EIE4512 - Digital Image Processing

Totorial

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Agenda

Corrupt an image with noise

Spatial noise filter

Adaptive spatial filter

Wiener Filter

Bilateral Filter

Corrupt an image with noise

- Degradation Function

$$g(x, y) = H[f(x, y)] + \eta(x, y)$$

- Function Definition

```
g = imnoise(f, type, parameters)
```

- Adding Gaussian noise of mean m, variance var

```
g = imnoise(f, 'gaussian', m, var)
```

- Adding Gaussian noise with zero-mean, local variance V

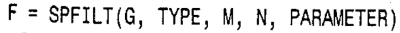
```
g = imnoise(f, 'localvar', V)
```

- Corrupting Image with salt and pepper noise with density d

```
g = imnoise(f, 'salt & pepper', d)
```

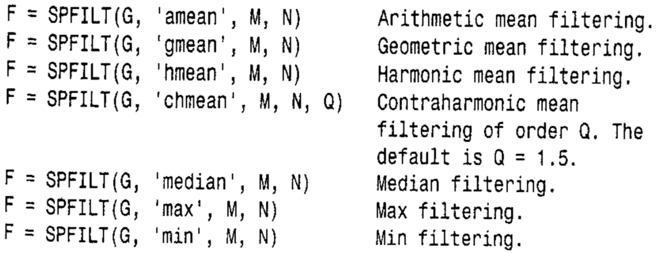
Spatial noise filter

- Spatial filtering on image G using a TYPE filter of size M by N.



```
F = SPFILT(G, TYPE, M, N, PARAMETER)
```

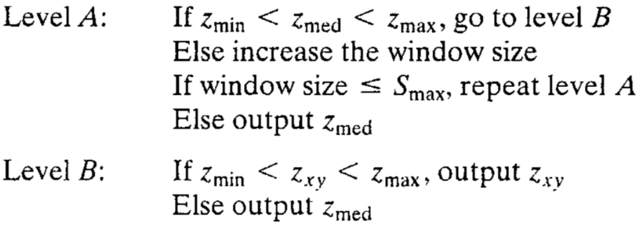
- Ex:following



```
F = SPFILT(G, 'amean', M, N)        Arithmetic mean filtering.
F = SPFILT(G, 'gmean', M, N)        Geometric mean filtering.
F = SPFILT(G, 'hmean', M, N)        Harmonic mean filtering.
F = SPFILT(G, 'chmean', M, N, Q)    Contraharmonic mean
                                    filtering of order Q. The
                                    default is Q = 1.5.
F = SPFILT(G, 'median', M, N)       Median filtering.
F = SPFILT(G, 'max', M, N)          Max filtering.
F = SPFILT(G, 'min', M, N)          Min filtering.
```

Adaptive Spatial Filter

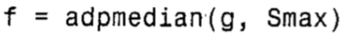
- Algorithm



```
Level A:    If $z_{\min} < z_{\text{med}} < z_{\max}$, go to level $B$
            Else increase the window size
            If window size $\leq S_{\max}$, repeat level $A$
            Else output $z_{\text{med}}$

Level B:    If $z_{\min} < z_{xy} < z_{\max}$, output $z_{xy}$
            Else output $z_{\text{med}}$
```

- An M-function implements Adaptive Spatial Filter, g is the input image, Smax is the maximum size of the adaptive filter window.



```
f = adpmedian(g, Smax)
```

Wiener Filter

- Formula

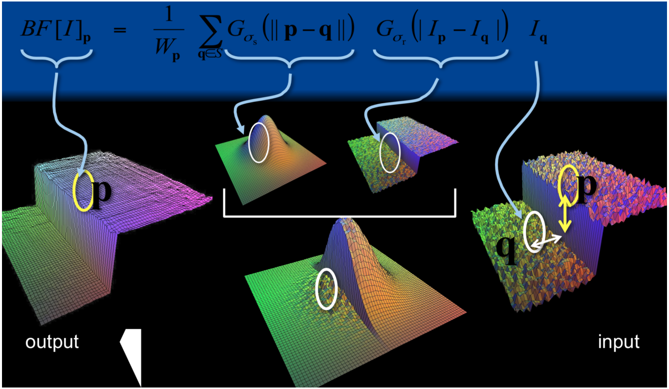
$$\hat{F}(u,v) = \left[\frac{1}{H(u,v)} \frac{|H(u,v)|^2}{|H(u,v)|^2 + S_\eta(u,v)/S_f(u,v)} \right] G(u,v)$$

- Wiener filtering is implemented in IPT using function deconvwnr

```
J = deconvwnr(I,PSF)
J = deconvwnr(I,PSF,NSR)
J = deconvwnr(I,PSF,NCORR,ICORR)
```

Bilateral Filter

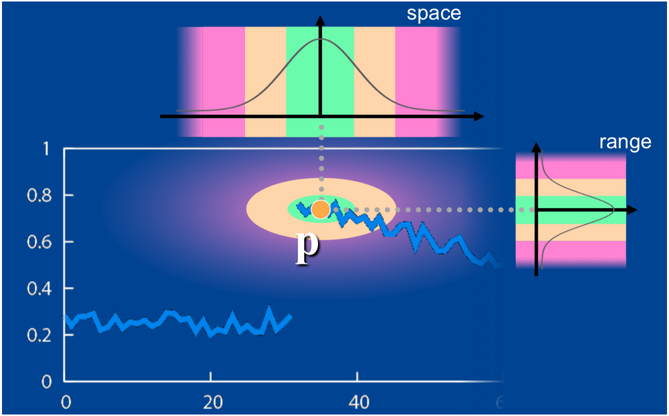
- Bilateral filtering of images with Gaussian kernels.



$$\underbrace{BF[I]_{\mathbf{p}}} = \frac{1}{W_{\mathbf{p}}} \sum_{\mathbf{q}\in S} \underbrace{G_{\sigma_s}(\|\mathbf{p}-\mathbf{q}\|)} \; \underbrace{G_{\sigma_r}(|I_{\mathbf{p}}-I_{\mathbf{q}}|)} \; I_{\mathbf{q}}$$

Bilateral Filter

- Sigma Parameters turning.



Practice

- Trying to implement Bilateral Filter by yourself.(note: reference the code on the GitHub)