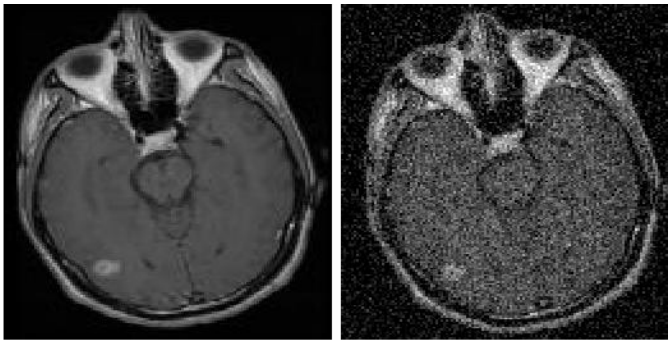

Figure 5 (a): Original image and (b) Noisy image

For comparison of the five different wavelet functions, the quantitative de-noising results of the MRI images obtained by using global thresholding are shown in Table I and II respectively. The MSE, MAE, PSNR error criteria are the ones which have been used to assess the performance of the wavelet functions. Their numerical results are summarized in the tables.

Table 1: Qualitative analysis (MRI image) – Gobal Thresholding For Level 1

Type of Wavelet	*Level 1*		
	MSE	*MAE*	*PSNR(db)*
Haar	0.0089	0.0748	21.4544
db2	0.0082	0.0716	21.1694
db4	0.0082	0.0722	21.5369
sym2	0.0084	0.0722	21.2592
sym4	0.0084	0.0725	21.9326
bior1.1	0.0093	0.0761	21.3245
bior 1.3	0.0095	0.0770	20.7880

It is clear from the table I, for Global Thresholding technique; sym4 gives best result for level-1 . Its gives higher PSNR & lower MSE & MAE value.

It is clear from the table II, for Global Thresholding technique; db4 performs well for level-2. Its gives higher PSNR & lower MSE & MAE value.

Table 2 : Qualitative analysis (MRI image) – Gobal Thresholding For Level 2

Type of Wavelet	Level 2		
	MSE	MAE	PSNR(db)
Haar	0.0130	0.0894	19.2090
db2	0.0117	0.0850	19.8857
db4	0.0119	0.0861	20.3062
sym2	0.0120	0.0867	20.0687
sym4	0.0116	0.0852	20.0149
bior1.1	0.0128	0.0886	18.7935
bior 1.3	0.0129	0.0888	19.3273

10. Conclusion and Future Scope

The de-noising process consists of decomposing the image, thresholding the detail coefficients, and reconstructing the image. The decomposition procedure of the de-noising example is accomplished by using the DWT. Wavelet thresholding is an effective way of de-noising as shown by the experimental results obtained with the use of different types of wavelets. Thresholding methods implemented comprised of the level (sub- band) thresholding and optimal thresholding. More levels of decomposition can be performed; the more the levels chosen to decompose an image, the more detail coefficients we get. But for de-noising the noisy MR data sets, two-level decomposition provided sufficient noise reduction

In this paper we have presented the generalization of the DWT method for the 2-D case. The resulting algorithms have been used for the processing of noisy MR image. Experimental results have shown that despite the simplicity of the proposed de-noised algorithm it yields significantly better results both in terms of visual quality and mean square error values. Considering the simplicity of the proposed method, we believe these results are very encouraging for other forms of de-noising. The Biorthogonal wavelet (bior1.1) & Biorthogonal wavelet (bior1.3) gave the best results compared to other wavelets for both Simulated & MRI image respectively. Optimal thresholding gives better denoised result among the three thresholding technique.

As the future perspective can be seen, the mentioned methods can be implemented that to look how it can be used on different images. With different spatial resolution, different behaviours of same image would be quite interesting. Since selection of the right denoising procedure plays a major role, it is important to experiment and compare the methods

Reference

[1] Byung Jun Yoon and P.P. Vaidyanathan, “Wavelet based denosing by customized thresholding”, Work suppored in part by the ONR great N00014-99-1-1002, USA.

[2] Weaver, J.B., Yansun, X Heavely, D. M. Jr., and Cromwell, L.D., “Filtering noise from images with wavelet transforms”, Magnetic Resonance in Medicine, 24 (1991), 288-295.

[3] Donoho, D. L. and Johnstone I. M., “Ideal spatial adaptation via wavelet shrinkage”, Biometrika, vol. 81, pp. 425- 455, 1994.

[4] Donoho, D. L., “De-noising by soft-thresholding”, IEEE Trans. Info. Theory, vol. 41, pp. 613-627, May 1995.

[5] DeVore, R. A. and Lucier, B. J., “Fast wavelet techniques for near-optimal image processing”, IEEE Military Communications Conference Record, San Diego, Oct. 11-14, 1992,m vol. 3, pp. 1129-1135.

[6] Crouse, M. S., Nowak, R. D., Baraniuk, R. G., “Waveletbased signal processing using hidden Markov models”, IEEE Trans. Signal Proc., vol. 46, pp. 886-902 Apr. 1998.

[7] S.Sudha, G.R.Suresh and R.Sukanesh, “Speckle Noise Reduction in Ultrasound Images by Wavelet Thresholding based on Weighted Variance”, International Journal of Computer Theory and Engineering, Vol. 1, No. 1, April 2009 1793-8201.

[8] S.Singh, Manish Kumar, "Denoising Of Natural Images Using The Wavelet Transform" (2010). Master's Theses.

[9] S. G. Chang, B. Yu, and M. Vetterli, 2000 “Adaptive wavelet thresholding For image denoising and compression,” IEEE Trans. Image Processing.,vol. 9, no. 9, pp. 1135–1151, sep.

[10] Cajo J.F. ter Braak "Bayesian sigmoid shrinkage with improper variance priors and an application to wavelet denoising", Computational Statistics & Data Analysis vol. 51, pp. 1232 – 1242 / 2006.
[11] C.O.S Sorzano, E.Ortiz, M.Lopez, J.Rodrigo "Improved bayesian image denoising based on wavelets with applications to electron microscopy/Pattern Recognition", vol. 39, pp.205 – 1213/2006.

Author Profile

Manoj Gabhel is currently pursuing his M.Tech (2012-14) from the department of Electronic & Communication Engineering Specialization in Digital Communication at Dr C.V.R.U. Bilaspur (C.G). He had done B.E in ET&T Engg. From K.I.T Raigarh C.G. in 2008 and PG Diploma in Industrial Automation System Design From NIELIT Calicut Kerala India in 2009. His Area of Interest includes Communication System. He has one year experience as a Lecturer in Government Engineering College Jagdalpur C.G. India.

Rikhee Ram, received the B.E. degree in Electronics and communication Engineering from Govt. Engineering College, affiliated to Guru Ghasidas University (presently known as Guru Ghasidas Vishwavidyalaya), Bilaspur (C.G.), India in 2007. Presently he receives M. Tech. in Digital Communication Engineering from Dr. C. V. Raman University, Kota, Bilaspur (C.G.), India. His area of interest in Signal Processing, Communication.