International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878,Volume-7, Issue-6S5, April 2019

An Analysis of Kohonen Algorithm Addition to the Backpropagation Method in Processing of Recognizing Temperature Data

A Hasibuan, M Zarlis, H Mawengkang, P H Putra

Abstract : Climate change is a global phenomenon triggered by an increase in the average temperature of the earth air layer as the greenhouse gasincreases in the air layer. This global temperature change has been impacted on climate change. The results of this study: With the addition of the Kohonen algorithm in the back propagation method, it is faster to reach the target error if compared by using random weights. An Decreasing of squared error in the training of back propagation method with a error target of 0.009 with random weight reach 37 iterations, while the addition of Kohonen weight in the back propagation method reaches the error target of 36 iterations. The results test with the addition of kohonen in back propagation method with a error target, 0.01, 0.0095, 0.009, 0.008, 0.007 is no better than using random weights. The testing data achieves better accuracy target error 0.009 reaches 95.73% accuracy

Indexterms:Neural Network, Kohonen, Backpropagation.

I.INTRODUCTION

Climate change is a global phenomenon triggered by an increase the average temperature of the earth's air layer as the greenhouse gas increases in the air layer. Change in global temperature have been impact on climate change, such as rainfall make the season uncertain, rainfall rise and fall in an area that been the potential to cause disasters (flood or wither).

Extreme weather occurs if temperatures are too high or too low. Indeed, a temperature averaging 27.5^{o} C is perceived to be normal. Also, a temperature whose maximum is about 32.9^{o} C is perceived normal. For temperature fluctuations, only estimated values can be obtained and presented. One of the techniques through which the temperature fluctuations have been predicted involves the use of artificial neural networks.

II.RELATED RESEARCH

Kohonen neural network (KNN)model, an adaptive neural network, has been employed towards the tracking of nonlinear system controls. Furthermore, the adaptive Kohonen neural network (ADKNN) has been proposed for minimizing errors between the target signal and the input, especially in situations involving discrete-time systems [1]. Regarding the backpropagation algorithm optimization, the Nguyen Widrow technique has been proposed [2]. The role of this approach involves adjusting learning level factors in the backpropagation's backward process. For studies that have focused on BPNN as an optimum parameter, findings suggest that RMSE with BPNN exhibits a smaller error than situations where Tsukamoto Fuzzy Inference System (FIS) is used [3].

Revised Manuscript Received on December 22, 2018.

A Hasibuan, Graduate school of Computer Science, Universitas Sumatera Utara,Malaysia

M Zarlis, Graduate school of Computer Science, Universitas Sumatera Utara, Malaysia

H Mawengkang,Graduate School of Mathematics, Universitas Sumatera Utara, Malaysia Email: kabuhocan@gmail.com

III.PROPOSED METHOD

A.Algorithm Kohonen

Kohonen network can recognize and classify patterns by training of vector patterns of input data with weight vector as a link between the input screen and the competition screen in the training process [4]. KNN training involves the stages below:

a. Initial weight selection with input vector range and learning rate $\lambda \in =[0,1]$

b. Apply step 3-7, stopping criteria is false, stopping criteria may be number of iteration or learning parameter is sufficently small

c. Apply euclidean measure from input vector and weight vector, for j=1...,m

$$D\ (j) = \sum_{i=1}^{m} \sum_{j=1}^{m} (xi - wij)2$$

d. Calculate winning node say index J, so that D(j) is minimum

e. J within a specified neighbourhood of j and for all i, calculate new weights as in equation

f . Update new weigt using

$$\text{Wij(new)} = \left(1 - \lambda\right) Wij(old) + \lambda Xi$$

g Update new weight λ using

$$\lambda\ (t + 1) = 0.5 * \lambda\ (t)$$

h Calculate error and test stopping criteria of network

B.Neural Network

Artificial neural networks consist of several neurons and there are relationships between neurons as in the human brain. Nerve cells / neurons are an information processing unit that is the basis for artificial neural network operations. Each neuron has an internal state called the activation level or activity level which is the input function received. Typically a neuron sends its activity to several other neurons as a signal. Noteworthy is that neurons can only send one signal for a moment, even though the signal can be transmitted to several other neurons [5].

The workings of Artificial neural network like the way humans work, that is learning through examples. The layers of the Artificial neural network compilation are divided into 3, they are input, hidden, and the output layers. [6].

C.Backpropagation

Backpropagation is a controlled type training which uses a weight adjustment pattern to achieve a minimum error value between the predicted output with a real output. Backpropagation is a systematic method for multiplayer neural network training. This method has a strong, objective mathematical basis and this algorithm gets the form of equations and coefficients in formulas by minimizing the number of squares of error through the developed model or training set [7].

The steps in building a backpropagation algorithm are as follows [Sutojo]:

a. Initialize weights take a fairly small random value.
b. Advanced propagation stage
   1) Each input unit *(X_1, i=1,2,3,…,n)* receive a signal x_i and forward the signal to all units in the hidden layer.
   2) Each input unit *(Z_1, j=1,2,3,…,p)* sum up the weight of the input signal, indicated by the equation (4).

   $$z\_in_j = v_{0j} + \sum_{i=1}^{n} x_i\, v_{ij}$$

   To establish the output signal, an activation function is applied to give:

   $$z_j = f(z_{in_j})$$

   The activation function used is the sigmoid function, and sends the signal to all output units.
   3) Each output unit *(Y_k, k=1,2,3,…,m)* sum up the weight of the input signal, indicated by the equation (6).

   $$y\_in_k = w_{0k} + \sum_{i=1}^{p} z_i\, w_{jk}$$

   And applying the activation function to calculate the output signal, is shown by the equation (7).

   $$y_k = f(y\_in_k)$$

c. *Backpropagation*
   1) Each unit of output *(Y_k, k=1,2,3,…,m)* accepts the target pattern in accordance with the training input pattern, then calculate the error, indicated by the equation (8).

   $$\delta_k = (t_k - y_k) f'(y_{in_k})$$

   f' is an instance of the activation function.
   Then calculate the weight correlation, indicated by the equation (9).

   $$\Delta w_{jk} = \alpha \delta_k z_j$$

   And calculate the correction bias, indicated by the equation (10).

   $$\Delta w_{0k} = \alpha \delta_k$$

   At the same time send it δ_k to the units in the rightmost layer.
   2) Each input unit *(Z_j, j=1,2,3,…,p)* sums up the delta input (from the units in the layer on the right), indicated by the equation (11).

   $$\delta\_in_j = \sum_{k=1}^{m} \delta_k\, w_{jk}$$

   To calculate error information, multiply this value by the derivative of its activation function, indicated by the equation (12).

   $$\delta_j = \delta_{in_j} f'(z\_in_j)$$

   Then calculate the weight correction, indicated by the equation (13).

   $$\Delta v_{jk} = \alpha \delta_j x_i$$

   After that, also calculate the correction bias, indicated by the equation (14).

   $$\Delta v_{0j} = \alpha \delta_j$$

d. Phase changes in weight and bias
   1) Each output unit *(Y_k, k=1,2,3,…,m)* changes in weight and bias are made *(j=0,1,2,…,p)*, indicated by the equation (15).

   $$w_{jk}(baru) = w_{jk}(lama) + \Delta w_{jk}$$

   Each input unit *(Z_j, j=1,2,3,…,p)* changes in weight and bias are made *(i=0,1,2,…,n),* indicated by the equation (16).

   $$v_{ij}(baru) = v_{ij}(lama) + \Delta v_{ij}$$

   2) Stop condition test.

IV.RESULTS AND DISCUSSIONS

With pattern recognition being a target subject in the current study, the target context involves Medan city. Indeed, backpropagation ANN algorithm is employed the two stages into which the investigation is divided include data testing and data training. In the research context, the temperature data on focus involves information for the years ranging from 1998 to 2017. It is also worth indicating that the study will embrace a data normalization procedure to achieve a match between the activation function employed and the network input. The intervals at which data normalization will be implemented are [0. 1], with the choice of these values informed by the need to present the data in terms of a zero or a positive value. The choice has also been informed by the binary sigmoid nature of the activation function.The sigmoid function involves:

$$x' = \frac{0.8(x-a)}{b-a} + 0.1 \qquad (7)$$

In this case, *x* reflects the data to be normalized, *b*represents the maximum data, and *a* reflects the minimum data.

The process of data training will be preceded by data training. The main aim of this procedure will be to establish the data pattern. The table below illustrates the data training outcomes.

Table 1: Training Result

#	Error (epoch)				
	0	0.01	0.01	0.01	0.01
B	30	33	37	44	55
B + K	29	32	36	39	55

B = Backpropagation

K = Kohonen

Form the Table 1 above it can be seen that the of Kohonen weight to the addition Backpropagation faster to reach the target error.

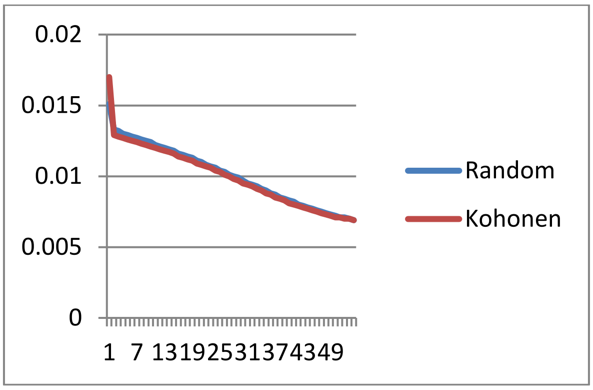

Figure 1. Decreasing Error Square

Based on the figure 1, it can be seen the decreace of error quadrance with kohonen weight addition to the backpropagation that can reaches error target 0.009 in 36 iteration mean while the with random weight reaches error 0.009 in 37 iteration. Overall, data test are done by using backpropagation weight random and backpropagation with kohonen weight addition. The results of the test can be seen in table 2 bellow:

Table 2. Testing Result

#	Error (%)				
	0.01	0.01	0.01	0.01	0.01
B	95.3	95.42	95.6	95.9	96.4
B + K	95.3	95.38	95.7	95.9	96.2

B = Backpropagation
K = Kohonen

In table 2, it can be seen the results of the test with the Kohonen combination weight addition to the Backpropagation is better than the random weight. Backpropagation with the addition of Kohonen weight addition can recognize the testing data which reaches 95.73% accuracy.

V.CONCLUSION

From the results of the study, some conclusions can be drawn, including: With the addition of the Kohonen algorithm to the backpropagation method, it is faster to reach the target error when compared to using only random weights (see table 1). The decrease in squared error in the training of the backpropagation method with a target error of 0.009 with random weight reaches 37 iterations, while the addition of kohonen weight in the backpropagation method reaches the target error of 36 iterations (see table 1). The test results of the addition of kohonen in the backpropagation method with a target error, 0.01, 0.0095, 0.009, 0.008, 0.007 is no better than using random weights. Where the testing data achieves better accuracy only the target error of 0.009 reaches 95.73% accuracy (table 2).

REFERENCES

1. Uday P S, Tiwari A, et al. 1989,Kohonen Neural Network Model References For Nonliniear Discrete Time Systems, 3rd IEEE International Conference on "Computational Intelligence and Communication Technology.
2. Ulfi Andayani, et al, 2017, Optimization Backpropagation Algorithm Based on Nguyen-Widrow Adaptive Weight and Adaptive Learning Rate,International Conference on Industrial Engineering and Applications.
3. Ida Wahyuni, et al, 2017, Modeling Backpropagation Neural Network For Rainfall Prediction In Tegger East Java, International Conference On Sustainable Information And Technology.
4. Rezzy Eko Caraka, Aplikasi Penggunaan Metode Kohonen Pada Analisis Cluster (Studi Kasus: Pendapatan Asli Daerah Jawa Tengah Dalam Menghadapi Asean Community 2015), Paper For Nation.
5. Puspaningrum, D. (2006). *Pengantar Jaringan Syaraf Tiruan.* Yogyakarta : Andi Offset
6. Sutojo, T., et al, 2010, Kecerdasan Buatan, Yogyakarta: Andi Offset.
7. F.Suhandi, Krisna. 2009, Prediksi Harga Saham Dengan Pendekatan Artificial Neural Network Menggunakan Algoritma Backpropagation..