Image Restoration with the Parametric Wiener Filter

Ken Castleman, 3/24/94
Section 16.2.4

pwf_2D.mcd

$Np \equiv 20$ $i := 0 .. Np$ $j := 0 .. Np$ $u_i := \frac{i}{Np} - 0.5$ $v_i := \frac{i}{Np} - 0.5$

$\sigma \equiv 0.2$ $k \equiv 20$ $N \equiv 0.08$ $\gamma \equiv .05$ $\mu \equiv 0$ $G(\mu, \sigma, x) \equiv \text{if}\left[|x - \mu| < 3\cdot\sigma, e^{-\left[\frac{(x-\mu)^2}{(2\cdot\sigma\cdot\sigma)}\right]}, \right.$

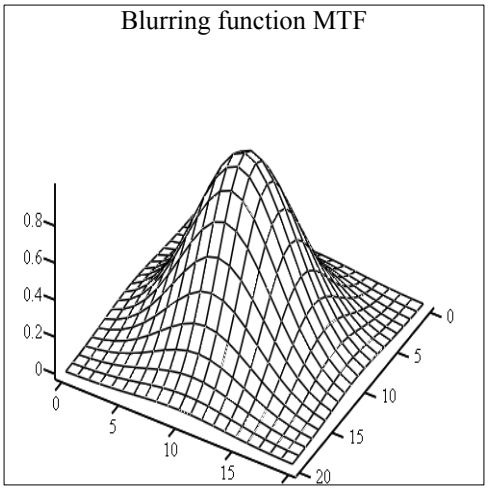
The image, f(x,y), has been blurred by H(u,v) and corrupted by additive white noise of power Pn.

$H_{i,j} := G(\mu, \sigma, u_i)\cdot G(\mu, \sigma, v_j)$ $Pf_{i,j} := \frac{2}{1 + k\cdot k\cdot\left[(u_i - \mu)^2 + (v_j - \mu)^2\right]}$ $Pn_{i,j} := N$

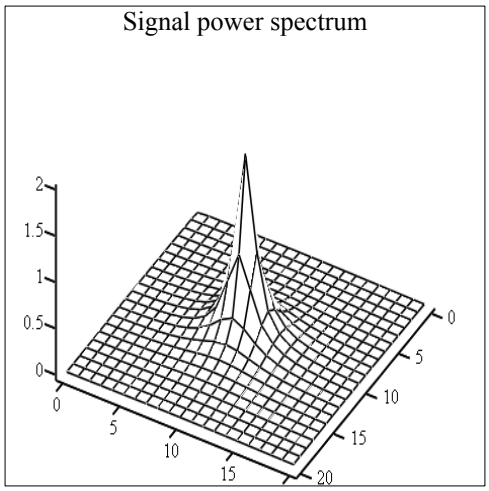
The filter:

$$K_{i,j} := \frac{H_{i,j}}{(H_{i,j})^2 + \gamma\cdot\left(\frac{Pn_{i,j}}{Pf_{i,j}}\right)}$$

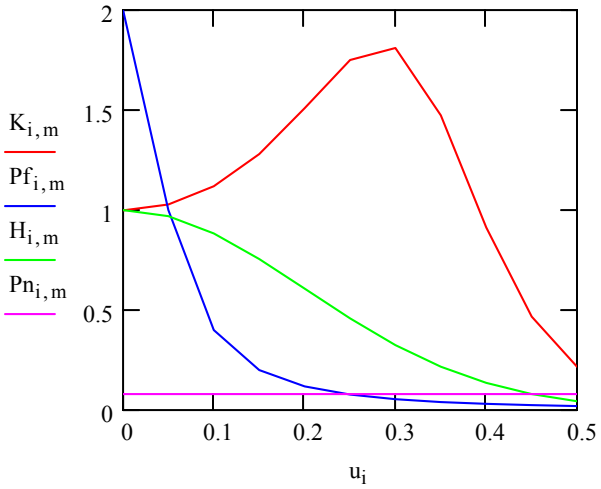
$H_{0,0} := 0$ $Pf_{0,0} := 0$ $K_{0.,0} := 0$ $m := \frac{Np}{2}$

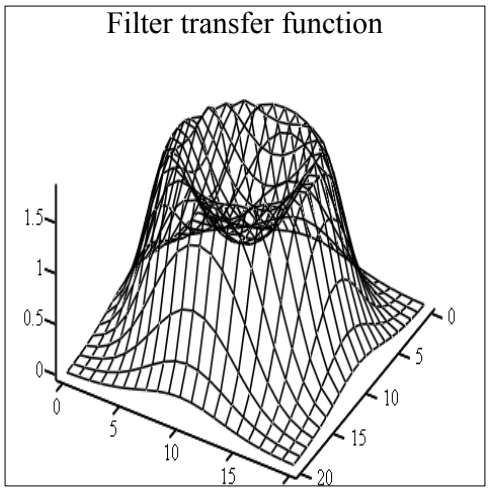


H



Pf





K

The Parametric Wiener Filter

In this example the noise dominates the entire upper half of the spectrum, but the blurring is not excessive. The paremeters k, N and σ permit modeling the signal and noise spectra and the blurring MTF, respectively, and γ controls the degree of restoration.