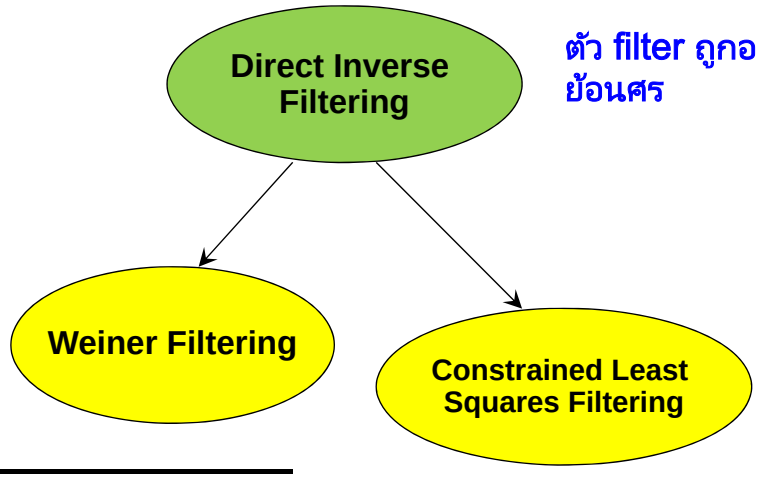
Image Processing

Image Restoration (Part II)

Pattern Recognition and Image Processing Laboratory (Since 2012)

Approaches for Image Restoration



ตัว filter ถูกออกแบบมาแบบย้อนศร

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

Approaches for Image Restoration

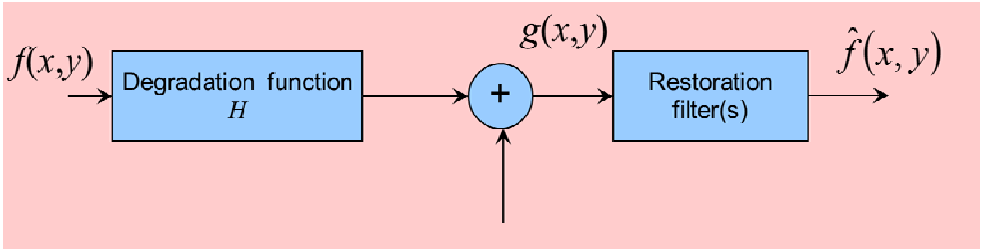
Lucy-Richardson Algorithm

Blind Deconvolution

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

ซ้ายไปขวา : ภาพคุณภาพดี ถูก degrade โดย H และเพิ่ม noise(แต่ในที่นี้ขอละไว้ก่อน)
ถ้าอยากกู้มันคืนมาต้องใช้ restoration filter

Direct Invert Filtering



Degradation Eq

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

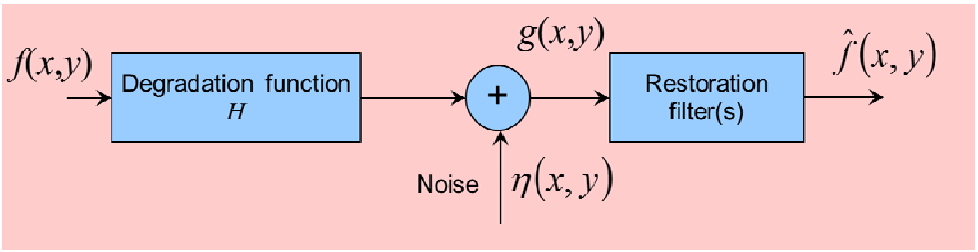
$$\hat{F}(u,v) = \frac{G(u,v)}{H(u,v)}$$

Restoration Eq

จะทำ restoration ก็ต้องทำย้อนศร (ย้าย H(u, v) ลงไปหาร)

กรณีนี้มี noise

Direct Invert Filtering



Degradation Eq

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

Restoration Eq

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

ถ้าทำ term หลังเข้าใกล้ 0 จะทำ F^ เข้าใกล้ F

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'

ไม่ต้องการให้สีเขียวเป็น 0 เพราะถ้าเป็นมันจะกลับเป็นเท่าเดิม เราต้องไม่ทำให้มันเป็น 0 (ต้องการ scaling factor ดีๆไปคูณ)

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

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
```

conjugate
c = a+jb — 1)
c* = a-jb — 2)
|c|^2 = 1) x 2)
|c|^2 = cxc*

Constrained Least Squares Filtering

conjugate

‘0’

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

if y|P(u,v)|^2 is close to 0 it will be the same at the last
So we must not let it be 0 by inserting gamma

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

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.

Don't know such a thing
because you need to estimate the suitable PSF
(estimate to the real problem (PSF(cause of blur)))

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