International Journal of Engineering Sciences & Research Technology

(A Peer Reviewed Online Journal)
Impact Factor: 5.164

IJESRT

RESEARCHERID
THOMSON REUTERS

[NACETEC' 19]
IC™ Value: 3.00

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

IMAGE ENHANCEMENT USING ADAPTIVE ANISOTROPIC FILTER FOR MRI SCANNING SYSTEM

Prof. SheejaVincent[*1], Prof. Anu,S.Nair[2]. Asha Mariam Roy[*1], Harshana A[*2] & Akhitha A Dev[*3]
Department of Electronics and Communication, College Of Engineering

DOI: 10.5281/zenodo.2631587

ABSTRACT
Magnetic resonance imaging (MRI) is a non-invasive medical test that physicians use to diagnose medical conditions. MRI uses a powerful magnetic field, radio frequency pulses and a computer to produce detailed pictures of organs, soft tissues, bone and virtually all other internal body structures. Usually in medical images, the boundary of anomaly maybe vague. Special attention has to be paid to preserve these weak edges while performing noise retardation. The simple spatial averaging does reduce the noise but simultaneously degrades edges also. The filtering does not respect region boundaries and the resulting images appear blurry. This undesirable effect can be reduced by the use of nonlinear filters, the most common being median filtering. Edges are retained to a certain extend in median filtering, but the filtering suppresses fine details. Another approach is adaptive filtering, which entails a trade-off between smoothing efficiency, preservation of discontinuities, and the generation of artefacts. The main objective is to propose an adaptive image driven estimation of threshold of gradient magnitude, rather than setting it manually. The performance of the modified anisotropic diffusion will be compared with conventional P-M model in terms of the ability to preserve edges during restoration.

KEYWORDS: Edge Content Ratio(ECR),Pratt's Figure of Merit(PFOM) and Percentage Reduction in the Standard deviation of Noise(PRNSD).

1. INTRODUCTION
For decades, medical imaging has been receiving a considerable attention of scholars. Simple spatial averaging degrades edges while reducing the noise. Filtering can cause blurring of image as they does not respect region boundaries. The use of non-linear filters like median filters can be used to reduce this undesirable effect. In median filtering edges are retained to a certain extend but fine details are suppressed. In case of adaptive filtering, there is a trade-off between smoothing efficiency, preservation of discontinuities, and the generation of artefacts. Ideal restoration scheme should minimize information loss by preserving object boundaries and detailed structures, efficiently remove noise in regions of homogeneous physical properties.

Usually in medical images the boundaries are weak, special attention has to be paid to preserve them while performing noise elimination. Conventional Gaussian smoothing results in blurring artefact for edges as the Gaussian kernel is symmetric and orientation insensitive. Hence edge preserving non-linear techniques are preferred. Among the edge preserving smoothing approaches like Guided image filter, Kuwahara filter, anisotropic diffusion, bilateral, trilateral, Non-Local Means (NLM) and wiener filters, anisotropic diffusion filter is widely used. Gradient magnitude which depend on noise level should not be used as a sole feature in diffusion process. When the noise level is low, the image gradient is high and it certainly reflects on the edges.

Perona–Malik diffusion, is an anisotropic diffusion technique. It reduce image noise without removing significant parts of the image content, edges, lines or other details. In the traditional P-M model, selection of number of iteration is required to ensure successful diffusion as this model is sensitive to the number of iteration. Perona and Mallik efficiently improved the classical scale space analysis, where they described the diffusion process and is known as Perona-Mallik equation. Adaptive anisotropic diffusion can preserve edges and at the same time it can reduce the speckle noise. Speckle noise is an interference effect that can alter the accuracy of

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

medical images. Usual filters can eliminate speckle noise adequately but do not preserve details efficiently. Automatic setting of gradient threshold k, which is changed for each iteration of the partial differential equation (PDE) integration steps can be done by two methods.

$$Y(i,j,n+1) = Y(i,j,n) + \sum_{m=1}^{M} {}_m . c_m(i,j). {}_m Y(i,j,n)$$

Where λ is an integration constant
∇mY(i,j,n) denote the gradients

Cm(i,j,n) represents the diffusion or conduction coefficients Y(i,j) is the connected neighbourhood at the n^{th} iteration
M is the type of neighbourhoodbis the Normalization factor

2. PROPOSED WORK

Analysis using Pratt's figure of merit involves huge computational complexity, hence cannot be directly adopted in this work. Therefore, detailed analysis of MRI images can be done by using Edge Content Ratio (ECR).Initially fractional reduction in noise standard deviation variables and Edge Content Ratio are compared with threshold of gradient with the pre-estimated values of Edge Content Ratio and percentage reduction in standard deviation. This comparison will give optimum K and N values. From this analysis it is clear that different magnetic resonance image inputs gives different structured pattern of percentage reduction in standard deviation. Therefore it is not possible to formulate the optimum values of K and N. Hence, Edge Content Ratio method was preferred. In this method optimum values of K can be obtained from the results having uniform structural pattern. Optimum value of K remains constant irrespective of the number of iteration. An abrupt transition happens at the beginning of Edge Content Ratio curve which indicate the maximum noise removal. The curve starts removing noise from its beginning to the optimum value. Further processing must be truncated on reaching the maximum value of noise suppression or else useful image information will be lost, this point indicates the optimum value of k.

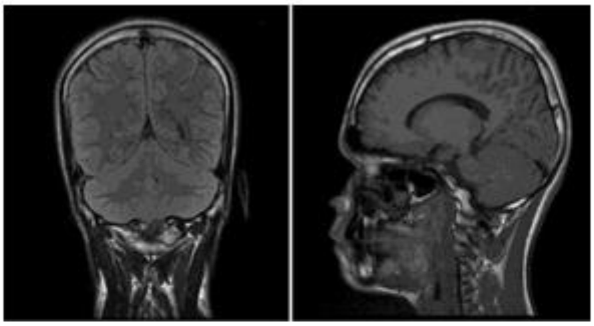
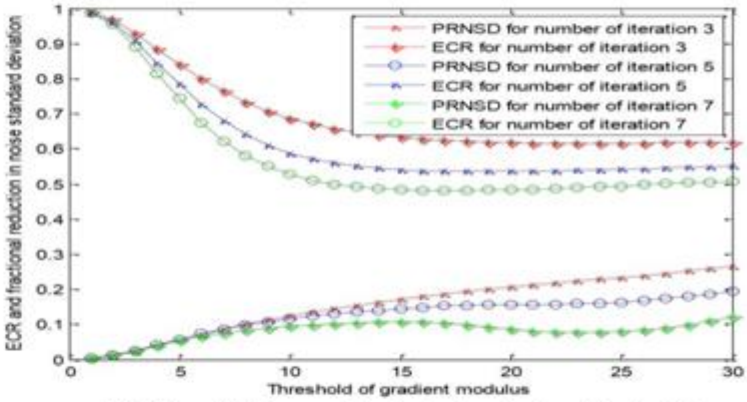


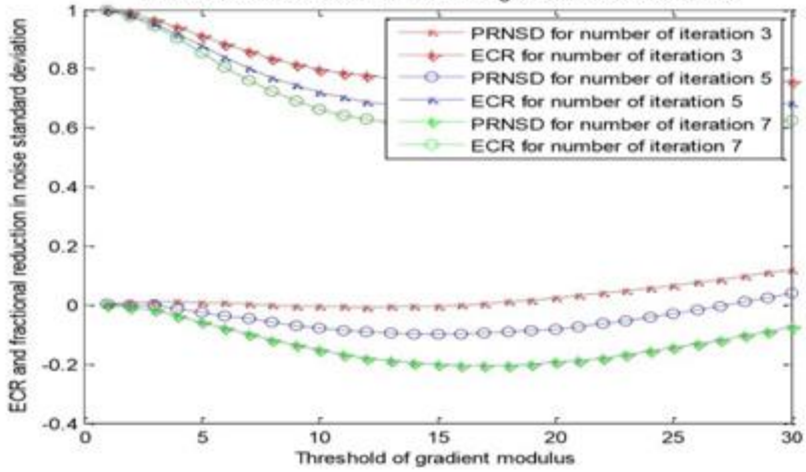
fig.1:The input MRI images for evaluation.

In the binary edge map representation of Magnetic Resonance image shows that noise is eliminated in the first three iterations and the useful information content of the given image will be removed in the further iterations. Over smoothened versions of image will be obtained at more iterations and lesser iteration leads to the presence of noise as exactly that of the original image. The main aim of this analysis is the determination of maximum suppression of noise with less edge degradation. The optimum value of K is obtained through the comparison and application of threshold arbitrary value. Normally value of threshold is 0.09.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7



PRNSD and ECR versus Threshold of gradient modulus for Z05



In this case study a uniform pattern of edge content ratio are obtained by analysis of 21 different magnetic resonance images.21 different optimum K value and their equivalent standard deviation of noise are calculated from each curve. Standard deviation of original image cannot be computed from the graph. It can be computed numerically. After obtaining 21 optimum K values and their corresponding standard deviation of noise investigate the correlation between them using n^{th} order polynomial method. Determine the degree of polynomial by detailed mathematical regression correlation analysis.

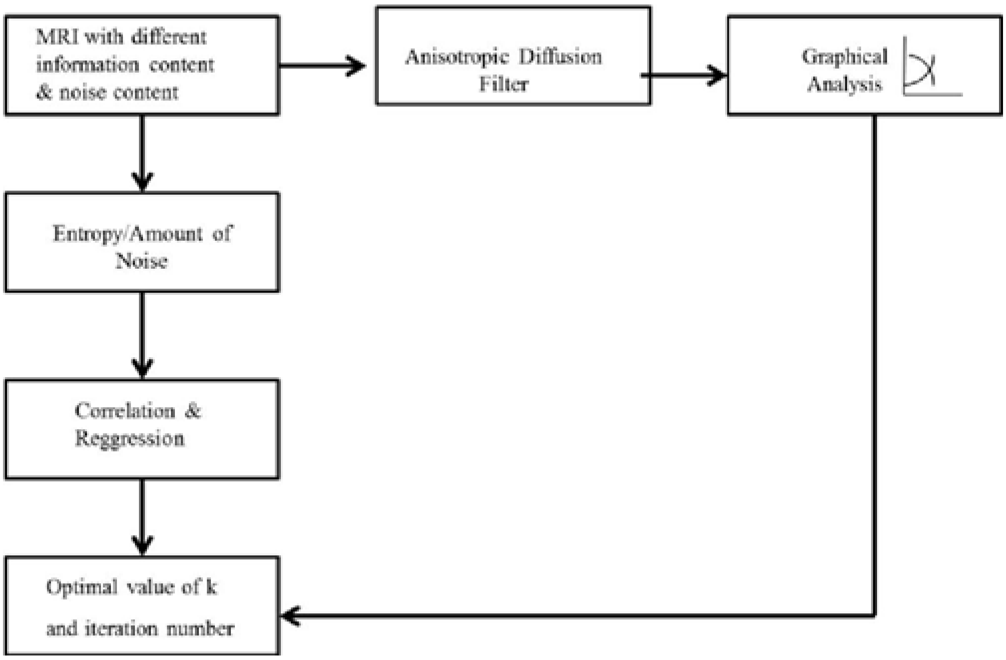
3. MATHEMATICAL MODEL

Steps for the determination of mathematical model

- Limit of correlated estimated value should be in between +1 and -1. +1 shows the direct proportional characteristics, -1 gives the inverse proportional characteristics and 0 indicates zero correlation value between K and standard deviation of noise.
- Least square regression method is used for the establishment of regression ratio. Minimum deviation from the predicted curve can be established through a polynomial model.
- Draw the residual plot and find its goodness. Coefficient of determination of R2 value or adjusted R2 value can be used to calculate the goodness. Simple R2 cannot be used for the higher degrees of polynomials.
- Take the regression

Moderate amount of noises are found in MRI image itself . Some of them can be predicted while others are not. Blinking of eyes is the very often seen predicted noise, which may cause changes in the characteristic details in the MRI.An anisotropic diffusion filter is used for processing given MRI, thereby maximum noise is suppressed with minimum edge degradation.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7



Graphical analysis of filter output can be done by using one of the statistical indices called edge content ratio versus gradient of threshold value (K).At the same time ,estimate the value of K by conducting a mathematical correlation regression analysis. Finalize the optimum value of K by combining the mathematical formulated result and graphical result.