

Chapter 44

Study of Noise Removal Techniques for Digital Images

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ABSTRACT

Images very often get contaminated by different types of noise like impulse noise, Gaussian noise, spackle noise etc. due to malfunctioning of camera sensors during acquisition or transmission using the channel. The noise in the channel affects processing of images in various ways. Hence, the image has to be restored by applying filtration process before the high level image processing. In general the restoration techniques for images are based up on the mathematical and the statistical models of image degradation. Denoising and deblurring are used to recover the image from degraded observations. The researchers have proposed verity of linear and non-linear filters for removal of noise from images. The filtering technique has been used to remove noisy pixels, without changing the uncorrupted pixel values. This chapter presents the metrics used for measurement of noise, and the various schemes for removing of noise from the images.

INTRODUCTION

The processing of visual information by computer has been drawing a very significant attention of the researchers over the last a few decades. The process of receiving and analyzing visual information by the human species is referred to as sight, perception or understanding. Similarly, the process of receiving and analyzing visual information by digital computer is called *digital image processing* (Jain, 1989; Russ, 2002; Gonzalez & Woods, 2009; Sridhar, 2011).

DOI: 10.4018/978-1-5225-0983-7.ch044

Any monochrome image may be described as a two-dimensional function I . (A. Yadav & P. Yadav, 2009).

$$I = f(x, y) \tag{1}$$

where, x and y are spatial coordinates. Amplitude of f at any pair of coordinates (x, y) is called intensity I or gray value of the image. When spatial co-ordinates and amplitude values are all finite, discrete quantities, the image is called digital image (Chanda & Majumder, 2002). The digital image I is represented by a single 2- dimensional integer array for a gray scale image and a series of three 2-dimensional arrays for each colour bands.

To send visual digital images is a major issue in the modern data communication network. The image sent from sender end may not be the same at the receiving end. The image obtained after transmission is often corrupted with noise. The image received at the receiving end needs processing before it can be used for further applications. Removal of noise is an important step in the image restoration process. The denoising of image remains a challenging problem in current research associate with image processing. The goal of image denoising is to manipulation of the image data to produce a visually high quality image from corrupted image, utilizing prior knowledge on the statistics of natural images, while retaining the edges and other detailed features as much as possible.

There have been several numbers of published algorithms and each target to remove noise from original signal. The problems have been studied intensively with considerable progress made in recent years. However, it seems to that image denoising algorithms are starting to converge and recent algorithms improve over previous one by only fractional dB values. It is thus important to understand, how much can we still improve natural image denoising algorithms? What are the inherent limits imposed by the actual statistics of the data? Those challenges in evaluating such limits that constructing proper models of natural image statistics which is a long standing and yet the problems are unsolved. Noise removal algorithms in spatial domain, as well as other, are finds too much useful in real time noise removal techniques, such as medical imaging and satellite imaging applications. The order of noise and performance measures to be analysed and decides the type of denoising algorithm.

In this chapter the authors tried to explore the different image denoising techniques. Also, the different additive noise models and also multiplicative models such as Gaussian Noise, Salt-and-Pepper Noise, Speckle Noise and Brownian Noise have been discussed. Depending on the noise present in an image a particular algorithm is to be selected. When the image is corrupted with Salt-and-Pepper Noise then it is found that the median filtering approach is the best. In case of Gaussian noise the wavelet based approach is found the best denoising method. For any complex type of noise it is found that the multifractal approach is the best method.

TYPES OF IMAGE

Image can be classified based on many criteria (Sridhar, 2011) as shown in Figure 1.

- Based on attributes

Images can be broadly classified based on attributes, as raster images and vector graphics. Raster images are pixel based however vector graphics use basic geometric attributes such as lines, circle, rectangle etc.

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