

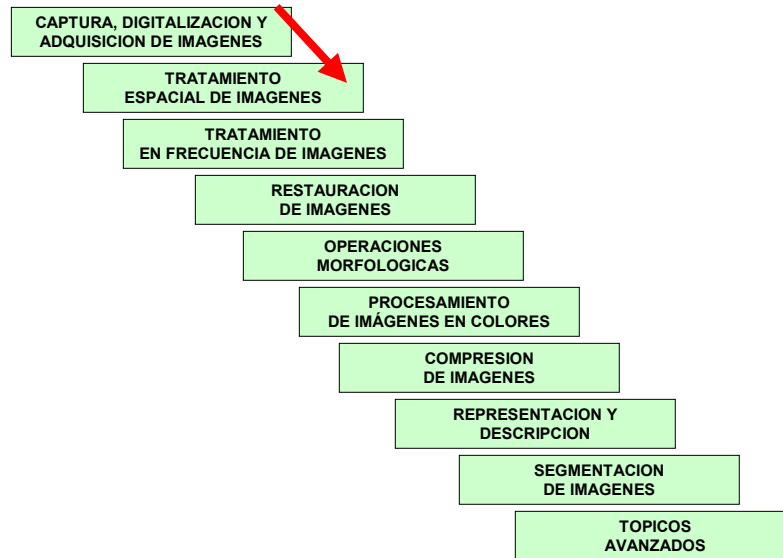
Procesamiento Digital de Imágenes

Pablo Roncagliolo B.

Nº 06



Orden de las clases...



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TRATAMIENTO DE IMÁGENES

FILTROS “PASA ALTOS” O PARA “DETECCION DE BORDES”

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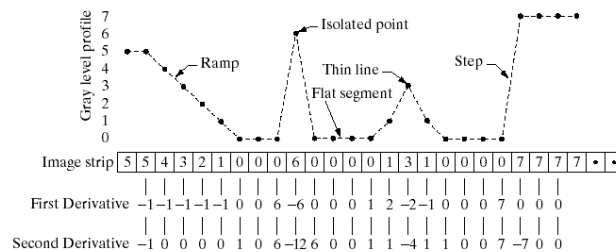
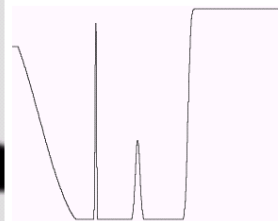
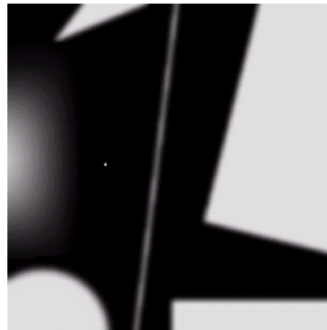
3

Tratamiento de Imágenes: Dominio espacial: FILTROS: “las dervidadas”



a b
c

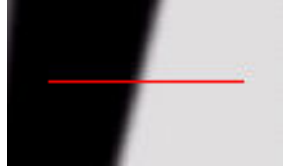
FIGURE 3.38
(a) A simple image. (b) 1-D horizontal gray-level profile along the center of the image and including the isolated noise point.
(c) Simplified profile (the points are joined by dashed lines to simplify interpretation).



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Tratamiento de Imágenes:

Dominio espacial: BORDES



MASCARAS DE KIRSCH (8 Direcciones)

Para cada pixel se determina la máscara con respuesta máxima

H1

5	-3	-3
5	0	-3
5	-3	-3

H2

-3	-3	5
-3	0	5
-3	-3	5

D1

-3	-3	-3
5	0	-3
5	5	-3

etc...

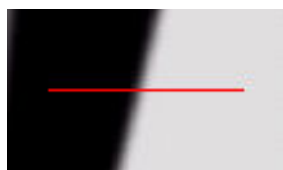
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Imágenes: Gonzalez&Wood

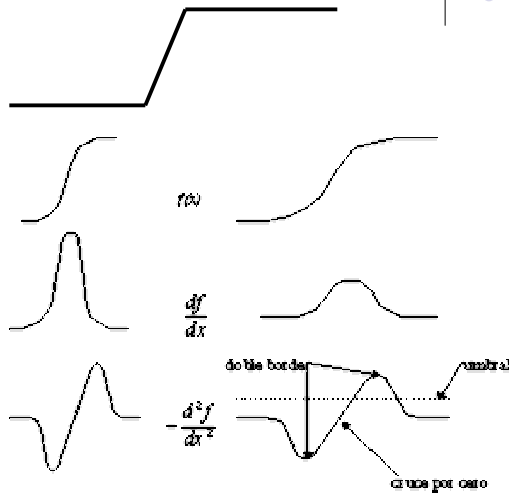
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Tratamiento de Imágenes:

Dominio espacial: BORDES



Primera y Segunda derivada:



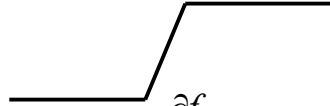
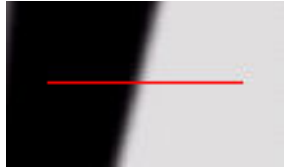
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Imágenes: Gonzalez&Wood

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Tratamiento de Imágenes:

Dominio espacial: BORDES



$$\frac{\partial f}{\partial x} = f(x+1) - f(x)$$

Aproximación discreta del operador gradiente (derivada en ambas direcciones):

Deriv. Parcial:

$$G_c(i,j) = [IM(i,j) - IM(i,j-1)]/1$$

$$G_f(i,j) = [IM(i,j) - IM(i-1,j)]/1$$

	0	0	0
Hf	0	1	-1
	0	0	0
Hc	0	-1	0
	0	1	0
	0	0	0

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Imágenes: Gonzalez&Wood

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Tratamiento de Imágenes:

Diferencia de Pixel

Hf	0	0	0
	0	1	-1
	0	0	0

Hc	0	-1	0
	0	1	0
	0	0	0

Diferencia de Pixel separados

Hf	0	0	0
	1	0	-1
	0	0	0

Hc	0	-1	0
	0	0	0
	0	1	0

Operador de Roberts

Hf	0	0	0
	0	0	1
	0	-1	0

Hc	-1	0	0
	0	1	0
	0	0	0

Operador de Prewitt

Hf	1	0	-1
	1	0	-1
	1	0	-1

Hc	-1	-1	-1
	0	0	0
	1	1	1

Operador de Sobel

Hf	1	0	-1
	2	0	-2
	1	0	-1

Hc	-1	-2	-1
	0	0	0
	1	2	1

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Imágenes: Gonzalez&Wood

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a
b c
d e

z_1	z_2	z_3
z_4	z_5	z_6
z_7	z_8	z_9

-1	0	0	-1
0	1	1	0

-1	-2	-1	-1	0	1
0	0	0	-2	0	2
1	2	1	-1	0	1

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$$\frac{\partial^2}{\partial x^2} = f(x+1) + f(x-1) - 2f(x)$$
$$G'(i,j) = IM(i+1,j) - 2IM(i,j) + IM(i-1,j)$$

$$\text{Hf} \begin{bmatrix} 0 & 0 & 0 \\ -1 & 2 & -1 \\ 0 & 0 & 0 \end{bmatrix} + \text{Hc} \begin{bmatrix} 0 & -1 & 0 \\ 0 & 2 & 0 \\ 0 & -1 & 0 \end{bmatrix} = \text{HL} \begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix}$$

Tratamiento de Imágenes: Dominio espacial: FILTROS LAPLACIANOS



La derivada isotrópica más simple es el *Laplaciano*

$$\Delta^2 f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2}$$

$$\frac{\partial^2 f}{\partial x^2} = f(x+1, y) + f(x-1, y) - 2f(x, y)$$

$$\frac{\partial^2 f}{\partial y^2} = f(x, y+1) + f(x, y-1) - 2f(x, y)$$

Luego la implementación Digital del Laplaciano se lleva a la forma:

$$\Delta^2 f = [f(x+1, y) + f(x-1, y) + f(x, y+1) + f(x, y-1)] - 4f(x, y)$$

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Imágenes: Gonzalez&Wood

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Tratamiento de Imágenes: Dominio espacial: FILTROS LAPLACIANOS



0	1	0	1	1	1
1	-4	1	1	-8	1
0	1	0	1	1	1
0	-1	0	-1	-1	-1
-1	4	-1	-1	8	-1
0	-1	0	-1	-1	-1

a	b
c	d

FIGURE 3.39

(a) Filter mask used to implement the digital Laplacian, as defined in Eq. (3.7-4). (b) Mask used to implement an extension of this equation that includes the diagonal neighbors. (c) and (d) Two other implementations of the Laplacian.

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Imágenes: Gonzalez&Wood

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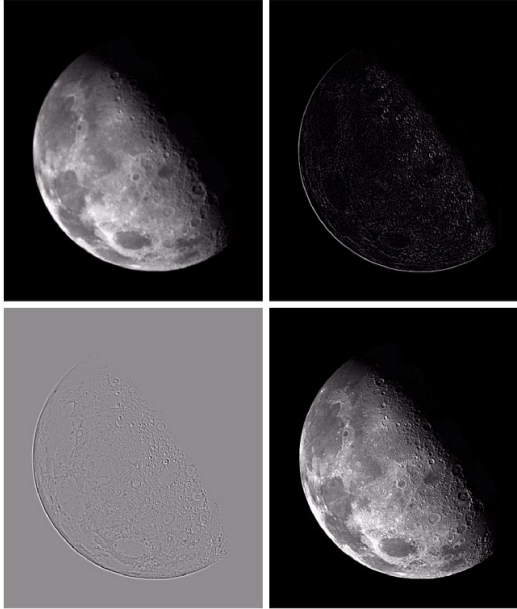
Tratamiento de Imágenes: Dominio espacial: FILTROS



a b
c d

FIGURE 3.40

(a) Image of the North Pole of the moon.
(b) Laplacian-filtered image.
(c) Laplacian image scaled for display purposes.
(d) Image enhanced by using Eq. (3.7-5).
(Original image courtesy of NASA.)



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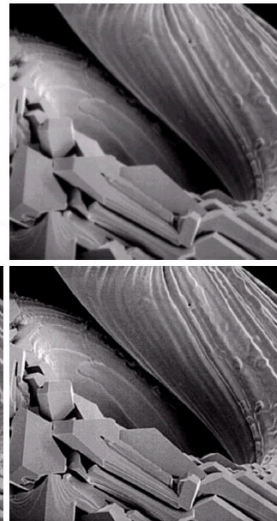
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Tratamiento de Imágenes: Dominio espacial: FILTROS



0	-1	0
-1	5	-1
0	-1	0

-1	-1	-1
-1	9	-1
-1	-1	-1



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a b c
d e

FIGURE 3.41 (a) Composite Laplacian mask. (b) A second composite mask. (c) Scanning electron microscope image. (d) and (e) Results of filtering with the masks in (a) and (b), respectively. Note how much sharper (e) is than (d). (Original image courtesy of Mr. Michael Shaffer, Department of Geological Sciences, University of Oregon, Eugene.)

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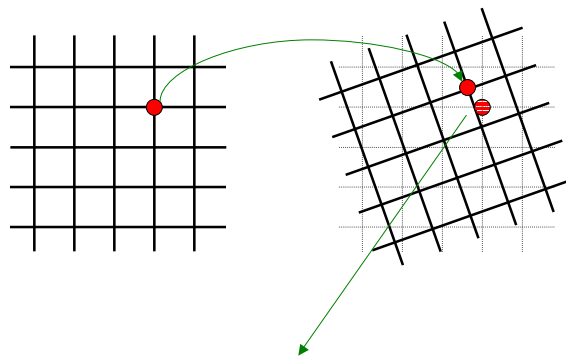
TRATAMIENTO DE IMÁGENES

TRANSFORMACIONES GEOMETRICAS

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Transformaciones Geométricas



Se requiere interpolar!

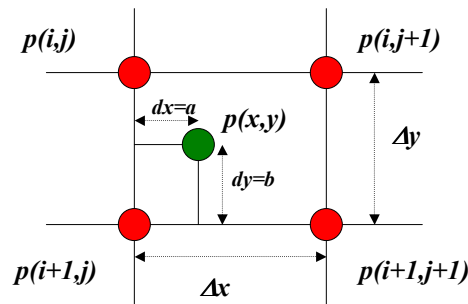
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Transformaciones Geométricas



Interpolación



Tres ejemplos:

- Asignar a $p(x,y)$ el valor del punto más cercano (distancia eucídea)
- Asignar a $p(x,y)$ el promedio entre el píxel más cercano en el eje X y el píxel más cercano en el eje Y
- Interpolación bilineal...

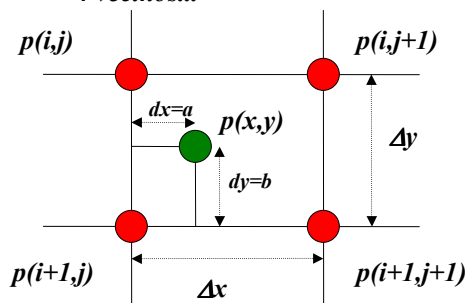
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Interpolación bilineal



Promedio ponderado de sus 4 vecinos...



$$a_1 = \left(1 - \frac{dx}{\Delta x}\right) \left(1 - \frac{dy}{\Delta y}\right)$$

$$a_2 = \left(\frac{dx}{\Delta x}\right) \left(1 - \frac{dy}{\Delta y}\right)$$

$$a_3 = \left(1 - \frac{dx}{\Delta x}\right) \left(\frac{dy}{\Delta y}\right)$$

$$a_4 = \left(\frac{dx}{\Delta x}\right) \left(\frac{dy}{\Delta y}\right)$$

Para $\Delta x=1$ y $\Delta y=1$

$$a_1 = (1 - dx)(1 - dy); a_2 = (dx)(1 - dy)$$

$$a_3 = (1 - dx)(dy); a_4 = (dx)(dy)$$

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$$p(x, y) = a_1 p(i, j) + a_2 p(i, j+1) + a_3 p(i+1, j) + a_4 p(i+1, j+1)$$

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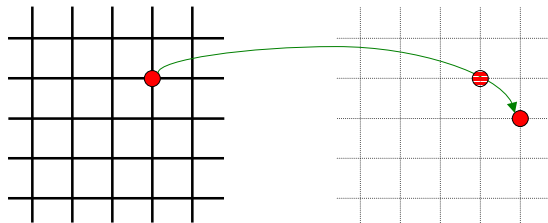
Traslación



$$q(x,y) = p(x+x_0, y+y_0)$$

Forma matricial...

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} 1 & 0 & x_0 \\ 0 & 1 & y_0 \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$



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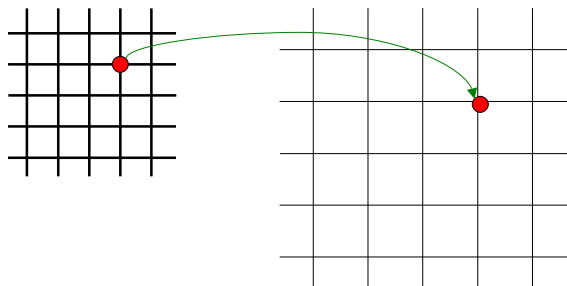
Cambio de Escala + traslación



$$q(x,y) = p(S_x \cdot x + x_0, S_y \cdot y + y_0)$$

Forma matricial...

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} S_x & 0 & x_0 \\ 0 & S_y & y_0 \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$



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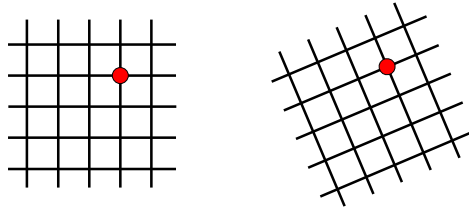
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Rotación



Forma matricial...

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} \cos(\theta) & \sin(\theta) \\ -\sin(\theta) & \cos(\theta) \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$$



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Zoom básico



Expandir e interpolar...

Ej. matricial... con interpolación lineal...

$$\begin{bmatrix} 10 & 6 & 10 \\ 6 & 10 & 6 \\ 10 & 4 & 10 \end{bmatrix} \longrightarrow \begin{bmatrix} 10 & 8 & 6 & 8 & 10 \\ 6 & 8 & 10 & 8 & 6 \\ 10 & 7 & 4 & 7 & 10 \end{bmatrix} \longrightarrow \begin{bmatrix} 10 & 8 & 6 & 8 & 10 \\ 8 & 8 & 8 & 8 & 8 \\ 6 & 8 & 10 & 8 & 6 \\ 8 & 7.5 & 7 & 7.5 & 8 \\ 10 & 7 & 4 & 7 & 10 \end{bmatrix}$$

Expandir filas...

Expandir columnas...

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