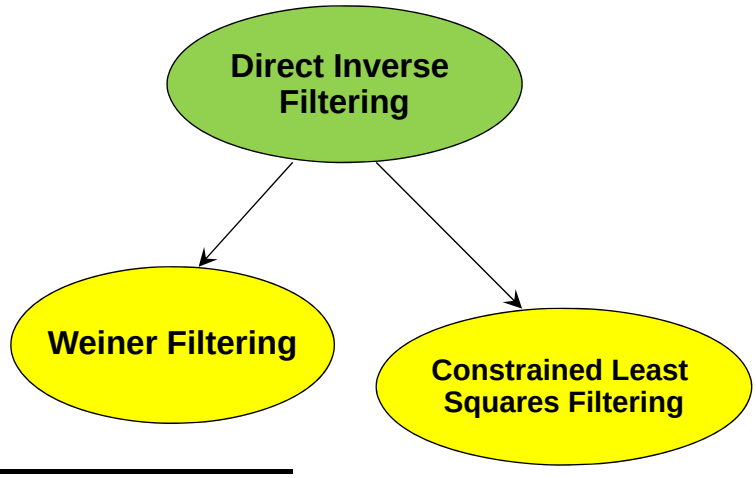
Image Processing

Image Restoration (Part II)

Pattern Recognition and Image Processing Laboratory (Since 2012)

Approaches for Image Restoration



Note: - These approaches are linear image restoration.
- PSF (Point Spread Function) is available.

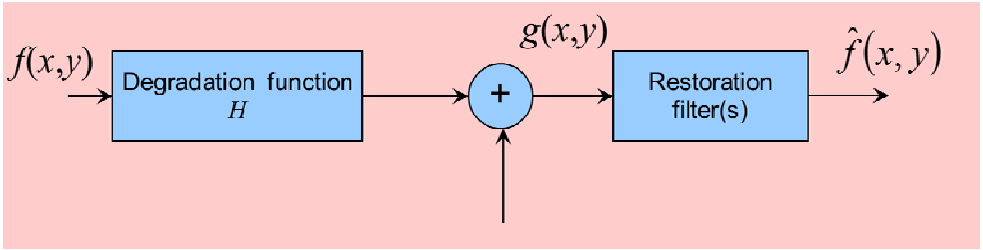
Approaches for Image Restoration

Lucy-Richardson Algorithm

Blind Deconvolution

Note: - These approaches are nonlinear image restoration.
- PSF is NOT available.

Direct Invert Filtering



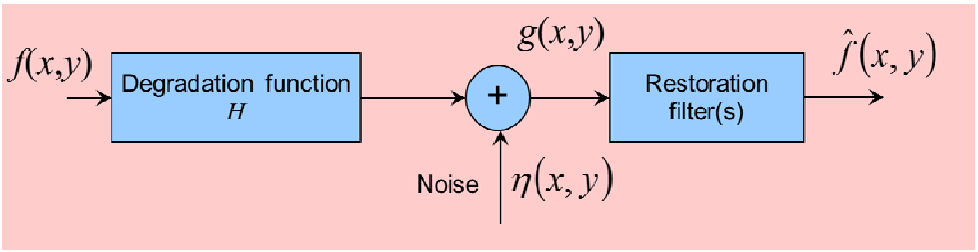
Degradation Eq

$$G(u,v) = H(u,v)F(u,v)$$

$$\hat{F}(u,v) = \frac{G(u,v)}{H(u,v)}$$

Restoration Eq

Direct Invert Filtering



Degradation Eq

$$G(u,v)=H(u,v)F(u,v)+N(u,v)$$

Restoration Eq

$$\hat{F}(u,v)=F(u,v)+\frac{N(u,v)}{H(u,v)}$$

Wiener Filtering

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

‘0’

$$\hat{F}(u,v)=\frac{G(u,v)}{H(u,v)}$$

Direct Inverse Filtering

Wiener Filtering

```
>> fr = deconwnr(g, PSF) % Direct Inverse Filter
>> fr = deconwnr(g, PSF, NSPR) % Parametric Weiner Filter
>> fr = deconwnr(g, PSF, NACORR, FACORR) % Weiner Filter with
                                          % Autocorrelation
```

```
>> degrad5_5 % See demonstration
```

Constrained Least Squares Filtering

$$\hat{F}(u,v) = \left[\frac{H^*(u,v)}{|H(u,v)|^2 + \gamma |P(u,v)|^2} \right] G(u,v)$$

'0'

$$\hat{F}(u,v) = \frac{G(u,v)}{H(u,v)}$$

Direct Inverse F iltering

Iterative Nonlinear Restoration Using the Lucy-Richardson Algorithm

```
>> degrad5_9 % See demonstration
```

Blind Deconvolution

One of the most difficult problems in image restoration is obtaining a suitable estimation of the PSF to use in restoration algorithm.

Blind Deconvolution

Image restoration methods that are NOT based on specific knowledge of the PSF are called “blind deconvolution” algorithm.

Blind Deconvolution

```
>> degrad5_10  % See demonstration
```


The end of
part II