

# EE5490: Image Signal Processing

## Lab-4

### Space-invariant and space-variant blurring

1. **Space-invariant blurring** Perform Gaussian blurring on `Mandrill1.pgm` with standard deviation  $\sigma$ . Assume space-invariant blur and a kernel of size  $[6\sigma + 1] \times [6\sigma + 1]$ . Observe the outputs for these values of  $\sigma$ : 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  $\sigma$  to be

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

with

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

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  $\sigma$ . Perform Gaussian blurring on `Globe.pgm` using the values of  $\sigma(m, n)$ .

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  $\sigma(m, n) = 1.0$  for  $0 \leq m, n \leq N - 1$ .

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

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