

EE410

Digital Image Processing

Dr. Omar A. Al-Swailem
Electrical Engineering Department
King Fahd University of Petroleum & Minerals

www.kfupm.edu.sa

Effects of N and M

Smaller n and M results in Checkerboard effects



a	b	c
d	e	f

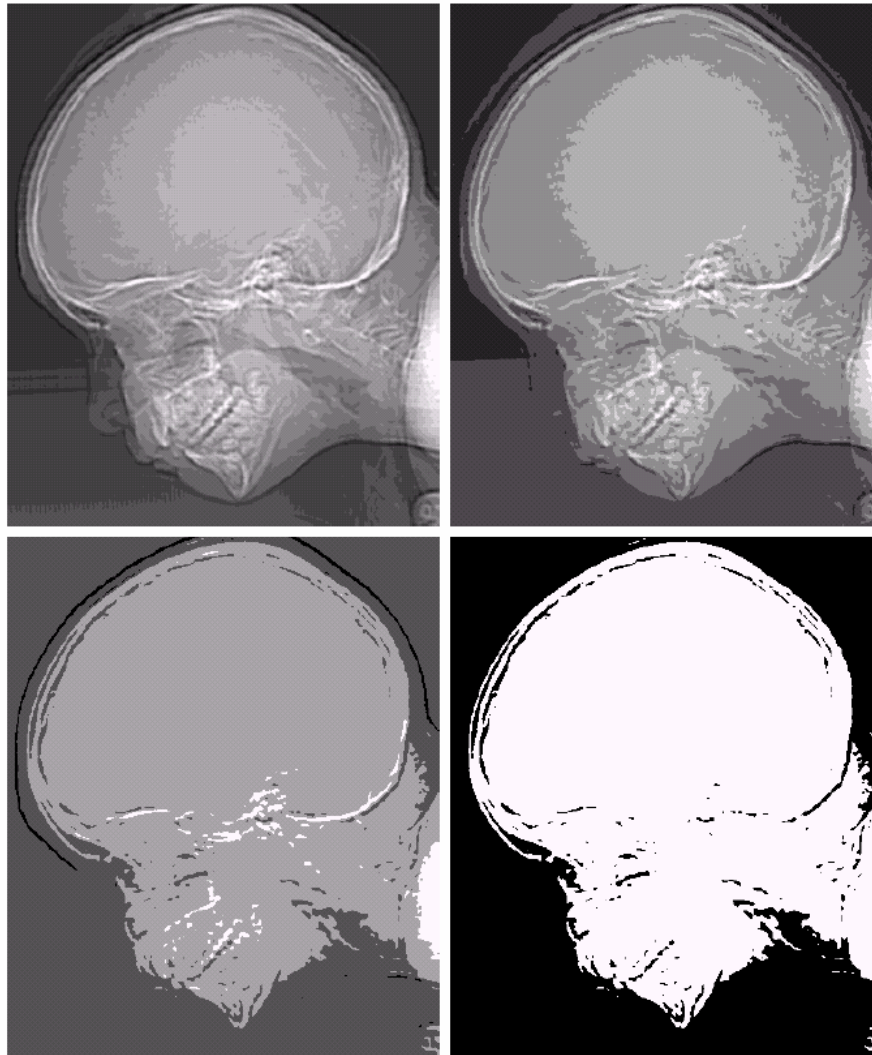
FIGURE 2.20 (a) 1024×1024 , 8-bit image. (b) 512×512 image resampled into 1024×1024 pixels by row and column duplication. (c) through (f) 256×256 , 128×128 , 64×64 , and 32×32 images resampled into 1024×1024 pixels.

Effects of k (# of gray levels)

Insufficient number of gray levels results in *false contouring*

e f
g h

FIGURE 2.21
(Continued)
(e)–(h) Image displayed in 16, 8, 4, and 2 gray levels. (Original courtesy of Dr. David R. Pickens, Department of Radiology & Radiological Sciences, Vanderbilt University Medical Center.)



Effects of k , N , and M

- Figure 2.22 in the text

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FILTERING

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Filtering Process

Image

<i>a</i>	<i>b</i>	<i>c</i>	
<i>d</i>	<i>e</i>	<i>f</i>	
<i>g</i>	<i>h</i>	<i>i</i>	

Mask

w_1	w_2	w_3
w_4	w_5	w_6
w_7	w_8	w_9

$$p = w_1 a + w_2 b + w_3 c + w_4 d + w_5 e + w_6 f + w_7 g + w_8 h + w_9 i$$

This is called Windowing, filtering, masking, convolving, neighborhood averaging, etc. and operated over every pixel in the image.

Filtering Process

Old Image

	1	2	3	4	5	6	7
1	X	X	X	●	●	●	●
2	X	X	X	●	●	●	●
3	X	X	X	●	●	●	●
4	●	●	●	●	●	●	●
5	●	●	●	●	●	●	●
6	●	●	●	●	●	●	●
7	●	●	●	●	●	●	●

New Modified Image

	1	2	3	4	5	6	7
1	●	●	●	●	●	●	●
2	●	●	●	●	●	●	●
3	●	●	●	●	●	●	●
4	●	●	●	●	●	●	●
5	●	●	●	●	●	●	●
6	●	●	●	●	●	●	●
7	●	●	●	●	●	●	●

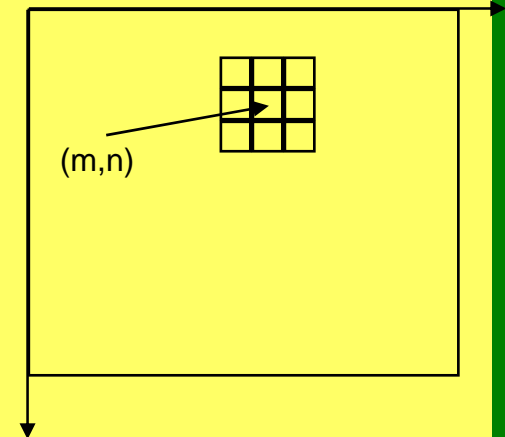
Filtering

- Spatial domain

$$g(m, n) = h(m, n) * f(m, n)$$

$$= \sum_{m=0}^M \sum_{l=0}^N h(k - m, l - n) f(m, n)$$

w_1	w_2	w_3
w_4	w_5	w_6
w_7	w_8	w_9



- Frequency domain

$$G(k, l) = H(k, l) f(k, l)$$

$$g(m, n) = \mathfrak{F}^{-1}(H(k, l) f(k, l))$$