

19CSE367 Digital Image Processing

SARATH TV

Last lecture

- Image restoration.
- Degradation-Restoration model
- Noise Model
- Image Denoising using AMF

Mean Filter-Geometric Mean Filter

- An image restored using a geometric mean filter is given by the expression

$$\hat{f}(x, y) = \left[\prod_{(r, c) \in S_{xy}} g(r, c) \right]^{\frac{1}{mn}}$$

- *each* restored pixel is given by the product of *all* the pixels in the sub image area.

- 3x3

Input image, $f(x,y)$

10	10	10	10	10	10
10	10	11	12	100	10
10	12	14	101	102	10
10	15	111	110	100	10
10	10	10	10	10	10

Input image, $f(x,y)$

10	10	10	10	10	10
10	10	11	12	100	10
10	12	14	101	102	10
10	15	111	110	100	10
10	10	10	10	10	10

- $(11*12*100*14*101*102*111*110*100)^{1/9}$

Order statistic filters

- Ordering the values of the pixels in the neighborhood contained by the filter.
- **Median** Filter-replaces the value of a pixel by the median of the intensity levels in a predefined neighborhood of that pixel. Median filters are quite popular because, for certain types of random noise, they provide excellent noise reduction capabilities, with considerably less blurring than linear smoothing filters of similar size.

$$\hat{f}(x, y) = \underset{(r, c) \in S_{xy}}{\text{median}} \{g(r, c)\}$$

123	125	126	130	140
122	124	126	127	135
118	120	150	125	134
119	115	119	123	133
111	116	110	120	130

Neighbourhood values:

115, 119, 120, 123, 124,
125, 126, 127, 150

Median value: 124

11	7	4	5	3	3	2	2
38	22	10	7	4	3	3	2
73	60	29	13	7	5	3	2
69	69	52	29	12	7	4	3
62	66	66	59	27	11	7	3
66	60	60	66	62	25	8	4
58	54	56	62	74	42	13	6
49	49	51	54	58	50	25	9

Original image

4	min
7	
10	
11	
22	median
29	
38	
60	
73	max

=

	22						

Median image

- **Max and min filters**

- The median represents the 50th percentile of a ranked set of numbers
- 100th percentile results in the so-called **max filter**
- This filter is useful for finding the brightest points in an image or for eroding dark regions adjacent to bright areas
- The 0th percentile filter is the **min filter**
- This filter is useful for finding the darkest points in an image or for eroding light regions adjacent to dark areas.
- Also, it reduces salt noise as a result of the min operation

$$\hat{f}(x, y) = \max_{(r, c) \in S_{xy}} \{g(r, c)\}$$

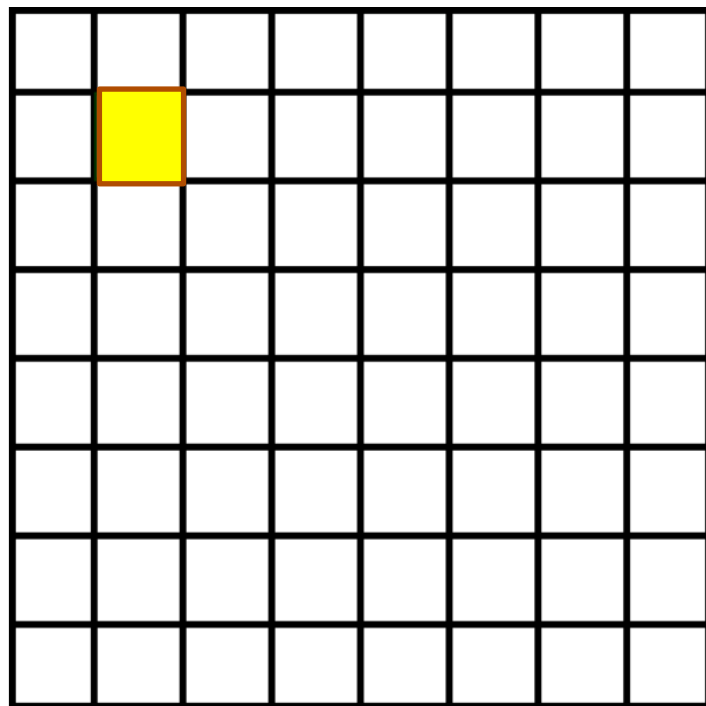
$$\hat{f}(x, y) = \min_{(r, c) \in S_{xy}} \{g(r, c)\}$$

11	7	4	5	3	3	2	2
38	22	10	7	4	3	3	2
73	60	29	13	7	5	3	2
69	69	52	29	12	7	4	3
62	66	66	59	27	11	7	3
66	60	60	66	62	25	8	4
58	54	56	62	74	42	13	6
49	49	51	54	58	50	25	9

Original image

4	min
7	
10	
11	
22	median
29	
38	
60	
73	max

=



Sort and rank

THANK YOU!