EE5175: Image Signal Processing

Lab-4

Space-invariant and space-variant blurring

1. **Space-invariant blurring** Perform Gaussian blurring on `Mandrill.pgm` with standard deviation σ. Assume space-invariant blur and a kernel of size $\lceil 6\sigma+1 \rceil \times \lceil 6\sigma+1 \rceil$. Observe the outputs for these values of σ: 1.6, 1.2, 1.0, 0.6, 0.3 and 0.0.

2. **Space-variant blurring** Now assume the blur to be space-variant, i.e. the standard deviation varies for each pixel. Consider the distribution of $\boldsymbol{\sigma}$ to be

$$\boldsymbol{\sigma}(m,n) = A \exp \frac{-\left(\left(m-\frac{N}{2}\right)^2 + \left(n-\frac{N}{2}\right)^2\right)}{B}, \quad 0 \le m,n \le N-1$$

with

$$\boldsymbol{\sigma}\left(\frac{N}{2},\frac{N}{2}\right) = 2.0 \text{ and } \boldsymbol{\sigma}(0,0) = 0.01,$$

where $N \times N$ is size of the image and pixel indices are in the range $[0,N-1] \times [0,N-1]$. Find A and B, and create the matrix $\boldsymbol{\sigma}$. Perform Gaussian blurring on `Globe.pgm` using the values of $\boldsymbol{\sigma}(m,n)$.

3. Blur `Nautilus.pgm` using

   (a) space-invariant blur code of part 1 with $\sigma = 1.0$, and

   (b) space-variant blur code of part 2 with $\boldsymbol{\sigma}(m,n) = 1.0$ for $0 \le m,n \le N-1$.

   Verify that the blurred images of the above two steps are same.

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