de Imágenes: Dominio espacial: FILTROS



FIGURE 3.33
Another representation of a general 3×3 spatial filter mask.

w_1	w_2	w_3
w_4	w_5	w_6
w_7	w_8	w_9

$\frac{1}{9} \times$	<table border="1"> <tr><td>1</td><td>1</td><td>1</td></tr> <tr><td>1</td><td>1</td><td>1</td></tr> <tr><td>1</td><td>1</td><td>1</td></tr> </table>	1	1	1	1	1	1	1	1	1
1	1	1								
1	1	1								
1	1	1								

$\frac{1}{16} \times$	<table border="1"> <tr><td>1</td><td>2</td><td>1</td></tr> <tr><td>2</td><td>4</td><td>2</td></tr> <tr><td>1</td><td>2</td><td>1</td></tr> </table>	1	2	1	2	4	2	1	2	1
1	2	1								
2	4	2								
1	2	1								

a b

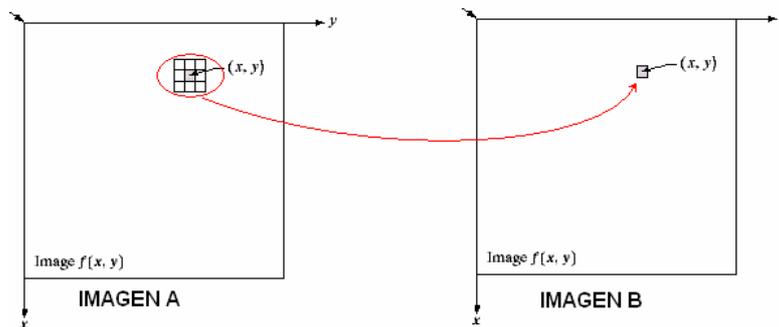
FIGURE 3.34 Two 3×3 smoothing (averaging) filter masks. The constant multiplier in front of each mask is equal to the sum of the values of its coefficients, as is required to compute an average.

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Imágenes: Gonzalez&Wood

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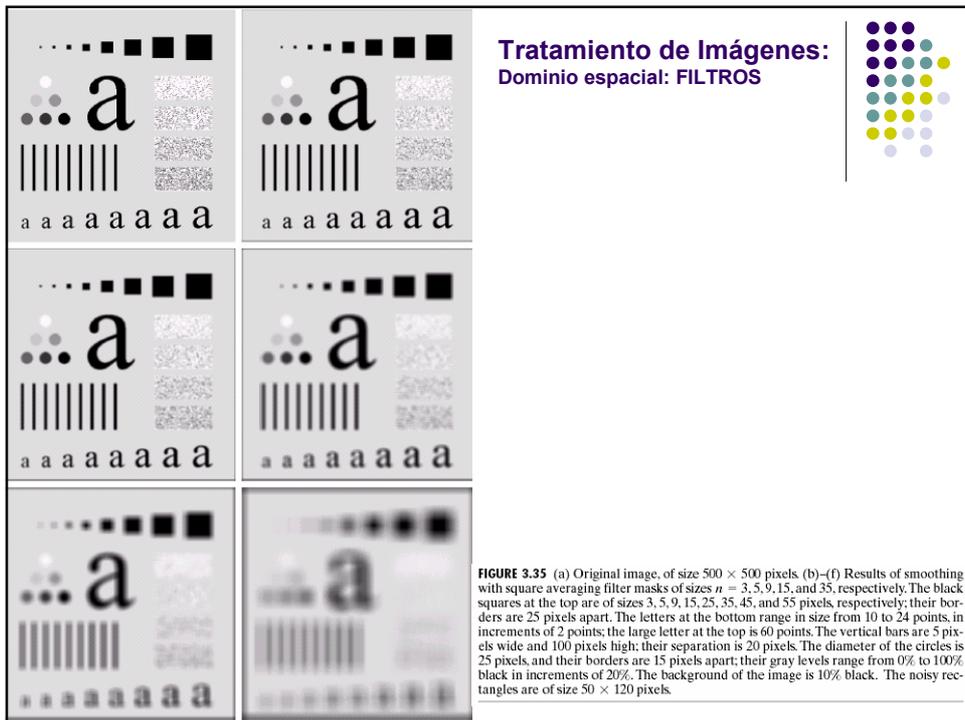
Filtro se puede interpretar como un promedio “móvil”
→ se deben utilizar variables diferentes



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Imágenes: Gonzalez&Wood

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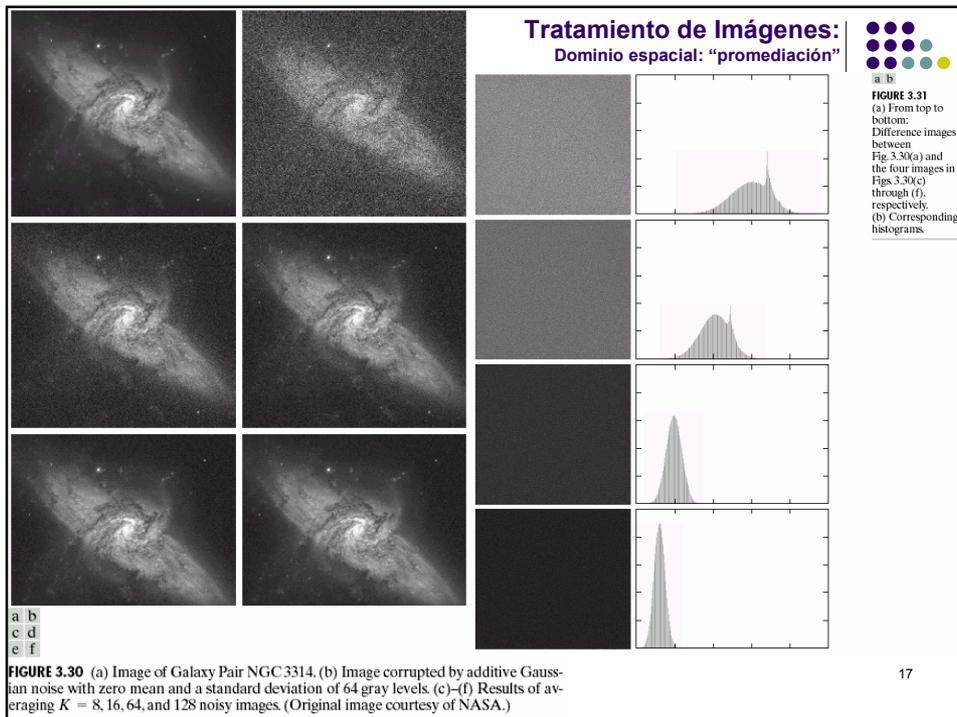


Otro tipo de filtro espacial es la promediación de imágenes secuenciales → permite eliminar “ruido”

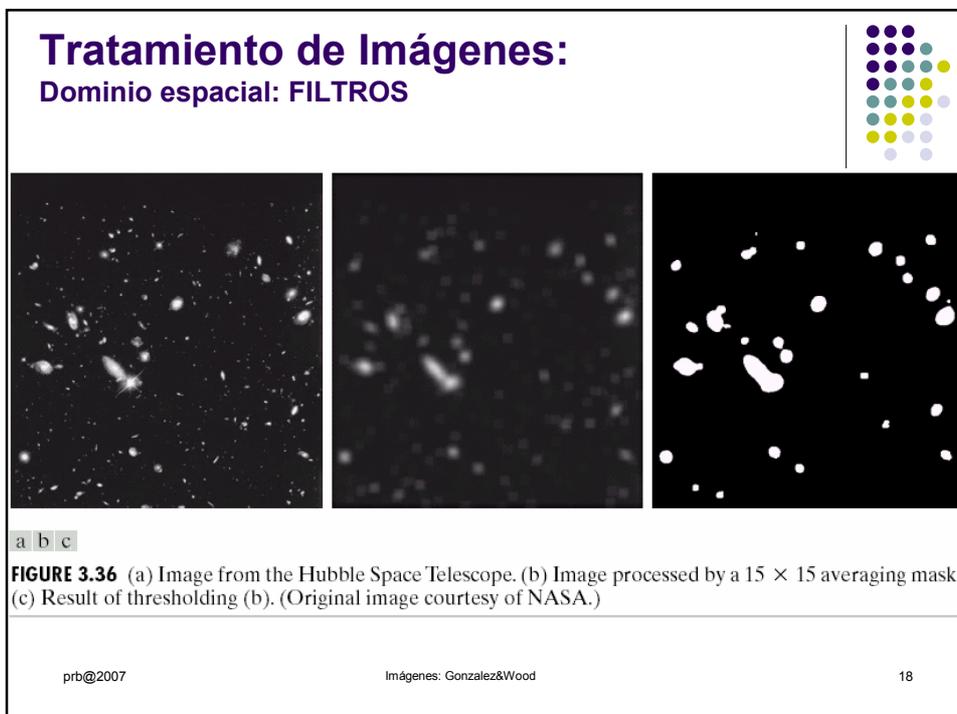
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Imágenes: Gonzalez&Wood

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Tratamiento de Imágenes:

Dominio espacial: FILTROS



- Promedio de vecindad

$$f(i, j) = \frac{1}{\#V} \sum_{(m,n) \in V} g(m, n)$$

Donde V es la Vecindad de (i,j) , incluido.
 $\#V$ es la cardinalidad de V

$$G = \frac{1}{9} \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

Filtro pasa bajos

La aplicación del filtro corresponde a un
 convolución de la imagen y el
 "núcleo" (kernel) G :

$$I' = I * G$$

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Tratamiento de Imágenes:

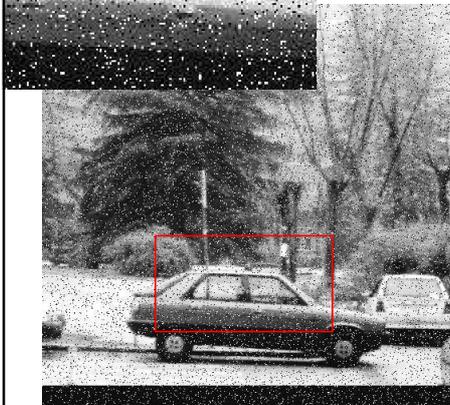
Dominio espacial: FILTROS



- Suavizado basado en promedio de vecindad



$$\begin{bmatrix} 220 & 221 & 220 & 222 \\ 219 & 220 & 220 & 221 \\ 220 & 221 & 59 & 220 \\ 219 & 219 & 220 & 221 \end{bmatrix} \rightarrow \begin{bmatrix} 220 & 221 & 220 & 222 \\ 219 & 220 & 220 & 221 \\ 220 & 221 & 202 & 220 \\ 219 & 219 & 220 & 221 \end{bmatrix}$$



Tratamiento de Imágenes:

Dominio espacial: FILTROS



- Expresión general de filtros 2D:

$$I'(i, j) = \sum_{c=1}^{nc} \sum_{f=1}^{nf} G(c, f) I(i-c, j-f)$$

Donde I es una imagen de nf filas y nc columnas.

G es el kernel (filtro)

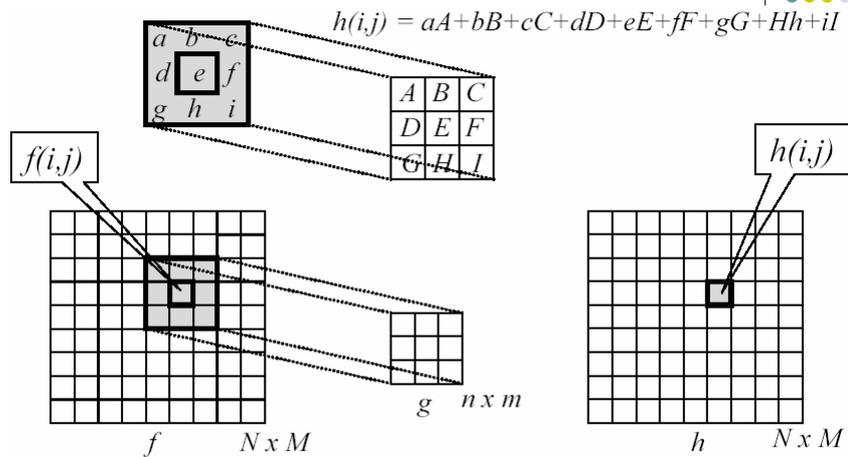
I' es la imagen filtrada

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Tratamiento de Imágenes:

Dominio espacial: FILTROS=CONVOLUCION



$$(f * g)(i, j) = \sum_{k=-n/2}^{n/2} \sum_{l=-m/2}^{m/2} f(i+k, j+l) g(k, l)$$

prb@zuur

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Tratamiento de Imágenes: Dominio espacial: FILTROS



$$H = \begin{bmatrix} 1/9 & 1/9 & 1/9 \\ 1/9 & 1/9 & 1/9 \\ 1/9 & 1/9 & 1/9 \end{bmatrix}$$

Media Simple

Filtrado de Mediana:

Método no lineal, que reemplaza el valor de un píxel por el valor de la mediana de su vecindad.

Mediana: valor central de la secuencia ordenada

200	203	255
180	190	208
150	0	195

Mediana: 195!

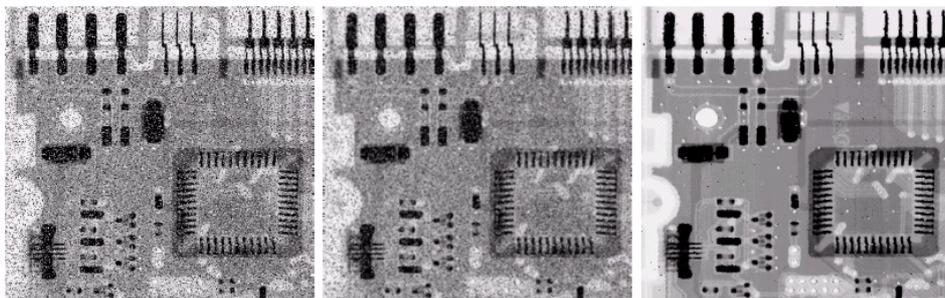
{0, 150, 180, 190, 195, 200, 203, 208, 255}

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Imágenes: Gonzalez&Wood

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Tratamiento de Imágenes: Dominio espacial: FILTROS



a b c

FIGURE 3.37 (a) X-ray image of circuit board corrupted by salt-and-pepper noise. (b) Noise reduction with a 3×3 averaging mask. (c) Noise reduction with a 3×3 median filter. (Original image courtesy of Mr. Joseph E. Pascente, Lixi, Inc.)

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Imágenes: Gonzalez&Wood

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Ej1. Filtro Espacial



```
%K 3x3

%ojo sin bordes...
for f=1+1:nf-1
    for c=1+1:nc-1
        sum=0;
        for ff=-1:1
            for cc=-1:1
                sum=sum+A(f+ff,c+cc)*K(ff+2,cc+2);
            end;
        end;
        B(f,c)=sum/9;
    end;
end;
```