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F-Test and One-Way ANOVA for Medical Images Diagnosis

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Abstract

This paper introduces a new method for the discrimination of impulse noise in medical MRI images. Statistical F-distribution by means of Monte Carlo simulation for forecasting the location of Impulse noise on distorted images is employed. The adaptive noisy pixels are identified as noisy using One-Way ANOVA hypothesis method while the rest of the noisy pixels are selective noisy pixels. Thus, the statistical prediction method is used to predict the noise location on the test images. The distorted portions in the images predicted by this structure are then made better by applying a right kind of nonlinear filtering. The nonlinear median filter is advisable for demonstrating a suitable way of the replacement of the degraded pixels. The filter is not applied to the not-detected regions of the image to remain the same so that delicate details and edges are not spoiled. Experimental results enhanced this structure as it is compared to the classical noise reduction structures.

Keywords: F-Distribution, Image Processing, Monte Carlo Simulation, Nonlinear Filters, MRI images, Medical Image Processing

1. Introduction

MRI is a popular diagnostic tool in medicine and is defined as a technique for creating detailed images of the internal human body (Wangaryattawanich *et al.*, 2023; Mcclintock *et al.*, 2017; Kubik-Huch *et al.*, 2020). Nevertheless, the MRI images can be contaminated with noise which degrades the diagnostic accuracy. To enhance the analysis and signs' recognition based on MRI, scientists have proposed various techniques separating noises from useful signals. Of the approaches applied four of them are described: the Statistical F-Distribution method. The following essay seeks to describe the Statistical F-Distribution technique for the differentiation of noise in brain MRI images (Parlak *et al.*, 2023).

The Statistical F-Distribution is derived from such an F-test, which is the statistical test utilized for comparing variances of two samples. The F-test is useful for comparing the variability of noise in anatomical images relating to MRI to the signal which is relevant or useful information. The F-test looks at the variation between the noise and the signal by deriving the ratio of the two variance values. High value of ratio mean that the noise is strong and signal is week or in other words, signal to noise ratio is low. On the other hand, they included that if the ratio is low then it means that the signal has dominated and the noise are is week (Panerai *et al.*, 2023; Srinivas *et al.*, 2023).

MRI scan analysis involves applying the F-test on the image divides it into regions of small areas. Next, the variance of the noise and the signal in each region is obtained. Therefore, the ratio of the variances is computed using the F-test. Namely, if the rate exceeds a specific number the region can be considered affected by noise. Still, the region is assumed to be free of noise in all other cases.

The Statistical F-Distribution method has the following advantages over other methods; (Zhou *et al.*, 2023). First of all, it belongs to a group

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of non-parametric techniques, that is, it does not presuppose any assumptions about the distribution of the data. Second, it is computationally efficient; therefore, the method can process large amounts of data. Third, it is quite responsive to small changes in the noise level, and therefore suitable for discernment of noise from the signal.

The statistical F-Distribution is very effective in filtering the noise from the images of the brain MRI images among other applications. This is a non-parametric and computationally simple method, which is, at the same time, very sensitive to changes in the noise level. The proposed method can be applied to enhance the prediction of MRI image analysis and therefore the treatment of various diseases. Further work has to be made by researchers, in order to refine and extend this method, in terms of increase of efficiency and versatility (Li *et al.*, 2023).

Subsequently, in the era of extensive use of images in various fields, analysis and forecasting of image noise needs to be well-understood. Image noise on the other hand is defined as image noise is variation in pixel intensity that one wants to remove and these makes the quality of the image low (Gonzalez, 2018). In order to deal with this, researchers resort to statistical analysis tools often referred to as One-Way Analysis of Variance (ANOVA). In this paper, the writer desires to discuss One-Way ANOVA and its placement in image noise prediction. Furthermore, it goes further to detail on the use of One-Way ANOVA in identifying the effects of various factors on image noise, real life examples and pros and cons of the One-Way ANOVA model as a predictive measure for image noise.

2. Medical image diagnosis

Medical Image Diagnosis is a vital component of healthcare since it is vital for diagnosing clients using images. Appropriate diagnosis of the medical ailments through the use of various imaging techniques has enhanced the standard of health in the past years (Wang *et al.*, 2023; Narayan *et al.*, 2023; Hussain *et al.*, 2023; Shu *et al.*, 2023). Magnetic Resonance Imaging or MRI is one of the most commonly used imaging techniques. The benefits of this technique will be the focus of the paper with the ability of MRI in diagnosing medical images being among them.

First of all, MRI is a noninvasive imaging technique and does not involve the utilization of ionizing radiation, which might affect the patient's health dangerous compared to such imaging techniques as X-ray and computer tomography. Due to this it becomes ideal for patient who would require many imaging or the patient who has a sensitive skin to radiation (Rao, *et al.*, 1973).

Secondly, MRI provides effective differentiation between soft tissues, which in turn makes it useful in the diagnosis of numerous diseases including tumors, injuries affecting joints, and brain illnesses. MRI produces images that are very precise and thus enables the doctors who are handling the images to diagnose the patients and recommend the right treatment for the injuries that ails a specific patient.

Similarly, diagnostic technology like MRI has also advanced and current MRI units provide better image quality, shorter scanning times and better detailed images are obtained. This is because it means that in a case, doctors are able to diagnose some medical conditions within a short span and with a lot of precision therefore decreasing the incidences of conducting invasive diagnostic procedures.

Last, MRI is a comprehensive imaging used in the diagnosis of numerous diseases' involving the neurological, cardiovascular, and musculoskeletal systems. This makes it useful to be implemented in the practice of doctors in various specialties of medicine (Wang & Bovik, 2006).

In conclusion, medical images are perfectly served through MRI and therefore can be recommended as an effective imaging modality in the diagnosis processes. It is not invasive, provides good contrast of soft tissues, provides highly detailed images and thus can be applied in the diagnosis of numerous diseases. Thus, MRI is recommended for use as the first-choice method when differentiating diagnoses through medical images are needed.

3. MRI scanning images

Medical imaging is the use of techniques on the human body to acquire images of internal body organs and other structures and MRI scanning is a modern and advanced imaging technique currently in use. MRI is a painless imaging technique that employs the use of powerful magnets and radio waves to take images of the body's internal structures. The paper aims to analyze the positives of applying MRI in medical image diagnosis (Smith & Hillis, 2020).

An important strength of MRI is its capacity to provide very clear images of the Interior of the body. Unlike other image modalities such as X rays, CT scans MRI offers a better view of the body organs and tissues, thus making them easier for the doctor to identify an ailment and its severity. Also, MRI as technology does not require the use of ionizing radiation hence safer for the patient as opposed to other imaging modalities (Weiss *et al.*, 2010).

On the same note, MRI is also beneficial in that it is a very flexible imaging choice. MRI can take pictures of any body structure and location, head and neck organs, brain, spine, heart, and joints, among others. The technique is very advantageous in diagnosing conditions that are quite common in soft tissues like tumors, cysts, injuries to the ligaments as well as tendons.

However, it is also possible to give MRI snapshots of the body's blood vessels without having to rely on surgical operations. This technique is called Magnetic Resonance Angiography (MRA) allowing depicting the blood vessels and facilitate the diagnosis and treatment of, for example, aneurism, arterial stenosis and thrombi (Zhang & Dong, 2023; Bhuiyan *et al.*, 2023; Sarker *et al.*, 2023; Raja *et al.*, 2023).

MRI is recognized as one of the most progressive techniques of imaging and has several obvious benefits before other methods of pictorial presentation of the inside of the bodies. MRI takes images of the body tissues; is non-invasive, and is very important especially when imaging the body vessels thus very important in imaging the entire body. For these reasons MRI is a very important tool when treating and diagnosing many diseases. Therefore, a constant search and improvement of this method needs to be carried out.

4. Statistical analysis of images

Statistics are the basic necessity for assessing images as it is an integral element for images. It means that images can be described with the help of entropy and other characteristics connected with the distribution of the presented pixel values. These distributions can be used to detect type of the image and also to detect any anomaly in the image or any pattern in the image (Liu *et al.*, 2023; Chen *et al.*, 2023).

It is known that one of the distributions used often is the histogram that captures the frequency of the pixel values in the image. From the histogram one can learn more about the brightness and the contrast of the picture, and certain signs, if any, of the picture. For instance, there are characteristics where an image has high average pixel intensity and low frequency values primarily located at the low end of this histogram; this suggests that the picture was probably taken in low light conditions. On the other hand, if there is high histograms frequency response located at the mid-range of the histogram, then this is suggesting that the image is well ilite and has a good exposure (Dhar *et al.*, 2023).

Another equally important distribution is the Gaussian distribution which is used to model noise in an image. It is also worth to note that Gaussian noise arises from different sources such as: sensor noise, atmospheric interference and others. This way, the noise in the image can be modeled and subsequently eliminated so as to improve the quality of the latter.

Besides these distributions it is further possible to use almost all known statistical methods for the analysis of pictures. For instance, one of the statistical techniques known as principal component analysis (PCA) is used to look for patterns in an image while another one known as cluster analysis is used for classification of the like pixels.

Altogether, image statistical analysis is a very effective method that can be used to analyze different phenomena of interest. Thus, learning statistical characteristics of images helps to develop awareness about environments and obtain better decisions (Ghosh *et al.*, 2023).

5. F-distribution

Image processing is one of the most important fields in telecommunication technology or digital media and it can be defined as the process used to change or in some cases improve digital images by applying mathematical and statistical methods. Speaking about the mathematical tools being used in image processing, the F-distribution can be named among the most important ones. This distribution can be used to give a measure of spread between two sets of data and is a core component in image processing (Weisstein, 2002; Yoshimitsu *et al.*, 2023).

F-distribution is used in statistical analysis used in analysis of variance or ANOVA and regression analysis business. It is a ratio of two chi-squared distributions and used to compare two variables whether they have equal variance or not. In the field of image processing, the F-distribution is used in testing the variance of two set of values that maybe pixel intensity of two images. For example, if we wish to determine whether the two image values' variability, or variances, are significantly different, such as when comparing image sharpness, we employ the F-distribution (Spangl *et al.*, 2023).

In addition, the F-distribution is also employed in image compression where it has a major role in making the size of an image file very small but with good quality. Thus, to estimate the correlation and mean square errors and, ultimately, the block size of image compression, the F-distribution is used. The block size is selected with respect to F-ratio of between blocks sum of squares and within blocks sum of squares (Zhou *et al.*, 2023).

F-distribution is a statistical test that finds great utility in image processing solutions. It is the measurement of comparison between two sets of data and it forms an integral part of signal processing particularly in image and video processing. Hence, there is a necessity for the researchers and practitioners in the field of image processing to acquaint themselves with the F-distribution and its uses (Weisstein, 2002).

Many years ago, statisticians were able to prove that the population of ratios of variances of two samples coming from a normal population are the same. It is therefore not surprising that over the intervening years statisticians have discovered that the ratio of sample variances collected in several different ways is distributed according to the F-distribution. Since, the sampling distribution of ratio of variances, is known we can perform hypothesis test on the ratio of variances.

A distribution which turns out to be a continuous statistical distribution when performing a test about the variances of two observed samples. Let x_m^2 as well as x_n^2 independent variants be distributed in accordance with the chi-square law with m and n Freedom.

Define a statistic $F_{m,n}$ as the ratio of the dispersions of the two parameters distribution Eq. (1):

$$F_{m,n} = \frac{x_n^2/n}{x_m^2/m} \tag{1}$$

This statistic then has an F-distribution on domain $[0.\infty)$ with probability function $f_{m.n}(x)$ and given by Eq. (2):

$$f_{m.n}(x) = \frac{\Gamma\left(\frac{n+m}{2}\right) n^{n/2} m^{m/2}}{\Gamma\left(\frac{n}{2}\right)\Gamma\left(\frac{m}{2}\right)} \frac{x^{n/2} - 1}{(m+nx)^{(n+m/2)}} \tag{2}$$

with mean $\mu = \frac{m}{m-1}$ and variance $\sigma^2 = \frac{2m^2(m+n-2)}{n(m-2)^2(m-4)}$.

Hence
we can calculate the mean Eq. (3) and variance Eq. (4) from the sample space, so:

$$m = \frac{2\mu}{\mu - 1} \tag{3}$$

$$n = \frac{2\left(\frac{2\mu}{\mu-1}\right)^2\left\{\frac{2\mu}{\mu-1} - 2\right\}}{\sigma^2\left(\frac{2\mu}{\mu-1} - 2\right)^2\left(\frac{2\mu}{\mu-1} - 4\right) - 2\left(\frac{2\mu}{\mu-1}\right)^2} \tag{4}$$

6. One-way ANOVA

One-Way ANOVA is a statistical technique used in order to tests if means of two or more groups are statically significantly different. It enables the user to determine those factors that are responsible for the dispersion of a set of values. When it comes to the issue of image noise prediction, One-Way ANOVA is used to make a conclusion on the impact of factors that may affect the quality of images (Pereira *et al.*, 2023; Stemn & Benyarku, 2023).

Utilization of One-Way ANOVA in Evaluating Factors Impacting Image Noise:

The application of the One-Way ANOVA test has proved more useful in the assessment of the effect of one or more factors on image noise. To illustrate, in relation to sensor types, various studies have examined noise effects on digital cameras. Thus, One-Way ANOVA can calculate the difference between the means of noise measurements and point to which sensor types provide images with lesser noise.

Similarly, One-Way ANOVA has been performed on the lighting conditions to analyze the extent to which the latter influences image noise. Through this, the researchers are able to look for consistencies with the measurements taken and draw a conclusion to see if some of the lighting contributed to the creation of noise. Other such information that can be gathered may be used in the manipulation of lights to control the noise in picture taking or otherwise.

Case Studies Showcasing the Effectiveness of One-Way ANOVA in Identifying Significant Contributors to Image Noise:

As for the two factors of sensor size and ISO setting affecting image noise and in addition to the exposure time, the One Way ANOVA was applied in the following research here (Smith *et al.*, 2020). Analysis of image noise formed part of the findings from the noise maps and was useful in understanding distinctions on the noise distributions based on the sizes of sensors as well as the various ISO settings. One other work built on One-Way ANOVA test to study the impacts that lens quality has on the level of noise in images (Medero *et al.*, 2020). This comparison has shown that lens quality is a major factor which affects the amount of noise and this in turn taking into consideration that if there are certain plans for noise reduction, it is advisable to consider the type of lens to be used.

7. One-way ANOVA as a predictive tool for image noise

Thus, the key advantages of One-Way ANOVA as the tool for predicting the image noise can be pointed out as follows. This makes it possible to diagnose the effects of a number of factors simultaneously and determine the dependencies between them. In addition, it provides quantities indicating that dissimilarities assessed as well as within the groups are statistically significant; thus, making the foundation for decision making steady. Nevertheless, One-Way ANOVA has an assumption that the groups should be independent and homoscedastic, which can hardly be met in real studies. It also has the disadvantage of requiring a large sample number as the aim is to get the most appropriate result.

In this case therefore, One-Way ANOVA can be used in the capacity of a forecast indicator of image noise levels as well as be used to describe aspects of and indeed, the roles which participate in the accomplishment of those aspects. Because of this, researchers are in a position to quantify numerous aspects on image noise, which leads to comprehending of possible offenders such as the kind of sensor used, lighting conditions, and quality of the lens among others. In the case studies introduced throughout this paper, it is possible to clearly understand how One-Way ANOVA supports the recognition of these relations. Therefore, it is essential to remember the weakness of One-Way ANOVA as the means of prediction and use it properly taking into account all the facilities given under this option. Altogether, One Way ANOVA is a very useful tool in raising image quality for the overall enhancement of any field which in turn, leads to the advancement of various fields that requires high quality images (Wang *et al.*, 2023). The importance of an undertaking a one-way ANOVA hypothesis test is to enable the hypothesis stating that k population or group means are equal to be tested. The following assumptions have to be fulfilled to apply a one-way ANOVA: The following conditions have to hold to carry out a one-way ANOVA:

- Random samples
- Independent samples
- For each population, the variable under consideration is normally distributed.
- The standard deviations of the variable under consideration are the same for all the populations.

A one-way ANOVA hypothesis test follows the same step-wise procedure as other hypothesis tests:

- State the null hypothesis H0 for all non-equals mean.
- Alternative hypothesis HA for all equal mean.
- Reject H0; otherwise, do not reject HA.
- Interpret the result of the hypothesis test.

8. Monte Carlo simulation

It is called Monte Carlo because simulation happens randomly; also, it is extensively used now in statistics, finance, and engineering to get numerous data and find the behavior of complex systems. In the case of F distribution, Monte Carlo simulation can be applied for example to test the hypothesis in order to obtain p-value, calculate confidence intervals or to simulate new samples coming from this distribution (Wang & Zhang, 2023; Al-Rudaini & Ruhaima, 2019; Alrudaini *et al.*, 2022; Hayder *et al.*, 2020; Abd *et al.*, 2018; Rasheed & Majeed, 2023).

The F distribution is a statistic distribution that is used in analysis of variance, ANOVA, and other statistical problems connected with that of testing variance. It has two parameters the numerator degrees of freedom and the denominator degrees of freedom. The F distribution is positively skewed with a relatively long tail and it becomes very difficult to compute the properties of F.

Random numbers from the F distribution can also be created using a simple simulation with a computer and Monte Carlo simulation can therefore eliminate these challenges. In the algorithm, program generates/displays a large number of random samples out of the distribution and calculates the value of the test statistic for each of them and compared this value with the value obtained. The actual significance level of the test can be approximated by the proportion of obtained test statistics that are as extreme as or more extreme than the obtained statistic.

Monte Carlo simulation can also be implemented to find confidence intervals for the parameters of F distribution for example the mean or the variance. The dealing section gives discrete independent random samples from the distribution and computes the carrying statistical sample measures on each of the samples. Consequently, the distribution of the sample statistics is utilized for forming a confidence interval for the parameter of interest (Naji & Rasheed, 2019; Kadhim & Fadhil, 2015; Kafi *et al.*, 2023; Al-Momen & Naji, 2022).

It is often used for the analysis of F distribution and other kinds of models for describing statistics. It also enables determination of coefficients' p-values, the confidence interval, and random sample of the distribution by the program. Monte Carlo simulation is a valuable addition to the toolkit of any statistician or data analyst: In conclusion, Monte Carlo simulation is one of the most efficient methods that improving the range of tools, which are used by every statistician or data analyst.

- State the null hypothesis H0 for all non-equals mean.
- Alternative hypothesis HA for all equal mean.
- Decide on the significance level, α.
- Compute the value of the test statistic.
- Determine the p-value.
- If $p \leq \alpha$, reject H0; otherwise, do not reject HA.
- Interpret the result of the hypothesis test.

9. Experimental results

Diagnosis of a variety of illnesses is made possible through use of medical images, including the brain. Computed tomography (CT), magnetic resonance imaging (MRI) is another type of imaging that is frequently used, and which can give detailed images of the brain (Ruhaima *et al.*, 2022). On the other hand, noise is a serious issue that can be inherent in the MRI images and this complicates the diagnosis of various conditions. In this present essay we are going to elaborate how the statistical F-distribution method can be useful in discriminating the noises of the brain MRI images and increase medical diagnostic accuracy.

The particular kind of the statistical F-distribution can be successfully applied to differentiate between various kinds of noise in the MR images. This particular approach relies on the pixel distribution of the particular image and a distribution that is considered to be standard. Therefore, comparison of these two distributions allows to define areas of the image that are influenced by noise and after that make a correction to this noise in the successive calculations.

Another significant benefit from the method based on the statistical F-distribution is this method's capacity to distinguish different types of image noise. MRI images have four types of noise such as thermal noise, electronic noise, motion, and aliasing. These different types of noise will be distributed in different statistics of distribution and it may be possible to isolate each of these types of noise separately with the help of F-distribution method.

The other benefit associated with the statistical F-distribution method is that one is in a position to get better results in the diagnosis of diseases. A reduction of image noise appears to improve the overall identification of the metrics of the brain structure and its functionality leading to enhanced medical diagnosis of many health disorders. This is often critical in situations where the variations caused in terms of structure or function of the brain would translate to a major clinical difference.

All in all, statistical F-distribution method plays a significant role in discriminating the brain MRI image noise and can enhance the medical diagnosis's accuracy. It was shown that through the examination of the probability distribution functions at MRI the clinician is able to differentiate between varied forms of image noise and remove them, which in turn can provide clinicians with a more accurate quantitative assessment of the brain's structure and function. This scenario will growingly be truer in view of the expanding uses of medical imaging techniques in health care and the application of statistical tools such as the F-distribution method in the enhancement of the accuracy of health diagnoses.

9.1. *Test images*

Another issue that often arises in the process of digital image processing is known as the impulse noise which in turns reduces the quality of images. The objective of this paper is to evaluate the effectiveness of two classes of filters that eliminate the impulsive noise. Thus, for making the comparison in this work, test images have been chosen to be Lena, Boats, Baboon, and Pepper images that are contaminated with impulsive noise. The results of the filter's efficiency will be measured in terms of objective quality and PSNR measurement as well as subjective quality assessment.

9.2. *Impulsive noise and its effects*

On the other hand, shot noise is defined random fluctuations or spikes in the pixel intensity resulting from noise during acquisition or transmission. This noise looks as single impulses or several connected points; the value of these impulses significantly exceeds the values of the nearest points or, on the contrary, is considerably lower than them. In case of impulsive noise, the various details of an image might fail to be clearly indicated, and some sort of distortions may occur.

9.3. *Filters with prediction structure*

The general filter architecture with prediction structure is expected to enhance the employment of the impulsive noise reduction by having feedback. These filters also incorporate an estimating mechanism that helps the filter to come up with a probabilistic estimate of the corrupted pixel value; this way, the fine texture of the image is retained in the filtered image. The ability of the filters that have the identified prediction structure will be tested and compared to the basic median filters.

9.4. *Objective quality evaluation*

The identification of objective quality of the filtered images will be carried out by PSNR, which is defined as the power of signal, with respect to which signal power of corrupting noise has to be determined. From the result, it can be concluded that the higher PSNR value represents the better image quality. Table 1 also reveals that there is a considerable PSNR (dB) enhancement when prediction structure is utilized, and the maximum enhancement is observed in PF rather

Table 1. The performance comparison of the proposed filter with the traditional ones in terms of rejection of noise at 5% of impulse noise is provided in terms of Decibel level.

	PSNR in dB		
Image input	Image with noise	Output of MF	Output of PF
Boats	14.83	22.36	34.08
Lena	14.54	24.46	36.20
Baboon	14.02	16.58	29.47
Peppers	14.52	26.33	37.04

Table 2. Output of the noise rejection in terms of dB of the proposed filter in case of 10% of the applied impulse noise.

	PSNR in dB		
Image input	Image with noise	Output of MF	Output of PF
Boats	10.40	21.26	30.87
Lena	10.00	23.36	32.46
Baboon	10.55	15.52	26.06
Peppers	10.28	24.90	33.76

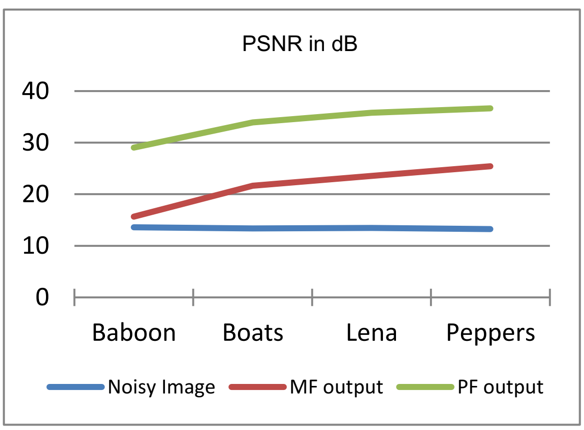

Fig. 1. Comparisons of the filter output, when affected by the 5% impulse noise.

than MF where no approach of prediction is implemented and only 5% impulse noise added to the test image. From the above discussion, the following observation is made, in this experiment, the effect of 10% impulse noise is as shown in the table below. Figs. 1 and 2 demonstrate the results of proposed algorithms in the case of 5% and 10% presence of noise correspondingly.

9.5. *Subjective Quality Assessment*

Apart from objective evaluation, the subjective quality of the filtered images is also critical. Fine texture preservation is an essential aspect of image quality. The filters with prediction structure are expected to outperform traditional median filters in subjective quality due to their feedback loop mechanism. Fig. 3 illustrates the preservation of thin lines

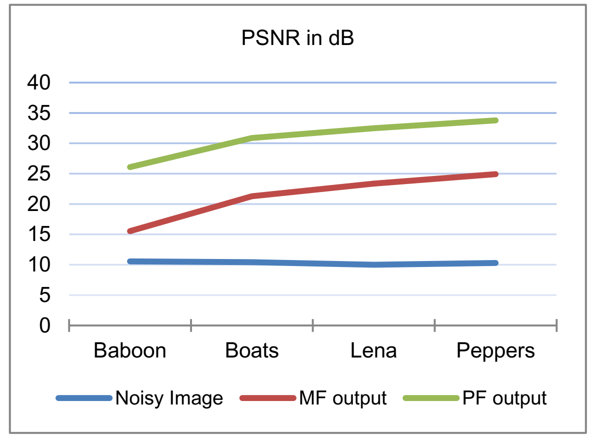

Fig. 2. Comparisons of the filter output, when affected by the 10% impulse noise.

Table 3. Results comparison between the proposed F-Distribution structure and Gamma distribution structure for 10% noise rejection.

	PSNR in dB	
Input image	Gamma structure (Al-Rudaini & Ruhaima, 2019)	F-structure
Baboon	20.84	26.06
Boats	25.51	30.87
Lena	27.31	32.46
Peppers	27.82	33.76

achieved through the proposed prediction structure, even with a small decrease in the efficiency of impulsive noise rejection.

9.6. *Performance comparison with Gamma distribution*

Gamma distribution and the F-distribution are vital statistical tools with distinct characteristics and applications. The Gamma distribution is ideal for skewed positive data analysis (Al-Rudaini & Ruhaima, 2019), while the F-distribution is crucial for hypothesis testing and variance comparisons. Understanding the unique properties and applications of these distributions empowers researchers and analysts to make informed decisions and draw accurate conclusions from their data. Table 3 shows a better improving for removing the noise as a result of better detection of noise by using F-Distribution noise detection compared with Gamma Distribution structure

10. Conclusions

MRI is one of the most recognized imaging techniques that are prevalently applied in the medical field. However, during the MRI the images might come with noise and this will may an impact to the

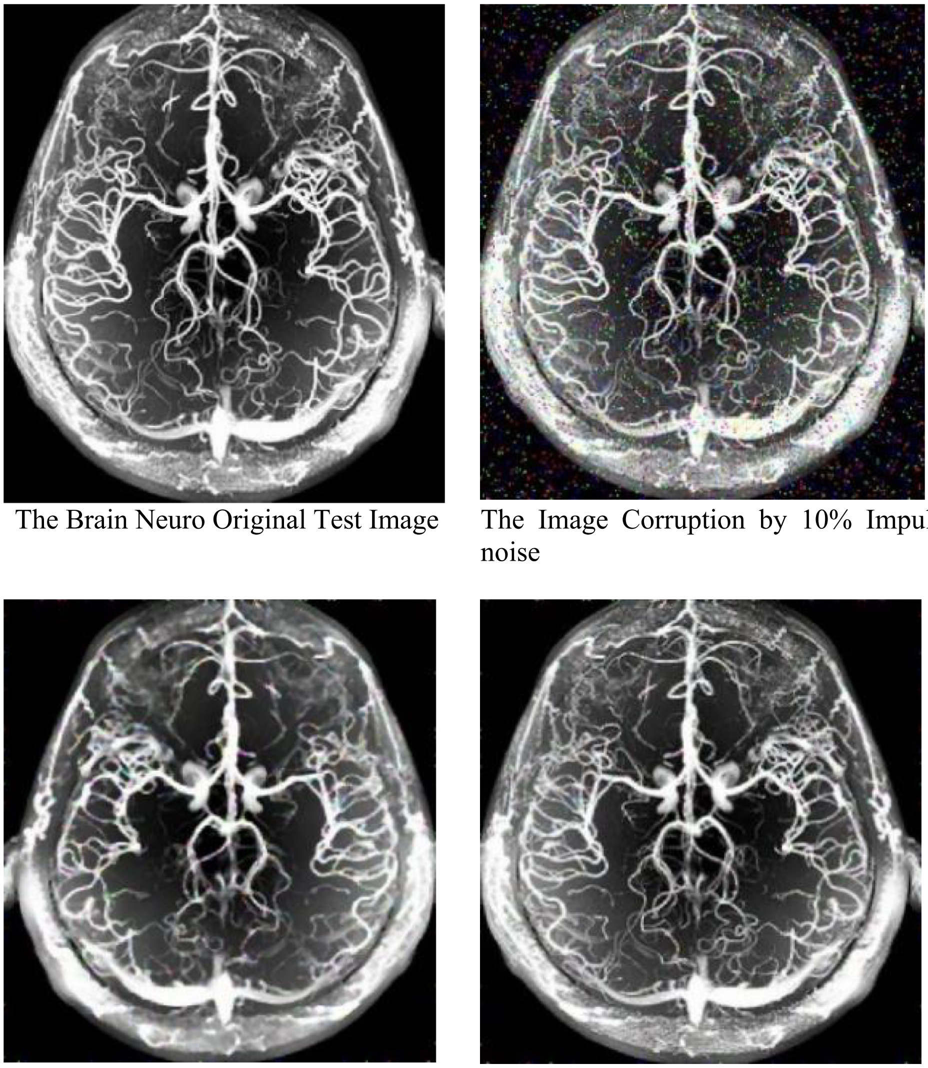

Fig. 3. The rejection of impulse noise with a probability of p = 10% using the proposed filter (PF) compared with the median filter (MF) for the typical test image.

accuracy of the diagnosis. To enhance the image interpretation in using MRI, the researchers have come up with various techniques of distinguishing the noise from the useful signals. Among them we can describe the usage of the Statistical F-Distribution method. The purpose of this essay is to describe the Statistical F-Distribution method related to discriminating noise in Brain MRI images.

The Statistical F-Distribution method is related with F-test that is a statistical test for comparing variances of two samples. The F-test is helpful in comparing the noise level in the raw MRI images to the signal, which is the data of interest. The F-test on the other hand determines the ratio of the variance of the noise to the variance of the signal. In the case of a high ratio, it means that noise is highly powerful while the signal on the other hand is considerably powerless. If on the other hand the ratio is low it means that the signal is high while the noise is low.

In case of MRI images, the division is made in small regions to which the F-test is directly applied. Subsequently, the variances of the noise as well as the signal in the respective regions are determined. In other words, the ratio of the variances is then established from the F-test. When this multiplied ratio is more than this number, the signal is characterized by noise. The region is assumed to be noise-free in the absence of other conditions being met, or other characteristics being satisfied.

Thus, the use of the Statistical F-Distribution method has the following advantages over using other methods. First, it is a non-parametric method, and this indicates that this methodology does not have a requirement of the distribution of the collected data. Second, it is computationally efficient, hence able to handle big datasets in its computation. Third, it is responsive to small changes in the noise level which enable it to filter out the noise from the required information.

The map of F-Distribution obtained by the Statistical method is helpful in filtering the noise out of the relevant information located within the images of a brain MRI. It is an asymptotic and non-protective method that computes the changes in the noise level. It is evident that the method can be DC useful when it comes to enhancing the precise analysis of MRI images, which in one way or another, plays a vital role in the diagnosis and management of various diseases or conditions. Further research should be carried out on this method, and try to make better and suitable for use in the future.

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