ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

CT and MRI Denoising Technique from corrupted Riccian and Gaussian Noise.

Baron Sam B*, Yuvashree S, and Piosajin A.

Faculty of Computing, Sathyabama University, Chennai, Tamil Nadu, India.

ABSTRACT

MRI and CT SCAN images play a important role that deals with detection of various diseases in patients but they confront the issue of Gaussian noise, Riccian noise and motion blur. Etc. The Denoising of images is the process of removing the noise from the image that are naturally corrupted by noise. Image restoration deals with bringing back the distorted image into to its original state. Hence our hybrid and spatial restoration method is constrained by the anatomical information extracted from a high resolution procedure such as MRI and CT. Our approach focuses on removal of noise methodologies in images with an in the area of denoising.

Keywords: MRI, CT, Denoising, Restoration

Corresponding author

INTRODUCTION

CT [computed tomography] and MRI[magnetic resonance imaging] scans are mostly used in diagnosis of medical Images.MRI imaging is mostly preferred over CT imaging processing due to better high contrast and safety. CT scanning of the abdomen has some drawbacks such as radiation burden, low contrast due to beam hardening. Inspite of all these limitations CT continues to be one of the main diagnosis tools of the head pathology as an alternate to the MRI.MRI scan is an best solution for claustrophobic patients who are unable to remain motionless during examination. Noise is such that it is an common problem in most of the medical images. Lots of studies have shown that the noise on **CT** images is found to be the additive **Gaussian** and on **MRI** it is **Riccian**. Due to the presence of noise even the experts with sufficient experience may not be able to draw right and helpful data from the pictures. Our main approach is that here the noise is filtered and image restoration is done without affecting important features of the image. It has two main sub processes that are named as degradation and restoration model respectively and they are discussed below.

Image Restoration

Image restoration is that it focuses on recovering an original image from a degraded image. The degraded image is that it can be a result of a Known or unknown degradation. Hence image restoration can be defined as a process of recovering a sharp image from a degraded image which is blurred by a degradation function.

The process of image restoration includes two sub processes. The first process deals with degrading the quality of the image by adding blur and noise to an image and second one deals with removing noise and blur from the degraded image and we can recover the original image.

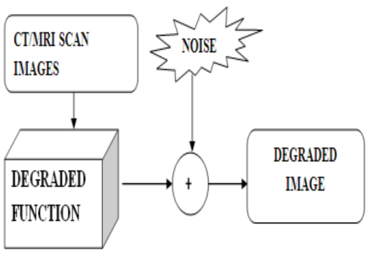


Figure 1: IMAGE RESTORATION

DEGRADATION MODEL

The image is blurred by using the degradation function and the additive noise. Such that, the degraded picture is represented by the mathematical statement

$$G = H * F + n$$

In this equation, G is the image that is degraded, H is the function of degradation, F is original image and n is an Additive noise.

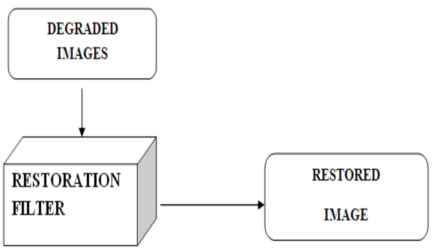


Figure 2: Image Degradation

RELATED RESEARCH WORK

Ranjbaran et al. Springer Plus (2015**)**: has recommended Laplacian-based image filtering system. Utilizing a local noise estimator capacity in an functional energy minimizing scheme it shows that, Laplacian that is known as an edge detection capacity can be utilized for commotion evacuation applications. This algorithm is implemented on a 3x3 window and they are easily tuned by number of iterations. Denoising of image is simplified to the reduction of their pixel esteem with their related Laplacian quality weighted by the local noise estimator. The smoothness is controlled by number of emphases. The quality of noise of the introduced method is compared and evaluated with some classic algorithms like Total Variation based filters and wiener for Gaussian noise

Aleksandra Pizurica (March 2003): has proposed efficient and method for commotion separating in MRI images and ultrasound images. This algorithm is such that it adapts itself to the various types of image noise, it involves a adjustable parameter "K", whose value is chosen as per the image modality. For the ultrasound images (speckle noise) K=3 and for MRI images (Riccian noise) K=2. The proposed system is of low many-sided quality, both in its usage and execution time but the disadvantage of this method isConventional discrete wavelet transform based denoising presents antiques during denoising of Images containing smooth curves and curved edges.

Shashikant Agrawal(sep 2012):has proposes a algorithm named as medical image denoising algorithm using (DWT)discrete wavelet transform.The DWT of image produce a image representation which provides excellent spatial and spectral localization of image.To evaluate performance of wavelet algorithms we implement three error criteria's are 1)Mean SquareError(MSE)2)MeanAbsoluteError(MAE)3) PeakSignaltoNoiseRatio(PSNR).The disadvantage of this method is that the result is poor for smooth curves and edges.

Antoine Leory (2004): This paper describes about the features of CT scan and allows the surgeon to perform 3D diagnosis, preoperative planning.we use two filters.1) The preprocessing of CT slice is done with the help of sobel gradient filter.2) The sticks filter is used for the removal of speckle noise from the ultra sound images.The disadvantage is that Satisfactory results were not obtained for IA slices. IA slice means the kidney at about 10mm in translation and 10 deg in inclination from the solution.

Sonali Patil (2012): The median filter is used for the preprocessing of the image .Here the morphological erosion operator is then applied and sobel edge detection is applied. After the edge detection, watershed segmentation is applied. The median filter used, removes all the film artifacts and removes the salt and pepper noise. The erosion operation reduces the effect of ribcage portions in the abdomen CT images. The Limitation in this paper is that they use Median filter in which it fails to remove the additive Gaussian noise and It also alters the pixel gray values not disturbed by noise.

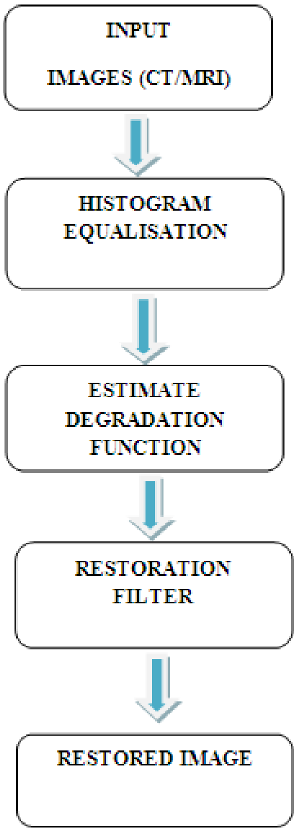
P.natarajan (jun-2013): This paper proposes a thresholding based segmentation of kidney from the abdominal CT images. Here Histogram equalization is done to alter the picture's power and to upgrade the picture's complexity to get the unmistakable and improved picture. High pass separating is utilized to evacuate or diminish high spatial recurrence clamor from the picture.Finally Morphological operation is done to extract the segmented output. The drawback in this paper is that Thresholding will lead to loss of vital information since a single threshold value is used for the segmentation and Preprocessing can be done by filters with high PSNR value compared to high pass filter.

Daw-Tung Lin(2006):In this paper the median filter is used to remove the spike like components.The kidney region is obtained based on geometrical location, statistical information, & anatomical knowledge.such as the abdominal boundary detection, spine landmark location, positioning of kidney regions is done ,here Adaptive region growing technique is used to segment the kidney from the abdominal image.The disadvantage in this method is that they use Median filter which alters the pixel gray values not disturbed by noise.

Shuiping Gou (2013): Hazy organ limits and delicate tissue structures show a noteworthy test in biomedical picture reclamation. The CT image sequences are decomposed in to sparse component and low rank component. Here the primary driver of debasement in restorative CT pictures is the blemished determination of the imaging framework. Weiner channel is utilized to productively uproot obscure in the inadequate part; a wiener separating with the Gaussian PSF is utilized to recoup the normal picture of the low-rank segment. The restoration results are with higher contrast, sharper organ boundaries and richer soft tissue structure information.

M.kiddo: A picture rebuilding strategy utilizing Iterative Blind Deconvolution His system evacuated an obscure by assessing the Point Spread Functions (PSF) of Chest X-beam Photography consequently. The Chest-XP contains an obscure in the rule of taking pictures. The traditional strategy uproots an obscure by measuring an apparition picture or utilizing the visually impaired Deconvolution. Be that as it may, these were issues that an apparition picture ought to be definitely taken, or the parameters of assessment capacity are exactly and physically given.

ARCHITECTURE DIAGRAM



METHODOLOGIES

Input Image

Mat lab can process images of format such that they may be of (jpeg, bmp) formats. Here, we take medical images as our input (i.e., CT and MRI scan images).Each pixel is a 3-dimensional vector values with range [0,255]. These numbers are helpful in identifying the amount of Red-Green-Blue (RGB).So a color image is really 3 gray scale images.

When displaying a single channel, Mat lab likes to use the red-blue jet colormap but now we change it to a gray scale colormap type: Colormap gray;

Adaptive Histogram Equalization

As an alternative to histogram equalization, we are performing contrast-limited adaptive histogram equalization (CLAHE) using adapthistequalization function. While histogram equalisation works on the entire image, adapthistequ operates on small regions in the image called tiles. After performing the equalization, adapthistequ combines neighbouring tiles using bilinear interpolation method to eliminate artificially induced boundaries. Adapthistequ produces a yield picture having values equally conveyed all through the extent.

Degradation Function

Image restoration algorithms are intended to abuse characteristic of a signal and degradation, accurate information of the corruption is key to build up an effective picture reclamation calculation. There are two ways to deal with acquire data about degradation.

APPROACH 1: It is to assemble data from the degraded image itself. Here, we can identify the regions in the image $b(n_{1,}n_2)$.It is to accumulate data for particular region of the images as $f(n_{1,}n_2)$and the degraded img in the same region as $g(n_{1,}n_2)$. Then point is roughly related by

$g(n_{1,}n_2)=f(n_{1,}n_2)*b(n_{1,}n_2)$ (5.3.1)

Since $f(n_1,n_2)$ and $g(n_1,n_2)$ are assumed known $b(n_1,n_2)$, can be estimated from (5.3.1). If $f(n_1,n_2)$ is the impulse ,then $\delta(n_1,n_2)$, $b(n_1,n_2)$ is given by $g(n_1,n_2)$

APPROACH 2: To obtain the study so as to learn about corruption is the system that brought on the degradation.

For example For example, let's assume that there is no corruption in the imaging framework aside from the movement obscure, we can now express the degraded image $g(x,y)$as

$$g(x,y)\frac{1}{T}\iint_t^{T/2} = -T/2 f(x-x_0(t),y-y_0(t))dt$$
(5.3.2)

Where $X_O(t)$ and $y_O(t)$ represent the horizontal and vertical translations of $f(x,y)$ at time t relative to the imaging system, and T is the exposure duration. The Fourier transform domain, (5.3.2) can be defined as:

$$g(\Omega_{x,},\Omega_y)=\int_x^{\infty} = -\infty \int_y^{\infty} = -\infty g(x,y)e^{-j}e^{-j}$$
$\Omega_x x_{e-j}\Omega_y ydxdy$ (5.3.3)

Where $g(\Omega_{x,}\Omega_y)$ is the Fourier transform of $g(x,y)$.Simplify (5.3.3), we obtain

$g(\Omega_{x,}\ \Omega_y)=f(\Omega_{x,}\ \Omega_y)b(\Omega_{x,}\ \Omega_y)$ (5.3.4a)

From (5.3.4), it is clear that the planar movement obscure can be seen as convolution of $f(x,y)$ with $b(x,y)$ whose the Fourier transform $B(\Omega_{x,}\ \Omega_y)$

$$b(\Omega x, \Omega y) = \frac{1}{T}\int_{-T/2}^{T/2} e^{-j}\,\Omega_x X_0(t)e^{-j}\,\Omega_y y_0(t)dt.$$
(5.3.4b)

is defined by (5.3.4b). The function $b(x,y)$ is sometimes referred to as the blurring function, since $b(x,y)$ typically is of blurs and low pass character the image. It is likewise alluded to as the point spread function, since it spreads an impulse. At the point when there is no movement ,such that $x_0(t)=0$ and $y_0(t)=0$,$B(\Omega_{x,}\Omega_{y)}$ is 1 and $g(x,y)$ is $f(x,y)$.If there is straight movement along the x heading so that $y_0(t)=0$ and $x_0(t)=kt$ then $B(\Omega_{x,}\Omega_{y)}$ in (5.3.4) reduces to

$$B(\Omega_{x,}\ \Omega_{y)} = \frac{sin\frac{\Omega x\ KT}{2}}{\frac{\Omega x\ KT}{2}}$$ (5.3.5))

A discrete image $g(n_{1,}n_2)$ may be approximately modelled by

$G(n_{1,}n_2)=f(n_{1,}n_2)*b(n_{1,}n_2)$ (5.3.6)

Where $B(\omega_1\omega_2)$ the discrete-space Fourier transform of $b(n_{1,}n_2)$, is the aliased version of $B(\Omega_{x,}\Omega_{y)}$ in (5.3.4 b). Different examples in which the corruption may be evaluated from its system incorporate film grain clamour obscuring because of diffraction-constrained optics, and spot commotion.

RESTORATION FILTERS

Bilateral Filter

The bilateral filter is such that it is an nonlinear filter technique in which it does spatial averaging without smoothing edges and it is an effective image denoising technique. It likewise can be connected to the blocking ancient rarities lessening. A crucial issue with the utilization of the reciprocal channel is the channel's determination parameters, which impact the results basically. Another investigation enthusiasm of respective channel is increasing speed of the calculation speed. There are three principle commitments of this postulation. The first contribution here is an empirical study of the optimal bilateral filter parameter selection in image denoising, where bilateral filtering is applied to the low-frequency sub-bands of a signal decomposed using a wavelet filter.

The second contribution is that we present a spatially adaptive method to reduce compression artifacts.The test outcomes demonstrate that the versatile strategy can enhance the quality of restored images essentially better than that of the standard bilateral filter.

The third contribution shows an improvement of the fast bilateral filter, such that here, we use a combination of multi windows to estimate the Gaussian filter all the more accurately.

Non-Local Means method

Efros and Leung were created the idea of self-comparability for surface amalgamation. A case of self-likeness is shown in Figure underneath. the vast majority of the pixels in the same section as p will have comparative neighbourhoods to p's neighbourhood. The self-similitude suspicion can be abused to denoise a picture. Pixels with comparable neighbourhoods can be utilized to focus the denoised estimation of a pixel. Each pixels *p* of the non-local means denoised image is then estimated with the following formulae:

NL (V) (p) $=\sum_{q:v} w(p,q)V(q)$

Such that, here *V* is the image that are noisy, weights are represented by *w(p,q)* and it meet the following conditions

$0\leq w(p,q)\leq 1$ and $\sum_q w(p,q) = 1$

To figure the closeness between two neighbourhoods take the weighted squares contrasts entirety between the two neighbourhoods by recipe

$d(p,q)=(V{:}N_p)V(N_q)b^2,F$

F is the neighbourhood filters that are applied to the squared difference of the neighbourhoods and The weights are computed using the following formula:

$W(p,q)\text{-}z^{1}(P)\ e^{-d(p,q)}z(p)$ is the normalizing constant that are defined as $z(P)\text{-}\sum_{q} (e)^{d}{}_{N}{}^{(p,q)}$ where *h* is that weight-decay control parameter. As we mentioned, *F* is the neighbourhood filter with radius which is specified as *Rsim*. The weights of *F* are calculated using the following formula:

$$\frac{1}{Rsim}\sum_{i=m}^{Rsim} 1/(2*i+1)^{2}$$

Here, m is the separation the weight is from the focal point of the channel. The channel gives more weight to pixels close to the focal point of the area, and less weight to pixels close to the area's edge. From above has an exceptional situation when q = p. This is on the grounds that the weight such that w(p,p) can be much be more vital than the weights from each other pixel in the picture. By definition this bodes well in light of the fact that each area is like itself. To keep pixel p from over-measuring itself let w (p,p) be equivalent to the most extreme weight of alternate pixels, or in more scientific terms

$W(p, p) = \max \{w(p, q) \mid p \neq q\}$

CONCLUSION AND FUTURE SCOPE

The medical image denoising is very sensitive and hence their restoration is done at maximum level. The images are pre-processed by using histogram equalization restoration filtering are implemented to remove noise from images**.** our main approach focus on the noise that are filtered and image restoration is done without affecting important features of the image and bringing back distorted image into to its original state which is very helpful in examination of medical images.

In future, further enhancements can be done in other medical image that suffers from other types of noises.

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