

Review of Image Denoising Methods using Satellite Images

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Abstract: In many fields the usage of the images for the application purpose is becoming very popular nowadays. The main problem is that the removal of the noise from the original image. The process of adding and removing a noise to an original image and removing the noise by means of denoising algorithm is said to be as the image denoising. Many a type of satellite image denoising methods have implemented before and some of their methods are reviewed in this study. Also, some of the different types of noises used for noises are also discussed in the study. The performance of each algorithm is analyzed by calculating the PSNR values.

Key words: Image denoising, PSNR, noise, performance, analyzed, satellite

INTRODUCTION

Digital image plays a vital role in our day to day life and also in the area of research and technology. Generally, when the image is sent from one place to the other, some of the transmission noises are introduced to the images. Some of the generally, used noises are additive white gaussian noise, salt and pepper noise, speckle noise, etc. Based on the image quality degradation percentage the noise removal algorithms are selected and used. Among them some of the algorithms are wavelet transform based image denoising, filter based denoising, etc. All the types of noises and its denoising algorithms are discussed further.

MATERIALS AND METHODS

Types of noises in image denoising: Noise is an unnecessary signal that alters the performance of the output signal. Some of the noises used in image denoising are discussed.

AWGN noise: Additive White Gaussian Noise (AWGN) is a normally used noise model (Lukac, 2008) as it is more sophisticated than other noise models and is popularly used. This additive noise is independent among the image components and also corresponds to the realizations of Gaussian noise without losing the generality and is modeled as having the same level of equal standard deviation of noise in every channel as by Rubel *et al.* (2015). This AWGN noise removal has a better performance over the filter based orthogonal transforms.

Salt and pepper noise: The salt and pepper noise is a basic noise present by Gonzalez and Woods (2002) images that is separated by a random distribution of black and white spots. This noise is caused due to the impulse noise generation present in channel transfer, signal decoding and sensor collection process. This noise usually doesn't have statistical features of distribution and is difficult to describe it in the mathematical models. Till now a traditional median filter algorithm is as same as the main method (Florencio and Schafer, 1994). A non-linear filtering algorithm has a good advantage in the process of salt and pepper noise pollution suppression.

Speckle noise: Speckle noise is a noise (Vishwa and Sharma, 2012) that is generally a multiplicative in nature in which the despeckling procedure becomes a little difficult as like most of the denoising methods that are based over additive noises. Speckle noise is usually modeled as the multiplicative noises, so that, the consequential signal is the result of original noise and speckle signal. This noise can be described by the pixel values that are multiplied by random values and hence, it is called as a multiplicative noise. This noise is sometimes a big problem in the field of radar applications (Singh and Shree, 2016).

Types of denoising algorithm: In the satellite, image denoising process the denoising algorithm is the most important as they play a major role in the denoising step and also it generates the outputs according to the corresponding algorithms used. Some of the majorly used denoising algorithms are discussed.

Wavelet transform based image denoising algorithm:

Some of the wavelet based image denoising algorithms are DWT and DCT Wavelet algorithm. WT is said to be as the illustration of the image as a sum of wavelets having a diverse scales and locations. When an image is decomposed by using wavelets, it comprises two frequencies namely, the higher frequencies and the lower frequencies.

DWT and DCT: When the wavelets are sampled discretely it is said to as DWT and is a multi resolution decomposition structure. By using the DWT, the original image is decomposed into high frequency and a low frequency sub-band (Kanika and Sharma, 2012).

A 2D DCT is given for each low resolution image and is decomposed by the cosine waveforms. The DCT is applied to each block that produces one AC coefficient and one DC coefficient (Dehuri *et al.*, 2015).

Filter based image denoising algorithms: Some of the filter based image denoising algorithm that is used frequently is as discussed. Some of the denoising filters are spatial filter, linear filter and non-linear filter.

Spatial filter: A habitual way for the removal of noise from image data is employed by spatial filters (Jain, 1989). This type of filter is used for cleaning the lasers output, damaged optics and also for removal of aberration of the beam. This filter is further divided into linear and non-linear filters.

Linear filter: The linear filter is a process of producing the output signal from a time-varying input that is subjected to constraint of linearity (Panda and Jena, 2016).

Non-linear filter: Non-linear filter has many applications like removing of specific types of noise that are not additive in nature (Panda and Jena, 2016). Usually, the spatial filter removes the noise at a reasonable extent but due to the blurring images it makes the edges visible as in the pictures invisible.

RESULTS AND DISCUSSION

The results for the proposed system for the satellite image denoising process are discussed and some of results are compared and shown. Table 1 shows the overall PSNR values for the wavelet transform and filter

Table 1: PSNR comparison of various denoising algorithm based on different noises

Types of noises	Wavelet transforms		Filter algorithms		
	DWT	DCT	Speckle	Linear	Non-linear
AWGN	45.8	45.89	44.6	44.7	44.65
Speckle	47.6	47.20	48.4	48.6	48.80
Salt and pepper	49.8	49.82	49.2	49.5	49.65

based denoising algorithms corresponding to the noise that are stated above. All the PSNR values for the denoising algorithms are shown as for a satellite image inputs. The results are obtained from the satellite image of a city picture.

CONCLUSION

This study is a review discussion of the satellite image denoising algorithm and different types of methods used in it. Various types of noises like AWGN, speckle and salt and pepper noises and denoising algorithms like wavelet transforms and filter based denoising algorithms are explained and its PSNR comparisons for each algorithms over the noise for the satellite images are shown and explained.

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