Original Article

Statistical Distribution To Distinguish Noise In Magnetic Resonance Images

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Abstract

Fisher's test in statistics is one of the statistical tests that is used to test hypotheses, in order to ascertain whether the differences between two samples or groups are equal or unequal. In this test, the data follows a Fisher distribution, and the q test is used to compare one variance with another by partitioning. The F test can be one-tailed or two-tailed, depending on the data and parameters of the problem to be solved. The F value is obtained after conducting the test, and then it is used in conducting a one-way ANOVA test. In this article, we will talk more about the Fisher test in statistics, how to conduct the test on hypotheses, and explain the steps for conducting the test manually.

The analysis method is added to the image testing and noise determination. The distorted parts of the laboratory images are improved by adding the nonlinear filter method, which is suitable for these cases.

The nonlinear median filter demonstrates a convenient method for replacing degraded pixels. The filter is not applied to the undetected portions of the image, preserving them intact and avoiding distortion of fine image details and important edges. Experimental results have improved this architecture compared to traditional noise reduction architectures.

Keywords: - Statistical, Simulation of Monte Carlo, magnetic resonance images, Image of medical testing.

Introduction:

A physical basis that controls a certain ratio of participation in the neutrophil to the lens by controlling its size and towards the light, as for the typical camera, the brand is simple, easy to use, and full .It is based on converting light into electric charges, and converting an image into a series of arcs and ones .To represent all that colored in the photo [1] .If the photo was taken in a cloudy weather or location it appears

A problem known as (bad contrast) which is the state of distribution

A dark site appears a problem known as (Contrast Bad), which is the state of poor distribution of lighting in the vicinity of the image details, and it is one of the most common problems that users or researchers face when working on scientific images such as dark medical x-rays, or images of old documents, and images of monuments that are often It is dark as well as images taken from satellites as well as images of public use by users [2].

effects.

A-magnetic resonance imaging (MRI):

MRI uses powerful magnets to polarize hydrogen nuclei (a single proton) in water molecules in human tissue, generating a detectable signal that is then decoded into an image of the body. MRI uses three types of electromagnetic fields: a very strong static magnetic field (of the order of several tesla units) for the polarization of hydrogen nuclei, called a static field, there is a weaker, time-varying field (of the order of 1 kHz) for special coding, called an inclination field, and a weak radio wave field in order to manipulate hydrogen nuclei to produce measurable signals that are collected through a radio wave antenna. As in a CT scan, an MRI was produced It takes pictures of sections and thin slices of the body [8], and therefore it is considered a type of CT scan. Modern MRI machines can produce three-dimensional images, which are a generalization of two-dimensional images. Therefore, there is no limit to the number of times a patient can be exposed to an MRI, unlike an X-ray. However, there are health risks from heating Tissue by exposing it to the field of radio waves and affecting devices implanted within the body, such as heart regulators. Since the CT and MRI methods differ in their sensitivity to different tissue materials, the images produced by both methods differ significantly. Here, the computer image matching technique is used to obtain a clear picture of the various tissues by matching the x-ray and magnetic resonance images

B-Positron emission imaging (PET):

Positron imaging **(PET)** is particularly used in the investigation of brain and heart diseases. As in nuclear medicine, an isotope with a short half-life is used, so the duration of its radioactivity in the body is short, such as the fluorine isotope 18 18F, which can enter into the composition of substances that are consumed in the human body, such as the sugar glucose, which is consumed directly by cancer cells.

Positron radiation imaging devices are located in parallel with CT imaging devices, as it is possible to perform both images without the need to move the patient. This allows the detection of carcinoid tumors in conjunction with the patient's anatomy obtained with X-rays.Knowing the answer to such a question is also important in selecting the appropriate statistical methods to study their true means [11].

THEORY:

The Signal-to-noise ratio (SNR) and MRI signals and can be represents as

MRI Image = Signal + Noise

The Understanding of noise statistics in any space such as k-space, or complex images, F space and the amplitude images with characteristic [13] • All explanations with Gaussian distribution, Rayleigh and others knowing the basic and elements methods to measuring Signal-to-noise ratio.

Noise in MRI is from two main sources:

1. Molecular motion - Charged particles in the human body emit electromagnetic noise.

2. Electrical resistance - The resistance of the receiving coils, data cables, and electronic components of the measurement system. The noise generated in an MRI depends on:

1. Coil - The number, type, and size of elements, and the type of coil, such as an eight-channel body coil or a four-channel flexible coil.

2. Bandwidth - Varies with each pulse sequence.

The Affecting factors of Signal with respect to Noise Ratio (SNR):

The SNR image can be determine **the** formula:

SNR = signal / noise

ROI definition is depicted on axial MRI TE20 (a) and TE90 (b–d). The TE20 has optimal contrast between gray (appears light gray) and white matter (appears dark gray). The TE90 has optimal contrast between brain (appears gray) and CSF (appears white) as shown in fig.(1)[15].

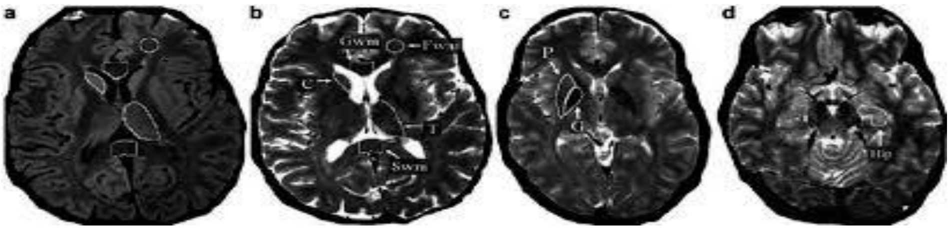


Figure (1): Several types include gray matter (shows bright body) and white matter (shows bright body).

Basic SNR Measurement (1 coil):

1- Linear measurement in the focus area.

2- Elastic aberration measurement in the region of interest with a value.

3- Rayleigh distribution correction in the background. **mean Rayleigh = 1.26**

$\sigma_{Rayleigh} = 0.65$

$\sigma_{gaussian}$ = mean Rayleigh / $\text{sqrt}(\pi/2) = 1.008$

$\sigma_{gaussian} = \sigma_{Rayleigh} / \text{sqrt}(2-\pi/2) = 0.997$

$\sigma_{Mag\text{-}Diff} = 1.394$, $\sigma_{gaussian} = \sigma_{Mag\text{-}Diff} / \text{sqrt}(2) \sim 1.0$

Experimental Results:

Table 1: Noise rejection results of the proposed filter in decibels at 10% of the applied impulse noise

Input of Image	**PSNR in dB**		
	Distorted images	**MF output**	**PF output**
Baboon	**13.67**	**15.75**	**29.11**
Boats	**13.48**	**21.73**	**34.01**
Lena	**13.65**	**23.66**	**35.70**
Peppers	**13.15**	**25.23**	**36.44**

Table 2: Noise rejection results of the proposed filter in decibels at 20% of the applied impulse noise

Input of Image	**PSNR in dB**		
	Distorted images	**MF output**	**PF output**
Baboon	**10.65**	**15.51**	**26.05**
Boats	**10.37**	**21.25**	**30.85**
Lena	**10.10**	**23.35**	**33.44**
Peppers	**10.29**	**24.91**	**33.77**

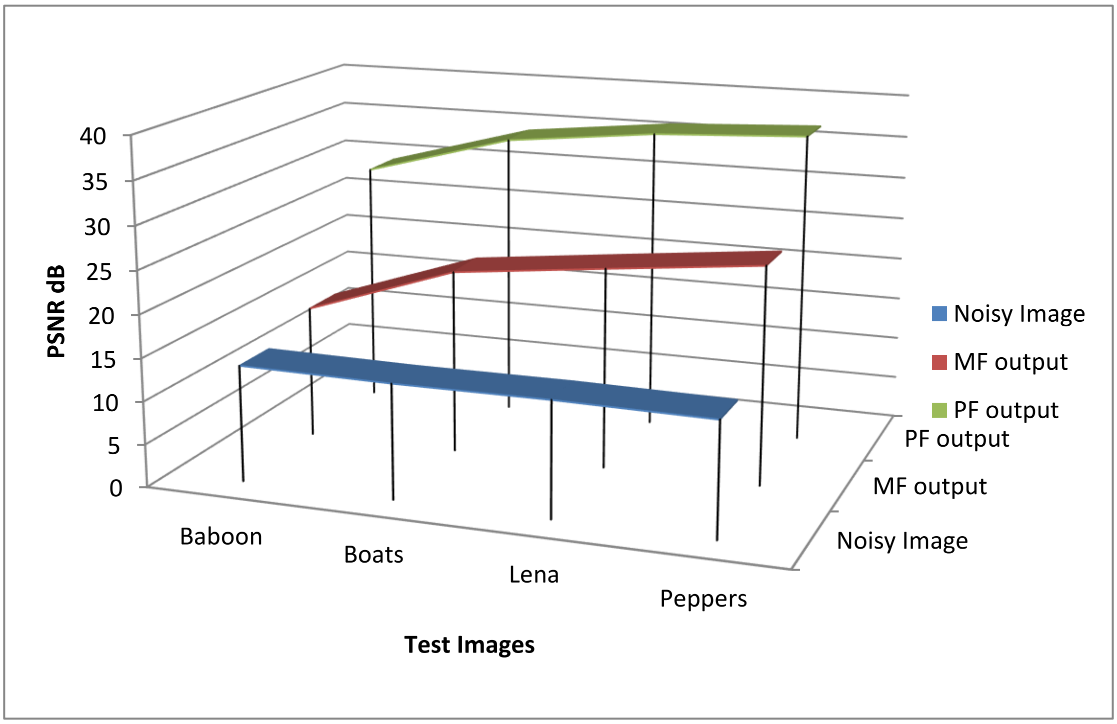


Figure 1: The output of filter comparison for impulse noise at 10% .

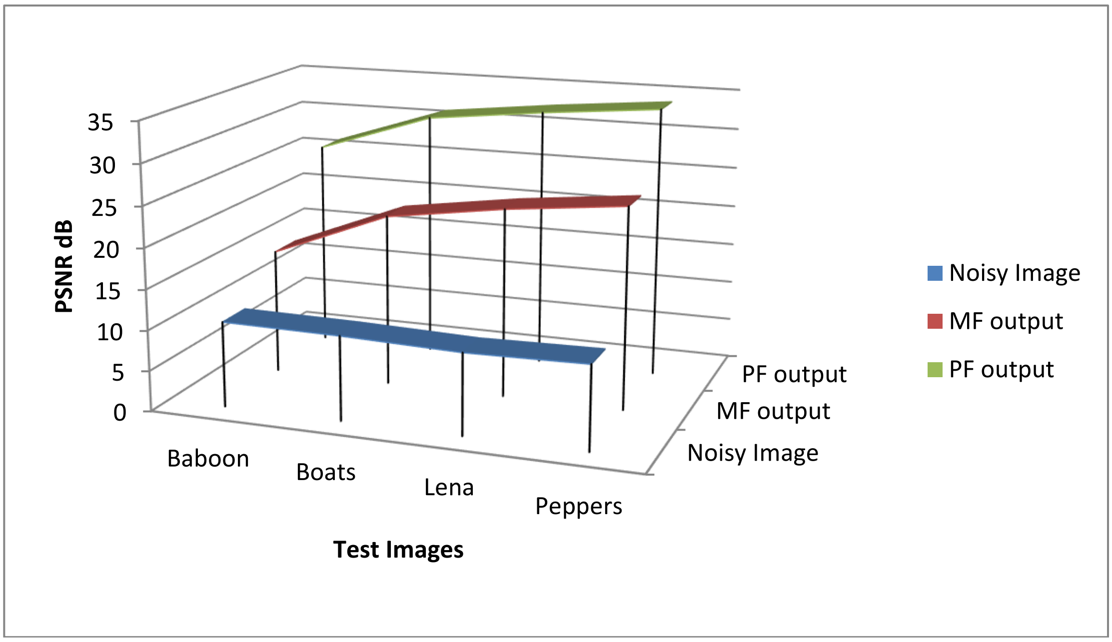


Figure 2: The filter output comparison in presence of 20% impulse noise.

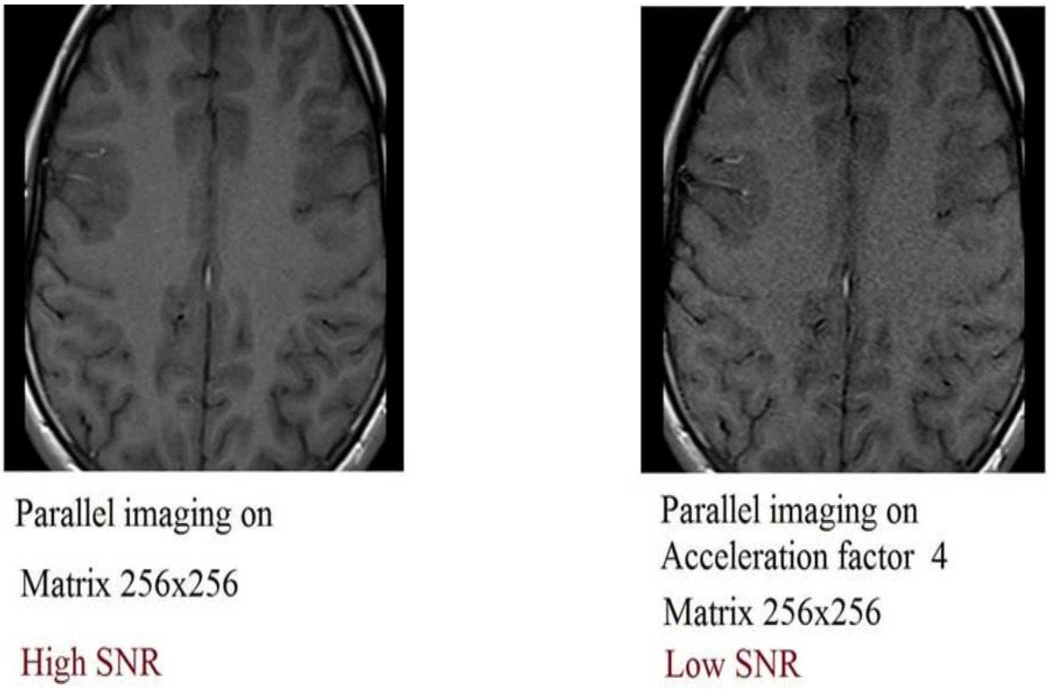
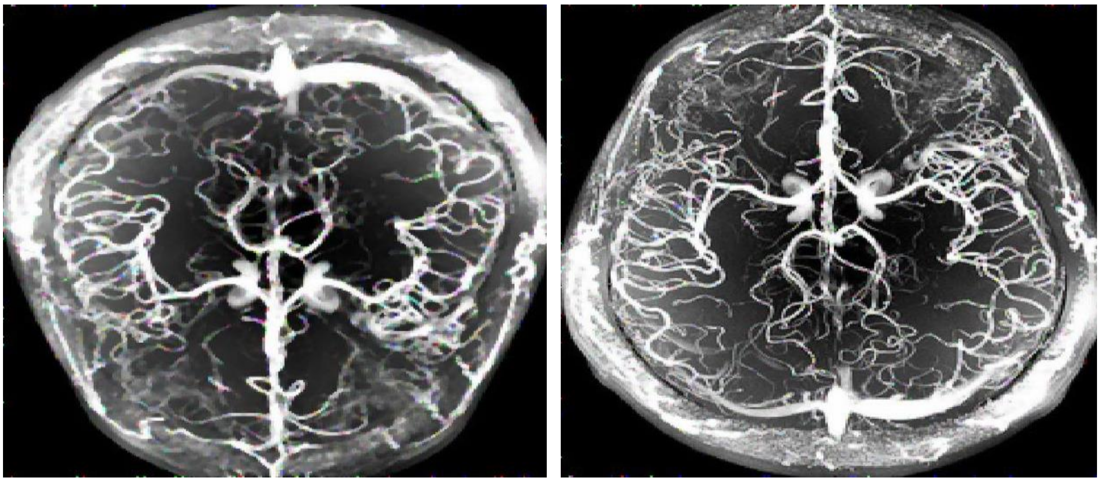


Figure 2: The differences of high SNR and low SNR with respect to the acceleration factor 4 .



The output by using the PF method The output using classical MF filtering

Figure 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.

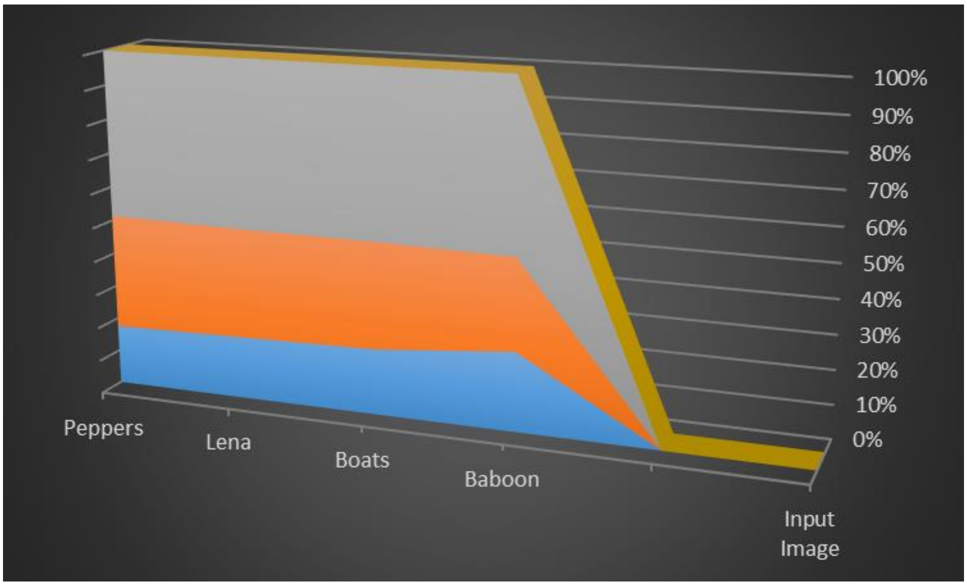


Figure 4: Impulse Noise Rejection Graph comparison using proposed filter (PF) compared with Median Filter (MF) for the impulse noise if 10% applied.

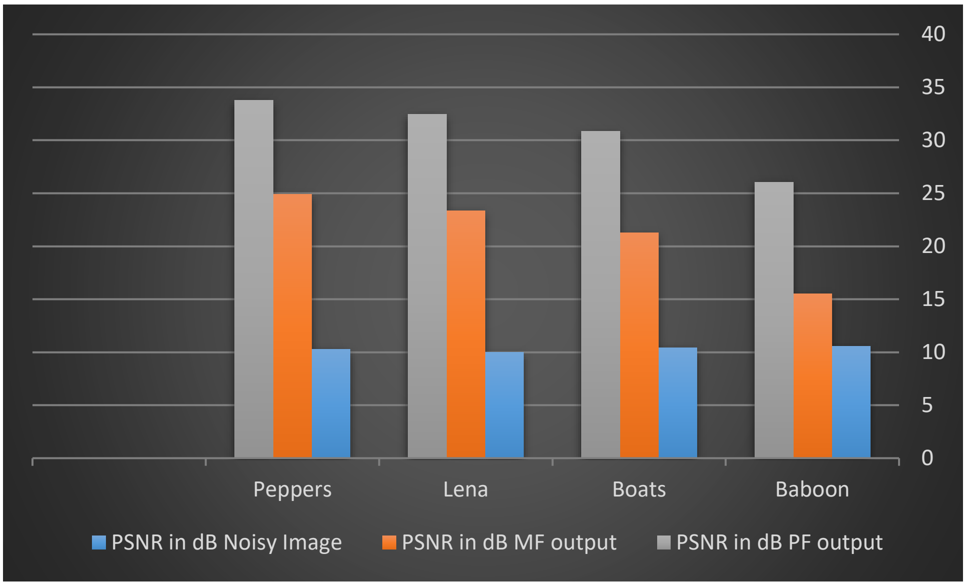


Figure 5: Impulse Noise Rejection Graph comparison using proposed filter (PF) compared with Median Filter (MF) at 20% applied impulse noise.

Conclusion:

The efficiency testing with the proposed filter, a set of standard 255 x 255 images was used. The images used in the test were artificially overexposed to different degrees. Images of Lena, Peppers, Boats,Baboon, and two other MRI test images are used in the tests. Standard images are used for easy verification and comparison with other papers and previous work. The noise imposed on the images is of the type of pulsed noise, in varying proportions, distributed over the image randomly and with a probability factor p. The experimental procedure shows the results when p = 5% and 10% of the image body.

The efficiency of the filters was measured by calculating the objective quality factor (PSNR) of the images used. Significant outperformance of the proposed filter using specular prediction factor (PF) over that of classical mean type filter (MF) was observed in both cases for subjective and objective quality metrics. Images were processed and noise removed using classic filters. The proposed filter having predictive structure was highlighted on the images and the results in both cases were calculated for comparison purpose. As shown in Figure 3, increasing the T1 TSE sequence compared to the parallel acceleration factor 2 will result in an acceleration factor of 4, resulting in a relative reduction in baseline noise by 40%.

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