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FACULTY OF EGINEERING

Digital Image Processing
LECTURE-20

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OUTLINE

- Weighted Smoothing Filters
- Order-Statistics Filtering
- Median Filtering
- Median Filtering (Example)
- Strange Things Happen At The Edges!
- Correlation & Convolution
- MCQ
- References

Weighted Smoothing Filters

•More effective smoothing filters can be generated by allowing different pixels in the neighbourhood different weights in the averaging function

- •Pixels closer to the central pixel are more important
- •Often referred to as a weighted averaging

$1/16$	$2/16$	$1/16$
$2/16$	$4/16$	$2/16$
$1/16$	$2/16$	$1/16$

Order-Statistics Filtering

- Nonlinear spatial filters
- Output is based on order of gray levels in the masked area (sub-image)
- Examples: Median filtering, Max & Min filtering

Median filtering

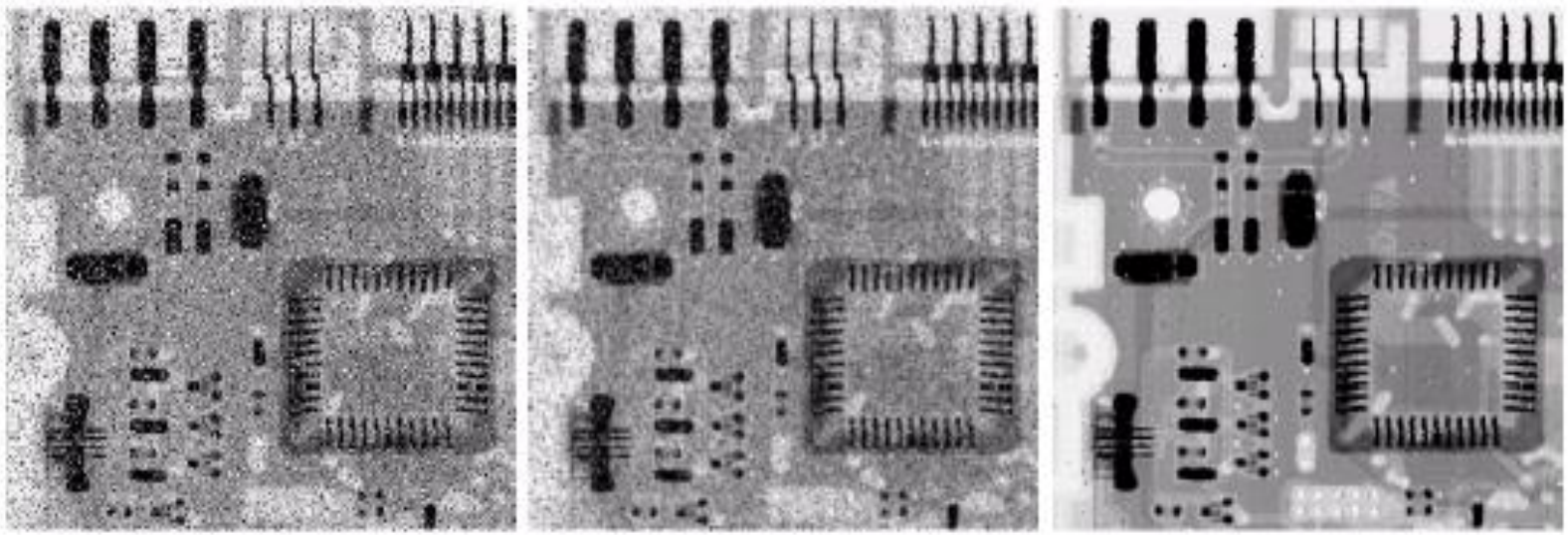
- Assigns the mid value of all the gray levels in the mask to the center of mask;
- Particularly effective when
  - – the noise pattern consists of strong, spiky components (impulse noise, salt-and-pepper)
  - – edges are to be preserved
  - – Force points with distinct gray levels to be more like their neighbors

Median Filtering

10	20	20
20	15	20
20	25	100

Output = ? **20**

Median Filtering (Example)



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.)

Strange Things Happen At The Edges!

- At the edges of an image we are missing pixels to form a neighbourhood

Strange Things Happen At The Edges!

There are a few approaches to dealing with missing edge pixels:

- Pad the image
  Typically with either all white or all black pixels
  - Replicate border pixels
  - Truncate the image

Correlation & Convolution

- The filtering we have been talking about so far is referred to as correlation with the filter itself referred to as the correlation kernel
- Convolution is a similar operation, with just one subtle difference

a	*b*	*c*
d	*e*	*e*
f	*g*	*h*

Original Image Pixels

r	*s*	*t*
u	*v*	*w*
x	*y*	*z*

Filter

$$e_{processed} = v*e + z*a + y*b + x*c + w*d + u*e + t*f + s*g + r*h$$

- For symmetric filters it makes no difference

MCQ

1. Which of the following is the valid response when we apply a first derivative?

   a) Non-zero at flat segments

   b) Zero at the onset of gray level step

   c) Zero in flat segments

   d) Zero along ramps

2. Which of the following is not a valid response when we apply a second derivative?

   a) Zero response at onset of gray level step

   b) Nonzero response at onset of gray level step

   c) Zero response at flat segments

   d) Nonzero response along the ramps

3. If f(x,y) is an image function of two variables, then the first order derivative of a one dimensional function, f(x) is:

   a) f(x+1)-f(x)

   b) f(x)-f(x+1)

   c) f(x-1)-f(x+1)

   d) f(x)+f(x-1)

MCQ

9. Isolated point is also called as noise point.

a) True

b) False

10. What is the thickness of the edges produced by first order derivatives when compared to that of second order derivatives?

a) Finer

b) Equal

c) Thicker

d) Independent

References

- https://www.javatpoint.com/digital-image-processing-tutorial
- https://www.geeksforgeeks.org/
- Digital Image Processing 2nd Edition, Rafael C. Gonzalvez and Richard E. Woods. Published by: Pearson Education.
- Digital Image Processing and Computer Vision, R.J. Schalkoff. Published by: JohnWiley and Sons, NY.
- Fundamentals of Digital Image Processing, A.K. Jain. Published by Prentice Hall,Upper Saddle River, NJ.