

ELIC 629

Digital Image Processing

Winter 2005

Image Enhancement in the Spatial Domain:
Mid-Term Exam Review

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Tuesday, February 14 2006

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Overview (1):

- **Material You are Responsible For**
 - Sections covered
- **Some Notes Regarding "Important Topics"**
 - Spatial filtering example

Material You are Responsible For (1):

- **Chapters and Sections Covered in the Exam**
 - Chapter 1
 - All sections
 - Easy read → you should know the basic definitions such as, what is an image, what is digital image processing and should be aware of some of the fields that use image processing
 - Chapter 2
 - Section 2.1: elements of visual perception → you should know some of the basic definitions related to the eye and image formation, in particular, focus on lecture notes

Material You are Responsible For (2):

▣ Chapters and Sections Covered in the Exam

▣ Chapter 2

- Section 2.2: light and the electromagnetic spectrum → you should know what the EM is
- Section 2.3, 2.3.1, 2.3.2, 2.3.3, 2.3.4: image sensing and acquisition → important!
- Section 2.4, 2.4.1, 2.4.2: image sampling and quantization → important!
- Section 2.5, 2.5.1, 2.5.2, 2.5.3, 2.5.4: Basic relationships between pixels → important!
- Section 2.6: Linear and non-linear operators → you should know definition of linear operator!

Material You are Responsible For (3):

▣ Chapters and Sections Covered in the Exam

▣ Chapter 3

- Section 3.1: background
- Section 3.2, 3.2.1, 3.2.2, 3.2.3, 3.2.4: basic gray level transformations → you should be familiar with the various transformations we covered in the lectures
- Section 3.3 (up to page 90 only): histogram processing → you should know what a histogram, how to construct one and how to normalize one
- Section 3.4, 3.4.1: Enhancement using arithmetic and logic operators

Material You are Responsible For (4):

▣ Chapters and Sections Covered in the Exam

▣ Chapter 3 (cont...)

- Section 3.5: Basics of spatial filtering → you should know what a mask (template, kernel) is, what the coefficients are and coordinate system of the mask e.g., origin at (0,0)
- Section 3.6, 3.6.1, 3.6.2: Smoothing spatial filters → important!
- Spatial filtering is important! Convolution etc.

Material You are Responsible For (5):

■ Important Material

- You are responsible for all sections we covered as listed in the previous slides.
 - Although the notes do contain plenty of information and probably the most important information, keep in mind, you are also responsible for the material in the corresponding sections in book → I cannot include every piece of information from the book in the lecture slides!
 - Spatial filtering is a very important topic and you should know how to filter an image using a mask

Material You are Responsible For (5):

■ Important Material (cont...)

- You are responsible for knowing Matlab at least with respect to the Labs we have already completed.
 - Creating matrices in Matlab
 - Now you should realize the importance of completing the Matlab review exercise!

Additional Notes

Spatial Filtering Example (1):

Convolution

- Consider the following sub-image intensity values
 - We wish to perform a blurring (averaging) operations using the kernel shown below
 - Lets work through the operation for one pixel (the shaded pixel)

10	12	50	45	128
5	10	100	25	55
225	200	210	30	40
100	125	100	0	125
10	20	25	120	15

1	1	1
1	1	1
1	1	1

$\frac{1}{9} \times$

Spatial Filtering Example (2):

Convolution (cont...)

- Recall the following expression

$$R = w(-1,-1)f(x-1,y-1) + w(-1,0)f(x-1,y) + \dots + w(0,0)f(x,y) + \dots + w(1,0)f(x+1,y) + w(1,1)f(x+1,y+1)$$

- or, its equivalent "shorter" notation

$$g(x,y) = \sum_{s=-a}^a \sum_{t=-b}^b w(s,t) f(x+s,y+t)$$

Spatial Filtering Example (3):

Convolution (cont...)

$$\begin{aligned}
 g(x,y) &= (1/9)(1)(10) + (1/9)(1)(12) + (1/9)(1)(50) + \\
 &\quad (1/9)(1)(5) + (1/9)(1)(10) + (1/9)(1)(100) + \\
 &\quad (1/9)(1)(225) + (1/9)(1)(200) + (1/9)(1)(210) \\
 &= (1/9) \times [(1)(10) + (1)(12) + (1)(50) + \\
 &\quad (1)(5) + (1)(10) + (1)(100) + \\
 &\quad (1)(225) + (1)(200) + (1)(210)] \\
 &= (1/9) \times [822] \\
 &= 91.3 \approx 91 \quad (\text{recall, integer intensity values!})
 \end{aligned}$$

Spatial Filtering Example (4):

- How About Median Operation on the Same Sub-Image ?
 - How would we perform a median operation on the same pixel (shaded one) ?

Good Luck!
