Image processing

ASSIGNMENT 4: RESTORATION (2024)

For this assignment you must write a short report in any word processor of your choice (MSWord, Latex, ....) where you explain your methods and show your results. All input and output images must be shown (preferably so that they can be compared on the same page). PLEASE print you images fairly large.

Add the code in an Appendix.

1. Take any grey-scale image of your own choice, and blur it with a gaussian mask *M* of the form



with *s* a chosen constant, and (*j*0*, k*0) are the indices of the center pixel of the matrix. Scale *M* so that its total sum of pixels is 1. (If it does not sum to 1, it will also brighten or darken the image, apart from blurring it.)

You may either do the blurring physically with periodic convolution, or in frequency space by multiplying its Fourier Transform with the Fourier Transform of the mask and performing the Inverse Fourier Transform afterwards. (The results ought to be equivalent.)

Then *deconvolve* the blurred image, using a *cut-off filter* in an attempt to reconstruct the image (i.e. *unblur* it). Let *A* be the blurred image and let *M* be the mask (both the same size), and let *B* be the reconstructed image. The over-hat denotes the Fourier Transform. The cut-off filter is

*H*ˆ = min(1*/M*ˆ *, C*)*,*

where *C* is a chosen constant. Deconvolution is performed by

*B*ˆ = *A*ˆ *× H*ˆ *.*

Here both */* and *×* are *element-by-element* division or multiplication. The reconstructed image *B* is given by

*B* = IFT(*B*ˆ)*.*

Play around with various choices of *C*, and show at least two examples in your report.

Recommendations: Do not take an image that is too large. An image of the approximate size 256*×*256 or smaller will be fine. If your image is *m × n*, make sure that *m* and *n* are both even (discard a row or a column where necessary), and let *j*0 = *m/*2 + 1 and *k*0 = *n/*2 + 1. The gaussian spread constant, *s*, must not be too large — the larger you make it, the worse the blur, and the more difficult it is to unblur the image successfully. Therefore apply reasonable blur, but don’t overdo it. The cut-off constant *C* should be larger (about 10*×* or so) than the minimum value at the center of 1*/|M*ˆ *|*.