SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECE301 – IMAGE PROCESSING AND COMPUTER VISION

III B.E. ECE / V SEMESTER

UNIT 2 – IMAGE ENHANCEMENT AND RESTORATION

TOPIC – CONSTRAINED LEAST SQUARE FILTER

CONSTRAINED LEAST SQUARE FILTERING

- When we do not have information on the power spectra the Wiener filter is not optimal
- Constrained least squares filter is an extension of Wiener filter where the deconvolution does not require information of the noise

The constrained approach tries to enforce a constraint to represent some degree of smoothness so that resultant image is smooth and noise free

Q is represented as →

$$Q = \text{Min} \left\{ \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} \left[\nabla^2 f(x,y) \right]^2 \right\}$$

CONSTRAINED LEAST SQUARE FILTERING

mask $P(x,y) = \begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix}$

⇓

* Let $P(u,v)$ → Fourier Transform of matrix

* Minimization of second order derivative of image

$$\| g - H\hat{f} \|^2 = \| n \|^2$$

↓ solution

$$\boxed{\| Q\hat{f} \| = \hat{f}^T Q^T Q \hat{f}}$$

* This solution leads to a TF in freq domain,

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

γ → Tune the degree of smoothness =

* Let the residual difference be

$$R_s = H - g\hat{f}$$

* Then,

$$\| R_s \|^2 = \| n \|^2 \pm c$$

where, $\| n \|^2 = MN(\sigma_n^2 + m_n^2)$

=

CONSTRAINED LEAST SQUARE FILTERING

For obtaining the optimal filter, the parameter γ should be tuned.

Procedure for tuning is:

1) Specify an initial value of γ
2) compute $\hat{f}$ and $\|r\|^2$
3) Check whether, $R(u,v) = G_2(u,v) - H(u,v)\hat{F}(u,v)$

→ If yes, then STOP

→ If $\|r\|^2 < \|n\|^2$, Increase the value of γ

→ Else if $\|r\|^2 > \|n\|^2 + a$,

decrease the value of γ


Thank
you!