SNS COLLEGE OF ENGINEERING

(Autonomous)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

19EC351 – IMAGE PROCESSING AMD COMPUTER VISION

UNIT -2

Image Enhancement

Introduction

What is Image Restoration:

Image restoration aim to improve an image in some predefined sense.

What about image enhancement?

Image enhancement also improves an image by applying filters.

Some Noise Probability Density Functions (PDFs):

- Gaussian Noise
- Rayleigh Noise
- Erlang (Gamma) Noise
- Exponential Noise
- Uniform Noise
- Impulse (Sal & Pepper Noise)
- Periodic Noise

Inverse Filtering

An approach to restore an image.

Compute an estimate F'(u, v) of the transform of the original image by:

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

Divisions are made between individual elements of the functions.

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

Inverse Filtering cont...

Inverse Filtering…

Above Equation concludes that:

Even if we know degradation function, we can not recover the undegraded image [Inverse Fourier Transform of F(u, v)] exactly because

N(u, v) is random function whose Fourier Transform is not known.

If degradation has ZERO or less value then N(u, v) / H(u, v) dominates the estimated F'(u, v).

No explicit provision for handling Noise.

Wiener Filters

Maximum Mean Square Error (Wiener) Filtering

- Incorporates both degradation function and statistical characteristics of noise into restoration process.
- Considers images and noise as random process.
- Find an estimate f^ of the uncorrupted image f such that mean square error between them is minimized. Error measure is given by:

$$e^2 = E\{(f - \hat{f})^2\}$$

- E{.} = Expected value of the argument
- Assumptions:
  - image and noise are uncorrelated.
  - One or other has Zero mean
  - Gray levels in the estimate are a linear function of levels in the degraded image.

Wiener Filtering Cont..

- Based on these conditions:

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

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

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

$H(u,v)$ = degradation function
$H^*(u,v)$ = complex conjugate of $H(u,v)$
$|H(u,v)|^2 = H^*(u,v)H(u,v)$
$S_\eta(u,v) = |N(u,v)|^2$ = power spectrum of the noise [see Eq. (4.2-20)]
$S_f(u,v) = |F(u,v)|^2$ = power spectrum of the undegraded image.

THANK YOU