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Calibration of Osteoporosis Using Artificial Neural Network

M. Aruna
Maharaja Institute Of Technology, Coimbatore
arunashaloom@gmail.com

Abstract: Osteoporosis is a very common Bone disease that leads to Fracture. Electromyography (EMG) is a major diagnostic tool used for analyzing the health of muscles and the nerve cells that control them (motor neurons). Motor neurons transmit electrical signals that cause muscles to contract. An EMG translates these signals into graphs, sounds or numerical values that a specialist interprets which lead to calibrate the Bone Mineral Density (BMD) value. This work aims to predict the level of Osteoporosis disease. Here we extract some features like variance, entropy, correlation, band power, median, normalization, etc. These feature values are used as inputs to train classifiers like artificial neural networks. After the training, we test the classifier with test EMG data.

Keywords: Bone Mineral Density (BMD), Osteoporosis, Electromyography (EMG), Artificial Neural Network (ANN).

1. INTRODUCTION

The osteoporosis fracture has become a significant social and health problem with definite pathological, physiological and economic consequences. It is therefore very urgent to carry out early warning testing and diagnosis of osteoporosis, with related effective interventions and treatments as well. The World Health Organization (WHO) defines osteoporosis as "the system for metabolic bone diseases", with characteristics of "low bone mass" and "degeneration of bone microarchitecture", which leads to increasing osteoporosis. This definition emphasizes the bone mass, paying more attention to the quality of the bones, such as the micro architecture of the bones. The definition of bone micro architecture is the connection degree between the three-dimensional construction of bone trabecular and the trabecular. The bone trabecular are highly complex, anisotropic materials, which could bear the different sized tensile and compressive stresses. Studying the anisotropy of the bone trabecular is the key to the accuracy of the biomechanical analysis, which reflects the problems of the consistency of bone trabecular. Similarly, compared with the bone mineral density (BMD), which would be the determinant of the osteopsathyrosis. Applying different techniques of classification to osteoporotic bone tissue texture analysis, exploring the recognition rate of the different classification methods. In this paper, PPG and EMG signals are considered to measure the disease.

2. MATERIALS AND METHODS

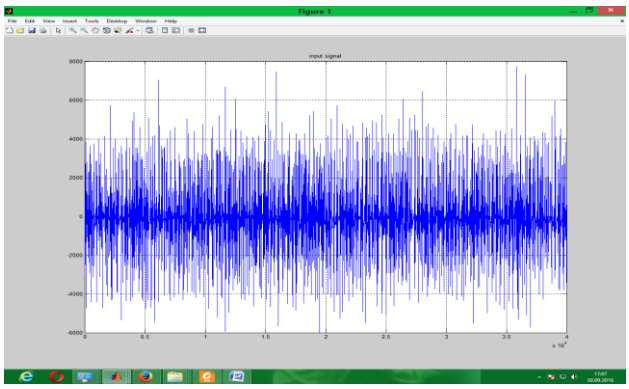
Artificial Neural Network (ANN) is just like digraphs where artificial neurons are connected to inputs and output. DEXA is the basic machine that can predict the accurate value of Bone Mineral Density (BMD). DEXA machine is preferred which is highly cost. Different techniques of classification are applied to osteoporotic bone tissue texture analysis, exploring the recognition rate of the different classification methods. The Electromyography (**EMG**) signals are used to access the health and structure of the trabecular network of muscles.

The input signal is gathered and the noise is removed from the input signal by filtering method. For the filtered signal the future values are determined. Mean, variance, etc such as 10 values are determined. The standard deviation is obtained for the measured values. The Future values are saved. The saved values are trained and tested. Here the FEED FORWARD ANN algorithm is used to get the desired output. In this algorithm, several values are given as input layer and in a hidden layer the process takes place and single output will be displayed in the output layer.

2.1 GETTING INPUT SIGNAL

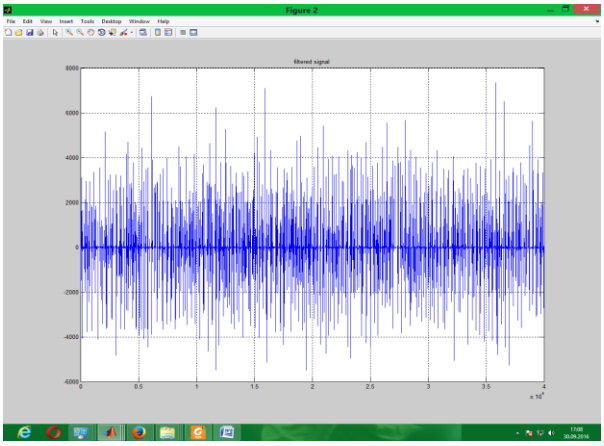
The required signal is initially gathered. Electromyography is taking in account in order to predict the Osteoporosis using the strength and structure of the muscles. Electromyography (**EMG**) is a diagnostic procedure to assess the health of muscles and the nerve cells that control them (motor neurons). Motor neurons transmit electrical signals that cause muscles to contract. An **EMG** translates these signals into graphs, sounds or numerical values that a specialist interprets. Now, the input signal gets as three categories such

as "1", "2", "3".If the input signal is "1" then the emg_1 value is loaded. Similarly, for input "2" and "3". Thus the required input value is getting and the correspondent EMG signal is loaded.



2.2 FILTERING THE NOISE

The received Electromyography signal is collected with several noises. It may lead to cause of many errors or wrong prediction of disease. So, the noise is removed or filtered from the inputted signal and saved as "a, noise". This signal is named as "filtered signal" and it is considered for further or upcoming steps.

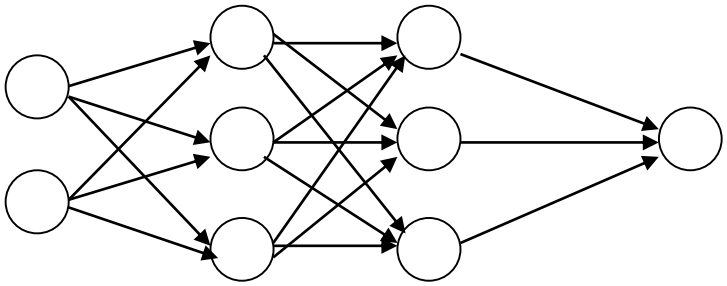


2.3 FEATURE ENHANCE

Several future values are derived and added to the inputted signal. Here, we added ten feature values such as mean, variance, entropy, skewness, kurtosis, correlation, band power, median, normalization, pwelch. These values are stored as "f1", "f2",”f10" respectively. The feature values are round off and saved in "Feature". And the standard deviation is applied to find the Bone Mineral Density (BMD) values.

2.4 CLASSIFIER

Mainly, the trading section is carried out in this phase. Feed Forward Network is used here for the train. Feed Forward Network always moves in the forward direction and not in backward direction. A elm based Feed Forward Neural Network is created and saved in "net1". The elm based Feed Forward Neural Network is trained using "input, target, created network" and saved in Net1.



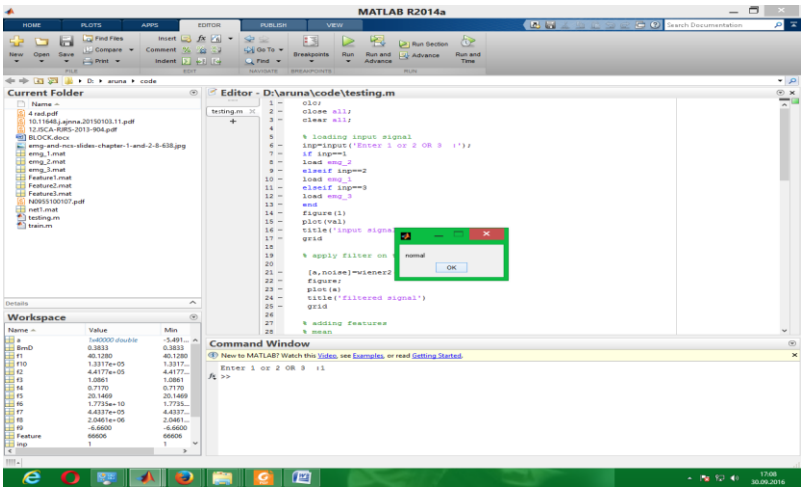
Input Layer **Hidden Layers** **Output Layer**

3. RESULT

The FFN network defines by getting the input values and operations or decision is taken in the hidden layer and finally, the single output is displayed (say"y").Finally, the output is displayed as "Normal" and "Abnormal".

The abnormal is classified as osteoponia and osteoporosis.

Diagnosis	T-score Relative to Bone Mineral Density
Normal	BMD value with in 1 SD, (T-score -1)
Osteopenia	BMD value more than 1 SD below the mean and less then 2 SD below the mean, (-1 > T-score > -2.5)
Osteoporosis	Osteoporosis BMD value 2.5 SD or more below the mean, (T-score ≤ -2.5)
Severe Osteoporosis	BMD value 2.5 SD or more below the mean with fragility fracture, (T-score ≤ -2.5)



CONCLUSION

The electromyography signal is used to predict the BMD values and the disease. The different techniques of classification are applied to osteoporotic bone tissue texture analysis, exploring the recognition rate of the different classification methods. The Electromyography (**EMG**) signals are used to access the health and structure of the trabecular network of muscles. The input signal is gathered and the noise is removed from the input signal by filtering method. For the filtered signal the future values are determined. Mean, variance, etc such as 10 values are determined. The standard deviation is obtained for the measured values. The Future values are saved. The saved values are trained and tested. Here the FEED FORWARD ANN algorithm is used to get the desired output. This can help in the prediction of Osteoporosis that leads with less economical usage.

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