EECS207A final Project Proposal. Image restoration in the frequency domain

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Written by Nasser M. Abbasi. December 2, 2004
University of California, Irvine

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1 Introduction

This is an outline of my final project for EECS 207A.
The project will be to develop an application which will accept as input a degraded image file, and will perform image restoration in the frequency domain and will generate the restored image and save it to the disk.

2 Theory

Assume that the original, undistorted object is f, Let the Point spread function (PSF) of the camera be h, and let the degraded resulting image of f produced by the camera be g.
The goal is that, given g, and assuming an h, we can restore g back as close as possible to f , call this restored image $\tilde{f}$. To do this, we will use the following model of image degradation

$$g = h \circledast \tilde{f} + \eta$$

Where η is the noise and $\circledast$ is the convolution operator.
In this project I will not consider noise and will assume it to be zero.
Converting the above equation to the frequency domain, we obtain

$$G = H \ \tilde{F}$$

Where G, H, and F are the 2 dimensional Fourier transforms of g, h, and $\tilde{f}$
Hence the transform of the restored image will be

$$\tilde{F} = \frac{G}{H}$$

Where in the above, the division will be done term by term between the two matrices. If a value of H contain a zero, then this term will not be used.
Now we need to apply the 2D inverse Fourier transform to obtain the spatial restored image $\tilde{f}$ from $\tilde{F}$.
The PSF used will be the 2D Gaussian, with a certain standard deviation (Will try 5 or 10 pixels, and experiment with these values to find the best value to get the best restoration) and with zero mean.
The degraded images will be generated by blurring using either a standard 3×3 or 5×5 averaging filter or a Gaussian filter. The restored image will be visually compared to the original image, and a conclusion as to the effectiveness of this method of restoration will be given.