

2. Filtering

Averaging

- if we take more than one shot of the same scene, any white noise will not be repeated on the same pixels, from that comes the idea of averaging and as the number of copies increase more white noise removal applied to the image

Image subtraction

- Sometimes the interest of an application will be on motion of elements or the changes in the seen the subtraction of a seen from the previous shots will highlight the changes
- a number of change or still scene will out come near zero or zero image.

Filtering in Spatial Domain

Low pass linear filters

Advantages	Disadvantages
Reduce the spark noise	Blurring of edges

Average filter

1	1	1
1	1	1
1	1	1

$$\text{weight} = \frac{1}{9}$$

Circular filter

0	1	1	1	0
1	1	1	1	1
1	1	1	1	1
1	1	1	1	1
0	1	1	1	0

$$\text{weight} = \frac{1}{21}$$

Pyramid filter

1	2	3	2	1
2	4	6	4	2
3	6	9	6	3
2	4	6	4	2
1	2	3	2	1

$$\text{weight} = \frac{1}{81}$$

Cone filter

0	0	1	0	0
0	2	2	2	0
1	2	5	2	1
0	2	2	2	0
0	0	1	0	0

$$\text{weight} = \frac{1}{25}$$

Gaussian filter

1	2	1
2	4	2
1	2	1

$$\text{weight} = \frac{1}{16}$$

OR

1	4	7	4	1
4	16	26	16	4
7	26	41	26	7
4	16	26	16	4
1	4	7	4	1

$$\text{weight} = \frac{1}{273}$$

Non-linear filters

Advantages	Disadvantages
Fix the problem of luring of edges and keep it sharp	need more processing time
remove spark noise	
do not blure edges	
do not bring new gray values	

Median filter

1. sort the gray values under the filter
2. Select the middle value after sorting
3. Get the mid value then replace it with current value

#Example Apply the median filter on this image.

6	8	5	6	5
2	3	9	4	6
31	32	33	16	8
96	65	63	2	12
1	5	66	6	1

#Answer 2 3 5 6 **8** 9 31 32 33

6	8	5	6	5
2	8	9	4	6
31	32	33	16	8

6	8	5	6	5
96	65	63	2	12
1	5	66	6	1

Kuwahara filter

1. Divide the region under the filter into 4 region
2. Find the mean for the 4 regions

$$mean = \frac{x_1 + x_2 + \dots + x_n}{n}$$

3. Find the standard deviation for the 4 regions

$$standard\ deviation = \sqrt{\frac{(x_1 - m)^2 + (x_2 - m)^2 + \dots + (x_n - m)^2}{n}}$$

4. we select the mean of region that has smallest standard deviation

Border treatment

- Ignore
- Repeat
- Reflect

Differential filters (High pass filters)

- Derivative filters could be used in enhancement to improve edges and corners to have better vision as well as more accurate segmentation

Image edges sharpening

- Idea: compute intensity differences in local image regions.
- Useful for emphasizing transitions in intensity