Noise Removal in Lung Cancer Images: A Survey

D. Jyoshna P. Saritha G. Amani
Asst Professor Asst Professor Asst Professor
Dept of EEE
Sree Dattha Institute of Engineering and Science

ABSTRACT

Lung cancer is the most prevalent kind of cancer, specifically affecting the pulmonary nodules in the lungs. The likelihood of survival from lung cancer is lower compared to other diseases. Therefore, early diagnosis of illness is crucial. In order to detect at an early stage, we utilize CT (Computed Tomography) scanning. Due to its effectiveness in detecting diseases, every second is crucial while using this scanning procedure. Efficient scanning produces a clear image of the components without any interference, in contrast to regular scanning. CT scanning exhibits lower levels of noise when compared to other scanning modalities. This study will explore many types of noise and the corresponding filtering strategies used to eliminate them.

Index Terms – Filtering techniques, CT Scan, Pulmonary nodule, Filters, Noise minimization.

1. INTRODUCTION

Noise in an image is an unwanted after-effect of a Computed Tomography (CT) scanned image that contains the important data which is useful for further analysis. Noise becomes a presiding part during the transmission of medical images, which degenerates the quality of an image and unintentionally will inhibit the important details. Hence removal of noise is the major intention in the processing of an image. For the better examination of the CT scan image, removing the noise is most crucial. Ocular noise is there in all CT scan images. Noise in an image is a dissimilarity of illumination or color details in the images, and is the characteristic of electronic noise.

Image noise can be generated by the circuitry used for image capturing from the patient. The existence of noise will degrades the quality of an image and the details too. Hence elimination of the noise plays a crucial role in understanding the important information from the CT scan images. In a CT scan image, the noise is measured via the SNR; comparing the level of desired photons to the level of background pixels deviating misleading from normal. The smaller noise will be due to higher value of SNR ratio. There are different types of noises in a CT scan image: Gaussian or Amplifiers noise, quantum noise, speckle noise and shot noise. Quantum noise and Electronics / Detector noise are the two major sources of ocular noise in the CT scan image. Hence the study of each noise most important.

2. BACKGROUND THEORY AND STUDY

Image processing modalities allows the radiologist to look at different levels of the lungs using X-ray beam. Computed Tomography (CT) is performed on a multislice spiral CT scanner and can detect cancer or smaller nodule or tumor. A nodule is a mass of cells that grows on the lungs. Initially the CT scan image is having visual noise and it should be removed for better analyzing.

Sarah Taghavi Namin [1] have proposed a system which detects the pulmonary nodules in the early stage of cancer by using a computer aided diagnosis system for detecting nodules automatically. Here, Gaussian filters have been applied for noise removing and nodule magnification.

Bum-chae kim [2] have proposed a novel method which identifies the nodules in a Computed Tomography scanned image of lung. The deep learning technique used here is extracting the required information from a pulmonary nodule image.

An algorithm has been proposed [3] for removing digital images impulsive noise. This

algorithm removes the noise from the Computed Tomography image.

V.R. Vijaykumar has been proposed an efficient and fast algorithm wherein Gaussian noise is being able to be reduced based on the number of damaged pixels in the image. Bilateral filters shows more blurring than the proposed method and trilateral filters adopted which are poorly performed. [4]

For removing impulsive noise, two different algorithms [5] are implement, blind imprinting and 10 minimization. These two algorithms proved abortive in random valued impulsive noise.

A Denoising algorithm [6] has been implemented based on the thresholding. But, the algorithm has been failed when the noise level is up to 20 and window size is 7*7. The performance is decreased for higher values of noise.

Another technique by Wu suiyuan [7] , based on shape features, which recognizes the nodules by using interpolation process, searching the corrupted area and identification.

Another technique proposed by Sunyi Zheng [8], a convolutional neural network technique takes the corrupted pixels in the maximum intensity projection using different thickness.

3. DIFFERENT NOISES AND CANCELLATION

GAUSSIAN NOISE: This is the noise with Gaussian amplitude, it was resulted due to poor illumination during capturing or high temperature, and there is another is to occur this noise is due to electronic circuit. And this noise is random noise and results blurred by frequency components which equally proportioned.

$$Eq\ 1:\ P_j(X) = \frac{1}{\sigma\sqrt{2\pi}}\bar{e}\frac{(X-\mu)^2}{2\sigma^2}$$

IMPULSIVE NOISE: The short duration noise is an impulse noise. They are resulted high sensor temperature or atmosphere distortion while transmitting. This noise is randomly spread in the images instead of correlated with the pixels, means it doesn't affect the all pixels of a scanned images, it affects only some pixels of the image. And impulsive noise is of two types

Salt and pepper noise: This noise takes either value of salt or paper that is either of -255 or 0, that means either black or white spots will be appear on the image.

Random noise: This noise does not particularly affect the pixels of the input image, this noise spread randomly throughout the image like Gaussian noise.

POISSON NOISE: The other name of this noise is photon noise is because of number of protons which are sensed by an exposure. Due to this, photons will result spatial and temporal randomness.

$$Eq\ 2: q(f_{(qi)}) = \frac{\lambda^k ie^{-\lambda}}{k!}$$

Speckled Noise: Is also referred as a random noise, this was resulted by ultrasonic imaging.

$$Eq\ 3: f(m,n) = g(m,n) * V(m,n) + \zeta(m,n)$$

m and n are the axial of an input image.

NOISE CANCELLING: The procedure of cancelling noise is eliminating noise in CT scanned images. It gives high quality output with less noise. And CT scanning images gives s very particular details; to keep the details is very much important. So, the corresponding noise reduction technique should remain the same result.

Noise can be any type, the filtering technique which eliminates the noise from an image of CT scanning. Based on the type of noise filtering techniques are existed. Filtering technique is nothing but applying algorithm on the pixels of an input image. Some set of pixels defined as a pixel neighborhood and the filters are of two supra linear and nonlinear filters.

Linear smoothing is a mostly used method in linear filtering. This filter replaces every pixel with the convolution is represented by

Blurred technique is one of the linear filtering techniques and is a fastest blurred algorithm; even it is fastest but having a conflict of it doesn't perform smoothing. This was based on the fact that a rectangular window divides it into two columns. First, this has no smoothing functions; we used Haarwindowing technique which is having smoothing function.

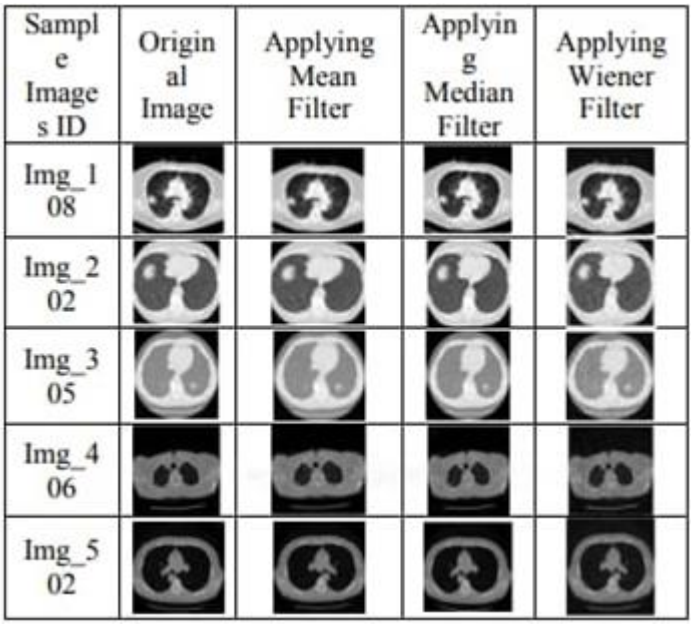

Fig: After applying filters on sample CT scan images

There is another type of filter like Gaussian filter, mean filter and median filter. In those, the first one is Gaussian filter; it divides or decomposes the given input image into two equal parts of rows and columns. Mean filter is very simpler filter, it performs smoothing on an image successfully and can also reduce the noise. The next filter in our survey is median filter; it is a non linear filter where as mean filter is linear filter. In this, non linear filter result is the median value of the given input image of array values.

4. CONCLUSION

Lung tumor is a very typical disease. The cells grow vastly in tissues of lung. The death rate due to lung cancer is very high. So detecting of this cancer at the starting stage is very much important. The detection at the starting stage saves many people who are suffering with lung cancer. For this, in this paper we studied and presented survey on how the different filtering technique removes the noise and how it gives effective result.

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