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Neural Network Technique for Lossless Image Compression Using Medical Images

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Abstract

Various types of Wavelets are used for image compression. This paper shows Better image compression by using different wavelet with the help of Neural network. The paper defines the threshold value to be obtain with the help of neural network by applying testing and training to array of various radiographic image. The obtain threshold are applied to different wavelet and different parameter for Wavelet are obtained and after that determines the wavelet which gives minimum value of mean square error and maximum value of peak signal to noise ratio. Thus help in getting best compression Wavelet. For Analysis considered MSE value should be a minimum and peak signal to noise ratio value should be a maximum.

The paper present the idea of image compression based on hierarchical back propagation neural network and results are analyzed. The further analysis is conducted in the network model and tested training algorithm. Finally image compression and image reconstruction are accomplished respectively, a minimum accuracy of 89% was considered as accepted. The neural network yielded 98.65% correct recognition rate of optimum compression ratios.

This concludes that a high compression ratio is achieved with Bi-orthogonal Wavelet functions. The results are obtained with a Bi-orthogonal 6.8 Reconstruction Wavelet function and proved the best. The Neural Network is implemented to prove the best threshold for wavelet and hence achieved. Experimental results suggest that the proposed system can be efficiently used to compress while maintaining high image compression.

Keywords

X-Ray; Image Compression; Wavelet Transform; Back Propagation.

I. Introduction

Efficient storage and transmission of medical images in telemedicine is of utmost importance however, this efficiency can be hindered due to storage capacity and constraints on bandwidth. Thus, a medical image may require compression before transmission or storage .Ideal image compression systems must yield high quality compressed images with high compression ratio; this can be achieved using wavelet transform based compression, however, the choice of an optimum compression ratio is difficult as it varies depending on the content of the image. In this paper, a neural network is trained to relate radiograph image contents to their optimum image compression ratio. Once trained, the neural network chooses the best wavelet compression ratio of the x-ray images upon their presentation to the network. Experimental results suggest that our proposed system can be efficiently used to compress radiographs while maintaining high image quality.

II. Wavelets and wavelet choice

Most wavelet-based signal compression system are based on the structure shown in fig. The wavelet coefficients C_i are quantized (divided by a step size and then rounded to nearest integers), and the resulting indices (noted C_i in the figure) are encoded without loss by the entropy encoder box, which usually employs contextual information. Higher amounts of compression are obtained by increasing the quan-tization step sizes (so that quantized values equal to zero are more likely), and by making better prediction for the ranges of quantized values via appropriate contexts and data structures.

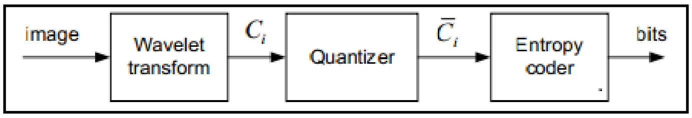

Fig. Simplified block diagram of typical wavelet signal coder.

III. Picture Quality Measures

Picture quality is measure by calculating different parameter[3]. Also calculating compression ratio for each image. It should be near about same for all the image.[6]

Mean Square Error (MSE) = $\frac{1}{N}\sum_{j=1}^{M}\sum_{K=1}^{N}\left(x_{j,k} - x'_{j,k}\right)^2$

Peak Signal to Noise Ratio (PSNR) = $10\log\frac{(2^n-1)^2}{MSE} = 10\log\frac{255^2}{MSE}$

Average Difference (AD) = $\sum_{j=1}^{M}\sum_{k=1}^{N}(x_{jk} - x'_{jk})/MN$

Maximum Difference (MD) = $Max\left(\left|x_{j,k} - x'_{j,k}\right|\right)$

Picture Quality Scale (PQS) = $b_0 + \sum_{i=1}^{3} b_i Z_i$

IV. Neural Network

The term neural network was traditionally used to refer to a network or circuit of biological neurons. The modern usage of the term often refers to artificial neural networks, which are composed of artificial neurons or nodes.

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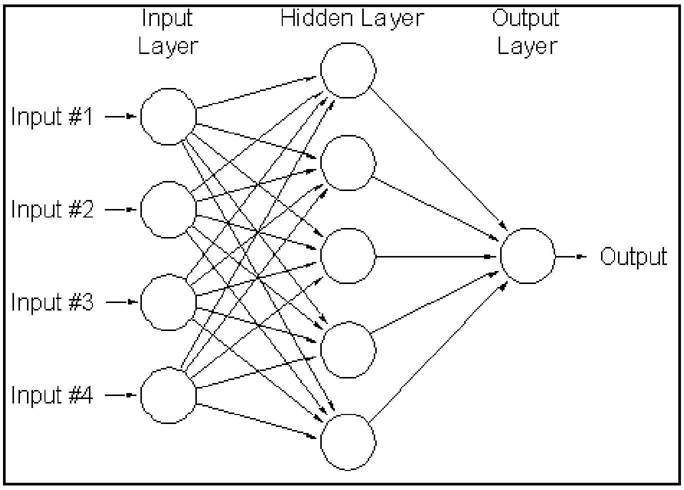

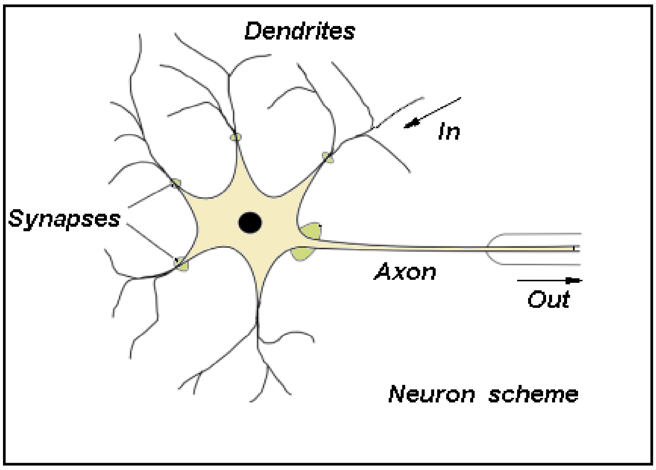

V. Backpropagation

It is a supervised learning method, and is a generalization of the delta rule. It requires a dataset of the desired output for many inputs, making up the training set.

The goal of any supervised learning algorithm is to find a function that best maps a set of inputs to its correct output. The goal and motivation for developing the backpropagation algorithm is to find a way to train multi-layered neural networks such that it can learn the appropriate internal representations to allow it to learn any arbitrary mapping of input to output.

Initially, before training, the weights will be set to random. Then the neuron learns from training examples, which in this case consists of a set of tuples (x_1, x_2, t) where $x_1$and $x_2$are the inputs to the network and $t$is the correct output (the output the network should eventually produce given the identical inputs). A common method for measuring the discrepancy between the expected output $t$and the actual output $y$is using the squared error measure:

$$E = (t - y)^2,$$

where E is the discrepancy or error.

As an example, consider the network on a single training case: (1, 1, 0), thus the input $x_1$and $x_2$are 1 and 1 respectively and the correct output, $t$is 0. Now if the actual output $y$is plotted on the x-axis against the error Eon the y-axis, the result is a parabola.

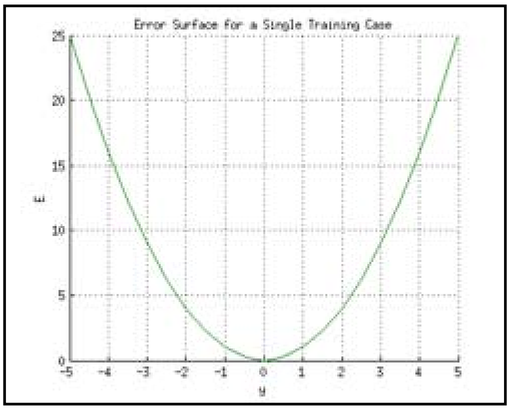

Fig. 4(a): Error surface of a linear neuron for a single training case.

However, the output of a neuron depends on the weighted sum of all its inputs:

$$y = x_1 w_1 + x_2 w_2,$$

where w_1 and w_2 are the weights on the connection from the input units to the output unit. Therefore, the error also depends on the incoming weights to the neuron,

VI. Methodology

Methodology Used

1. Selection of best wavelet for medical Radiographs.
- Compress input image with each wavelet with fixed CR.
- Find the following parameters to make comparison
2. MSE, PSNR, Correlation, Average difference, Normalized absolute error, Structural content.
3. Make database using selected wavelet.
4. Save each with its optimum compression ratio using subjective and objective evaluation.
5. Train and testing of neural network.
6. Apply input image to neural network with unknown CR.
7. Compress this image with CR defined by neural network.
8. Comparison with implemented paper based upon following parameters
- CR
- PSNR
- MSE

VII. Experimental Results

Firstly we have done selection of best wavelet for medical Radiographs.

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Choice of wavelet Table : Analysis of Radiograph image compression using various wavelets

Wavelet	THR	CR	MSE	PSNR	MD	SC	NAE	CC
db2	0.7	50.4	0.0469	141.4959	1.0959	1	0.0019	1
db4	0.6	50.46	0.034	144.5272	0.9071	1	0.0017	1
db8	0.6	50.87	0.0357	144.2412	0.9414	1	0.0018	1
bior1.1	2.6	50.1245	0.5303	117.2472	3.75	1	0.0064	1
bior1.3	2.6	51.995	0.5066	117.7048	3.7109	1	0.0064	1
bior1.5	2.4	51.6671	0.4339	119.2527	3.2912	1	0.006	1
bior2.2	0.8	49.38	0.0794	136.2351	1.6523	1	0.0025	1
bior2.6	0.8	51.313	0.0792	136.2574	1.4348	1	0.0026	1
bior2.8	0.7	49.4246	0.0636	138.4601	1.1896	1	0.0023	1
bior3.1	0.5	51.8102	0.064	138.374	1.1602	1	0.0024	1
bior3.3	0.4	48.2939	0.0332	144.9532	0.7946	1	0.0017	1
bior3.5	0.4	48.6704	0.0313	145.5413	0.7535	1	0.0016	1
bi0r3.7	0.4	48.9488	0.0307	145.7351	0.7542	1	0.0016	1
bior4.4	0.6	51.87	0.0372	143.809	0.9595	1	0.0017	1
bior6.8	0.5	49.163	0.0254	147.6272	0.7523	1	0.0015	1
rbio1.3	0.6	48.5924	0.0336	144.8497	0.8555	1	0.0016	1
rbio2.2	1	49.61	0.0719	137.2215	1.3125	1	0.0024	1
rbio2.4	0.9	47.54	0.0577	139.425	1.082	1	0.0021	1
rbio2.6	0.8	49.91	0.0477	141.3389	0.9793	1	0.002	1
rbio2.8	0.8	51.54	0.0487	141.1204	0.9848	1	0.002	1
rbio3.3	1	42.36	0.0682	137.736	1.2757	1	0.0023	1
rbio4.4	0.7	50.9181	0.0446	141.9998	1.0022	1	0.0019	1

It is clearly seen that, for bi-orthogonal 6.8 wavelet, we are getting least MSE and highest PSNR of 147.6272 db with fixed CR. From the above observation table it is more cleared with mathematical formulae support, that bi-orthogonal type 6.8 wavelet is best suitable for medical image.

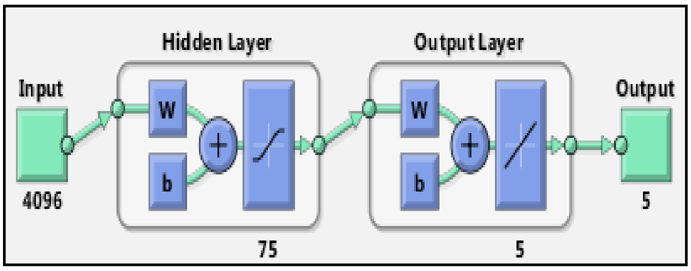

Fig. : Train Nueral Network final Parameter

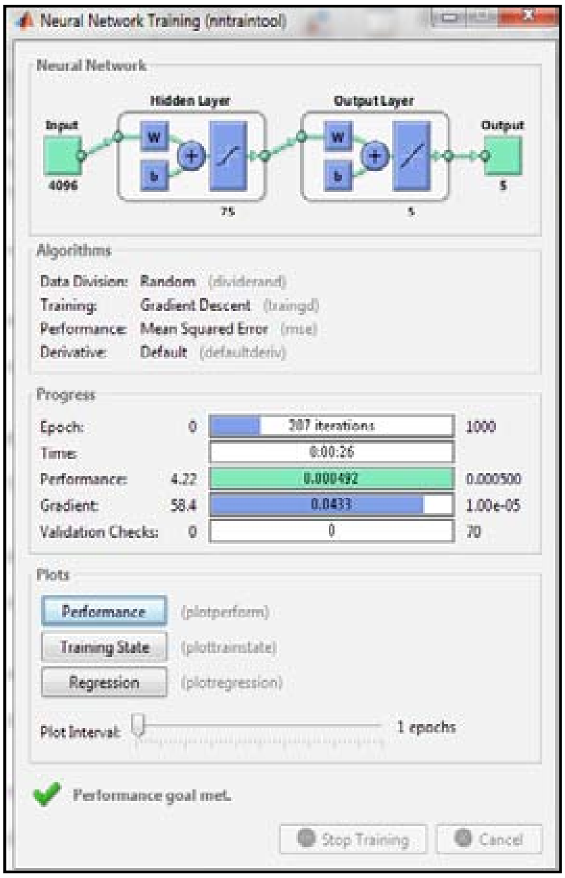

Fig. : Nueral Network Training

VIII. Conclusion

When we have done selection of best wavelet for medical Radiographs. Then to compress input image with each wavelet with fixed CR. After that to find the following parameters to make comparison MSE, PSNR, Correlation, Average difference, normalized absolute error, Structural content. Then we have database using selected wavelet. And then to save each with its optimum compression ratio using subjective and objective evaluation. To train and testing of neural network. And then apply input image to neural network with unknown CR. To compress this image with CR defined by neural network. It is clearly seen that, for bi-orthogonal 6.8 wavelet, we are getting least MSE and highest PSNR of 147.6272 dB with fixed CR. From the above observation table it is more cleared with mathematical formulae support, that bi-orthogonal type 6.8 wavelet is best suitable for medical image.

IX. Future Scope

In future we can apply JPEG (Joint Photographic Expert Group) compression method instead of threshold for finding better compression. Another scope is to optimized the compression method by using AI (Artificial Intelligence) algorithm

References

[1]. *K. Tomar and A. Khuteta, "Perfect Compression Technique in Combination with Training Algorithm and Wavelets" on Communication Systems and Network Technologies (CSNT), 2013 International Conference on Digital Object Publication Year: 2013*

[2]. *Marta Mrak, Sonja Grgic and Mishav Grgic, "Picture Quality Measures in Image Compression Systems." Proceeding in EUROCON 2013*

[3]. *Ljubljana, Slovenia.G Boopathi and S Arockiasamy, "Image compression: Wavelet transform using radial basis function (RBF) neural network" has published by IEEE in 2012*

[4]. *M.M Sevak and F.N Thakur and R.K Kher, "CT Image Compression using Compressive Sensing and Wavelet Transform" on Communication Systems and Network Technologies (CSNT), 2012 International Conference on Digital Object 2012*

[5]. *Adnan Khashman and Kamil Dimililer, "Medical Radiographs Compression Using Neural Networks" has published by IEEE members in 2009.*

[6]. *V. K. Bhairagi and A. M. Sapkal, "Selection of Wavelets for Medical Image Compression." Proceeding in 2009 International Conference on Advance in Computing, Control, and Telecommunication Technologies.*

[7]. *Kamrul Hasan Talukder and Koichi Harada, "Wavelet Based Approach for Image Compression and Quality Assessment of Compressed Image." Proceeding in IAENG International Journal of Applied Mathematics in Feb 2007.*

[8]. *Adnan Khashman and Kamil Dimililer, "Comparison Criteria for Optimum Image Compression." Proceeding in EUROCON 2005 Serbia & Montenegro, Belgrade, Nov 22-24, 2005.*