Image Restoration Basics*

Robert Nowak

This work is produced by OpenStax-CNX and licensed under the
Creative Commons Attribution License 1.0†

Abstract

The module provides an introduction into the concepts of image restoration and filtering.

1 Image Restoration

In many applications (*e.g.*, satellite imaging, medical imaging, astronomical imaging, poor-quality family portraits) the imaging system introduces a slight distortion. Often images are slightly blurred and image restoration aims at **deblurring** the image.

The blurring can usually be modeled as an LSI system with a given PSF $h[m,n]$.

Figure 1: Fourier Transform (FT) relationship between the two functions.

The observed image is

$$g[m,n] = h[m,n] * f[m,n] \tag{1}$$

$$G(u,v) = H(u,v)\,F(u,v) \tag{2}$$

$$F(u,v) = \frac{G(u,v)}{H(u,v)} \tag{3}$$

Example 1: Image Blurring

Above we showed the equations for representing the common model for blurring an image. In Figure 2 we have an original image and a PSF function that we wish to apply to the image in order to model a basic blurred image.

*Version 2.2: Jul 22, 2005 2:35 pm -0500

†http://creativecommons.org/licenses/by/1.0

(a) (b)

Figure 2

Once we apply the PSF to the original image, we receive our blurred image that is shown in Figure 3:

Figure 3

1.1 Frequency Domain Analysis

Example 1 (Image Blurring) looks at the original images in its typical form; however, it is often useful to look at our images and PSF in the frequency domain. In Figure 4, we take another look at the image blurring example above and look at how the images and results would appear in the frequency domain if we applied the fourier transforms.

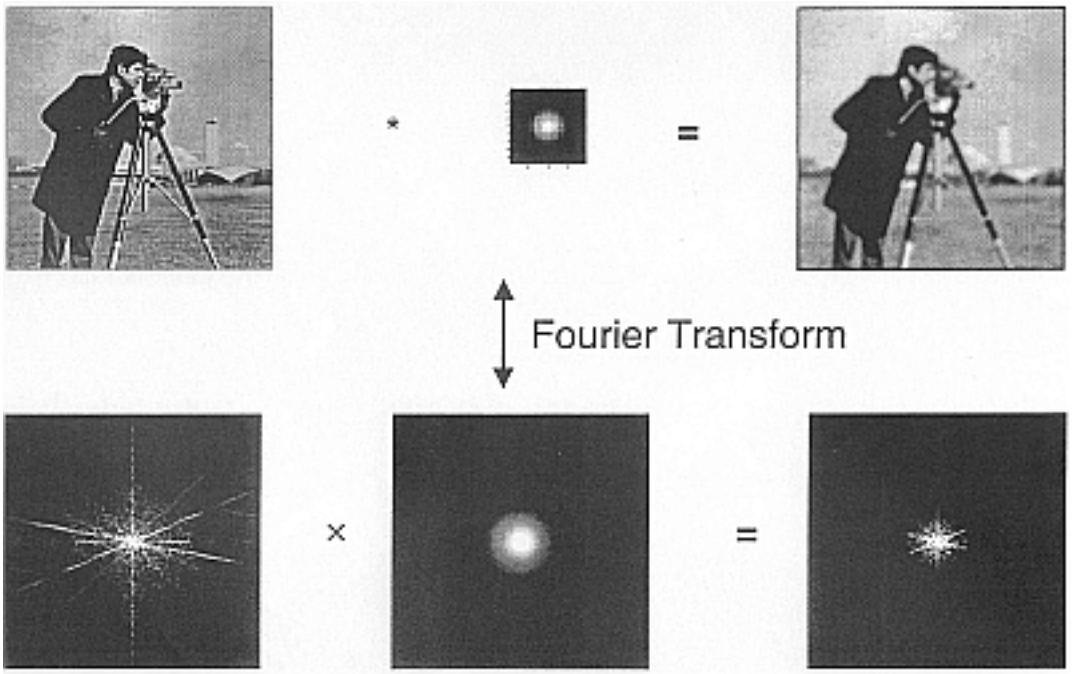

Figure 4