Neural Network Data Modeling and Its Application on Effect Analysis of Head and Shoulder Acupoint Massage

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***Abstract*—In this paper, a neural network (NN) data modeling method is proposed to analyze the relationship between the inputs and output of a complex system. Meanwhile, the data analysis method is applied on the scientific study of head and shoulder meridian acupoint massage. First, the NN data model is introduced by involving relationship weightings and trained by the least-square method. Next, the experiments of head and shoulder massage are performed by massaging five important meridian acupuncture points in a standard manner, while the heart rate variability of each subject is evaluated before and after the massage. Then, the NN data analysis indicates the validity and effect of the massage, and the result is checked with a statistical method. Thus, the stress relaxing effect of massaging head and shoulder meridian acupoints can be obtained from the NN data analysis.**

Keywords—Neural Network, relationship analysis, meridian acupuncture.

I. Introduction

Artificial neural network (ANN) has widely been applied on engineering systems, such as data classification [1], control systems [2, 3], communication [4], etc. The main benefit is that the ANN can be trained to approximate system behaviors based on the back-propagation neural network (BPNN) method, such that the ANN provides an alternative method to solve complicated and nonlinear problems (e.g., [1, 5]). Fault tolerance and free mathematical model are allowed, so that ANN is robust for artificial applications of engineering problems. Furthermore, the learning convergence of the neural network has been proven with high accuracy, cf. [6]. Unfortunately, although the data learning is able to be achieved by the BPNN, the applications on data relationship analysis are lacked in literature. This is because the BPNN can model only the input/output function but lack capability of relationship clarification. Thus, the BPNN cannot be easily applied on data relationship analysis. This is the reason for developing a new data analysis method.

The meridian therapy is very popular in complementary medicine. Different to traditional medicinal treatments, the meridian therapy takes acupuncture massage to palliate the symptoms of patients [7]. In the traditional Chinese medicine, the meridian acupuncture massage is performed to relax headaches, dizziness, stiff neck, shoulder and back pain, etc. There are many researches proposed to study the effects and mechanisms of the meridian therapy [8, 9]. For example, the stress can be relaxed by the back massage [10]. Indeed, the effect of reducing stress has been received much attention in the meridian therapy because most of people have high stress in daily life [11]. If the stress is not properly adjusted, then chronic stress will induce various physical and psychological bad responses. Although the works [10, 11] indicate the stress release after body massage, the evaluation on stress change is only according to data statistics of blood pressure, heart rate, and feeling of the patient. On the other hand, some researches (e.g., [12, 13]) measure the heart rate variability (HRV) to evaluate the effect of meridian massage therapy for more scientific study. However, since a lot of experimental data are required for accurately studying the effect, these works still cannot find the interaction model from incomplete data statistics of the physiological change due to the massage therapy. In other words, although Chinese meridian theory [7] claims that massaging acupuncture points on head and shoulders are related to improve the body stress, interaction quantitative analysis is lacked in current literature. No integrated method can offer explanation of the impact and physiological changes due to the head and shoulder acupoint massage. Thus, a more detailed analysis method is required for studying the meridian massage therapy.

Motivated by the above, this study will propose a new neural network data modeling method for analyzing relationship between inputs and output of a complex data system. The proposed NN modeling can be used for assistant data mining applications. First, the NN data model is introduced by involving relationship weightings for coupling the analyzed data sequences (which is the influence sequences) with inputs of the neural network. If the neural network can be well trained such that the output of the data system (i.e., main factor sequence) is accurately simulated from the weighted inputs, then the proposed NN model is reduced to the relation from the influence sequences to main sequence. This means that the relationship weighting can indicate the affection of the inputs to output of the data system. Next, the backpropagation training approach is utilized to solve the data learning problem. For demonstration, the NN data analysis method will be

This work was supported by Ministry of Science and Technology, R.O.C. under grants MOST 104-2221-E-033-050.

applied to investigate the effect of massaging acupuncture points on the head and shoulders. Afterward, the study method of the head meridian acupoint massage is given by introducing the acupoint massage therapy and measuring physiological factors of the HRV to evaluate the status change of autonomic nervous system before and after the massage. Here the important physiological factors include: physiological stress index (PSI), very low frequency (VLF) power, low frequency (LF) power, high frequency (HF) power, and total power (TP). Total 24 mid-aged women in Taiwan join this experiment for four weeks, while all the test subjects are with long-term work stress and high PSI before the massage. Furthermore, the NN data modeling is applied to find the relationship between the head massage and each physiological factor of HRV. The head and shoulder meridian massage relaxes the stress and improves autonomic nervous system function. The detailed physiological action principle of the h massage is understood from integrating the statistic and NN data modeling analysis. The result shows the validity of the NN data modeling method and verifies the effect of the head and shoulder meridian massage.

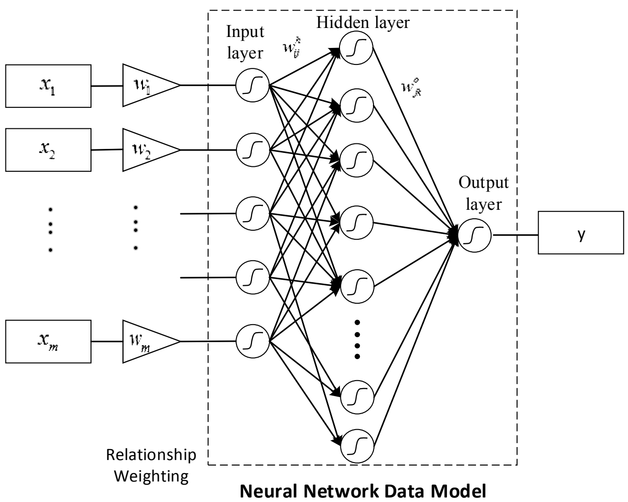

Fig. 1 Relationship analysis structure of neural network data modeling.

II. Neural Network Data Mining

This section applies the artificial neural network (NN) learning method to construct the data model of some complex systems and further to analyze the input/output action relationship of the complex systems. Here, we consider the complex system described by some uncertain and incomplete data which is obtained from sever experiments and data recording. The data system is assumed to be with only one main output and sever inputs. Although the traditional neural network can model the data system from learning, the relationship between the input and output is failed to find. To this end, the new neural network data modeling structure is proposed as shown in Fig. 1. The main concerned factor of the system is taken as the major sequence factor, i.e., the output of the NN data model. Meanwhile, the other factors are taken as the influencing sequence factors, i.e., the inputs of the NN data model. Moreover, to understand the relationship between the influencing sequence factors and the major sequence factor, each influencing sequence factor is multiplied with a relationship weighting before input to the NN model (see Fig. 1). This means that the relationship weighting w_i will describe the importance from influencing sequence factors to the major sequence factor. The importance rank is inversely proportional of the value of relationship weighting. Also, the relationship weighting can represent the characteristic of the action system or process. This means that the change of relationship weighting of the NN data modeling structure can point out the resultant status of the action system. Thus, the NN data modeling method is introduced and applied to identify the relationship weightings in the following.

First, let us denote the data sequence of the main factor as y to be the desired output the neural network, i.e.,

$$y = (y(1), y(2), \ \dots \ , y(L))$$

where $y(k)$ is the *k*-th data of the main factor sequence; and L is the sequence length of the measured data. The data sequences of influence factors are respectively defined as follows:

$$x_1 = (x_1(1), x_1(2), \cdots, x_1(L))$$
$$x_2 = (x_2(1), x_2(2), \cdots, x_2(L))$$
$$\vdots$$
$$x_m = (x_m(1), x_m(2), \cdots, x_m(L))$$

where total m data factors are considered; and $x(k) = [x_1(k)\ x_2(k)\ \cdots\ x_m(k)]^T$ is the input data. In other words, the data patterns are denoted as $(x(k), y(k))$, for $k = 1, 2, \dots, L$. Before feeding the data patterns to the artificial neural network, the data of each influence factor is respectively multiplied with a relationship weighting w_i, i.e., the input sequences of the artificial neural network are

$$z_i(k) = w_i x_i(k) \tag{1}$$

where $i = 1, 2, \dots, m$. Since the measured data is not dynamic sequence, the traditional artificial feed-forward network is used for modeling our static data, i.e., the neural network is a multilayer perceptron network without any recurrent propagation path as shown in Fig. 1. Without loss of generality, all the neurons of the neural network are acted by a sigmoid activation function *f*(*net*) defined below:

$$f(net) = \frac{1}{1 + \exp(-net)}$$

where *net* denotes the net internal activity level of one neuron. It is worthwhile to note that the neurons of the input layer are also involved with activation functions to represent the effect of the relationship weighted data z_i. The weighted input data is transformed into the normal data region for the neural network. Thus, from the viewpoint of the neural network, the relationship weighting w_i can represent the importance or influence level once the neural network model completely simulates data characteristics.

Next, in the input layer of the neural network, the net activity level of the i-th neuron is z_i, so that the output of the i-th neuron is

$$q_i(k) = f_i(z_i(k)) = f_i(w_i x_i(k)) . \tag{2}$$

In the hidden layer, the net input for the j-th hidden neuron is

$$net_j^h(k) = \sum_{i=1}^{m} w_{ij}^h q_i(k) \tag{3}$$

for $j = 1,2,..., N$, where the superscript 'h' denotes the hidden layer; N is the number of the used neurons in the hidden layer; and w_{ij}^h is the weighting from q_i to net_j^h. The output of the neuron in the hidden layer is

$$p_j(k) = f_j^h(net_j^h(k)) \tag{4}$$

In the output layer, the net activity level for the neuron is

$$net^o(k) = \sum_{j=1}^{N} w_j^o p_j(k) \tag{5}$$

where the superscript 'o' denotes the output layer; and w_j^o is the weighting from p_j to net^o. As a result, the output of the neuron in the output layer is

$$\hat{y}(k) = f^o(net^o(k)) \tag{6}$$

Afterward, the relationship weighting and the weightings of the neural network should be adjusted to let the output $\hat{y}$ completely simulating the desired output y. The backpropagation training approach is utilized to solve this problem. Let the training squared error be

$$E = \frac{1}{2}(y(k) - \hat{y}(k))^2$$

By substituting (1)-(6) for $\hat{y}(k)$, the weights are updated according to the least-square method. The steepest-descent values are calculated as follows:

$$\Delta w_j^o = -\frac{\partial E}{\partial w_j^o} = e(k)\hat{y}(k)(1-\hat{y}(k))p_j$$

$$\Delta w_{ij}^h = -\frac{\partial E}{\partial w_{ij}^h} = \delta_o w_j^o p_j (1-p_j) q_i$$

$$\Delta w_i = -\frac{\partial E}{\partial w_i} = \sum_{j=1}^{N} \delta_j^h w_{ij}^h q_i (1-q_i) x_i$$

where $\delta_o = e(k)\hat{y}(k)(1-\hat{y}(k))$; and $\delta_j^h = \delta_o w_j^o p_j (1-p_j)$. Then, the weights at the t-th training iteration are updated by the forms:

$$w_j^o(t+1) = w_j^o(t) + \eta\delta_o p_j + \gamma(w_j^o(t) - w_j^o(t-1)) \tag{7}$$

$$\begin{aligned} w_{ij}^h(t+1) &= w_{ij}^h(t) + \eta\delta_o w_j^o p_j (1-p_j) q_i \\ &+ \gamma(w_{ij}^h(t) - w_{ij}^h(t-1)) \end{aligned} \tag{8}$$

$$\begin{aligned} w_i(t+1) &= w_i(t) + \eta\sum_{j=1}^{N} \delta_j^h w_{ij}^h q_i (1-q_i) x_i \\ &+ \gamma(w_i(t) - w_i(t-1)) \end{aligned} \tag{9}$$

with the learning rate η and the momentum parameter $0 \le \gamma < 1$ (i.e., the last term is the addition of a momentum term). Based on the above least-square training method, the error E is minimized. To obtain the best data modeling, all the data patterns $(x(k), y(k))$ are iteratively used in the backpropagation learning procedure. If the NN data model can completely simulate the system process, then the relationship weightings act the roles that map the input to the NN data model and to obtain the output. Since the relationship weighting w_i can represent the characteristics from the influence factors to the main factor, the coefficients w_1, ..., w_m carry the intrinsic information contained in the data sequences. When the data property is changed, the relationship weighting is changed. From the change of the relationship weighting, the status is observed to distinguish the effect of the system process.

III. Application on Effect Data Analysis of Head Meridian Acupoint Massage

A. Experimental Method of Head Massage

To understand the effect of the head meridian acupoint massage, the experiments of the head massage are performed, while the NN data analysis method is applied. First, let us introduce five important meridian acupuncture points on the head and the shoulders.

EX-HN5 (Taiyang): Taiyang acupoint is an extraordinary acupuncture point. The EX-HN5 acupoint is in the depression about one finger-breadth behind the midpoint of a line connecting the lateral end of the eyebrow and the outer canthus of the eye.

UB10 (Tienzhu): Tienzhu acupoint is on urinary bladder meridian which is located about 5cm lateral from the midline in the depression on the lateral aspect of the trapezius muscle.

Du16 (Fengfu): Du16 is an important point at the Du meridian which is located superiorly about 3 cm on the edge of the thumb joint which is directly below the occipital protuberance on the posterior midline of the head.

GB20 (Fengqi): Fengqi acupoint belongs to the gall bladder meridian which is located laterally to the sternomastoid and the trapezius muscles in the back below the occipital bone.

GB21 (Jianjing): GB21 is on the midway between the spinous process of cervical vertebra and the acromion process at the highest point of the trapezius muscle. Massaging this point may effectively relieve a stiff neck, neck pain and shoulder and back pain.

Although some actions and effects of massaging these acupuncture points are claimed in Chinese medicine, scientific analysis is lacked in related researches. Thus, the massaging effect to autonomic nerve activity will be estimated and analyzed by the proposed NN modeling method.

Next, the scientific experimental method of the head massage is described in the following. In our experiments, since the heart rate variability (HRV) can reflect the mutual influence between the sympathetic nerve and the parasympathetic nerve. Here the heart rate variability (HRV) is measured by a heart rate variability analyzer, SA-3000P, and is transformed in the Power Spectral Density including physiological stress index (PSI), total power (TP), very low frequency (VLF) power, low frequency (LF) power, and high frequency (HF) power. These physiological indices are related to emotion and stress of subjects.

Table 1. The averaged sequenced values before massage.

GREY FACTORS	y	x_1	x_2	x_3	x_4
SUBJECTS	PSI	TP(ms2)	VLF(ms2)	LF(ms2)	HF(ms2)
01	38.09	1797.85	770.11	670.26	357.11
02	82.06	683.10	297.60	179.24	205.64
03	25.86	1685.74	524.09	371.14	790.71
04	42.72	1392.84	561.71	319.80	511.33
05	63.26	1186.25	466.13	428.13	290.50
06	44.21	1156.71	258.54	537.44	360.74
07	67.96	579.73	328.29	163.34	88.09
08	38.55	1325.08	447.01	572.10	305.98
09	32.88	1493.45	635.47	606.76	251.22
10	41.73	1165.58	425.87	280.80	458.92
11	43.30	2102.25	904.75	733.75	463.00
12	119.75	414.51	175.36	108.37	130.02
13	90.69	718.25	200.00	345.25	172.50
14	21.32	4598.75	2090.75	1937.00	571.00
15	76.32	953.61	405.42	357.57	190.62
16	105.22	566.25	187.68	226.44	152.14
17	56.01	2658.25	1145.38	1141.13	371.75
18	70.54	2506.25	1133.06	1022.69	350.51
19	38.51	1076.12	322.57	362.34	391.20
20	135.16	360.50	138.06	106.31	116.01
21	35.88	1415.10	615.21	438.54	361.35
22	37.85	1457.39	434.35	594.74	428.31
23	91.20	938.46	265.31	380.38	292.75
24	35.89	1500.08	495.02	573.60	431.46

Table 2. The averaged sequenced values after massage.

GREY FACTORS	y	x_1	x_2	x_3	x_4
SUBJECTS	PSI	TP(ms2)	VLF(ms2)	LF(ms2)	HF(ms2)
01	27.26	2145.09	604.52	750.00	803.20
02	57.65	1028.64	289.92	365.22	360.98
03	22.30	2049.12	524.03	568.10	932.14
04	25.36	1596.35	400.63	338.29	857.43
05	46.23	1728.75	582.13	552.13	606.88
06	30.14	2275.88	949.83	617.87	733.18
07	50.69	1067.97	404.82	283.35	404.79
08	26.79	2389.41	801.95	772.93	801.98
09	23.44	2502.94	754.11	952.96	795.85
10	36.24	1446.79	368.57	611.45	466.76
11	31.09	1787.25	718.50	521.25	546.75
12	79.06	610.50	236.25	119.00	255.00
13	70.80	1325.75	465.00	483.00	377.75
14	14.82	1416.00	595.00	331.25	489.25
15	51.25	1556.58	495.18	535.98	525.42
16	74.93	968.00	350.63	301.00	316.38
17	42.81	1370.63	530.00	407.13	433.50
18	41.76	1012.88	415.63	225.13	372.13
19	36.49	1558.62	464.43	425.73	668.46
20	91.64	532.88	199.50	157.50	175.88
21	24.40	2049.65	577.37	645.62	826.64
22	28.20	1801.92	623.67	567.86	597.89
23	67.45	1503.63	531.94	603.63	368.06
24	25.34	1970.60	705.12	497.23	780.77

For the experiments, a quiet room is chosen as the test site to reduce the environmental affection. The test is performed at a specific time from 18:00 to 21:00 in everyday to avoid interference of the heart rate variability for the time difference. Medication, stimulating drinks, such as coffee, tea, alcohol, hunger or overeating are avoided for subjects. Each subject takes a rest before the testing, then the physiological data of the autonomic nervous system is measured before the head massage. Afterward, the massage of meridian acupuncture points is performed in turn from EX-HN5, GB20, UB10, Du16, to GB21 for the subject. Acupuncture points are massaged by using thumbs or middle-fingers of two hands. The gesture is clockwise iteratively in a fixed tempo and a comfortable strength about 1 minute for each acupuncture point. We also relax the neck and knead the neck from Fengqi to the shoulders in slight force strength. The massage process is performed by one massagist who has perfect hand skill. The acupuncture points can be correctly located, while the massage strength is properly controlled for uniform experiments. Finally, the physiological data of the autonomic nervous system is measured again after the massage. The same test procedure is done one time per week and continued four weeks for all subjects.

Table 3. NN Relationship weighting before head massage.

No./Factor	TP	VLF	LF	HF
1	1.0965	1.7262	2.4069	4.6211
2	1.0291	1.7454	2.4051	4.6729
3	1.0148	1.7439	2.4623	4.5244
4	1.0484	1.6918	2.3418	4.5251
5	1.0900	1.7177	2.4521	4.5788
6	1.0331	1.7357	2.4281	4.5951
7	1.0061	1.741	2.4633	4.5957
8	1.1118	1.7251	2.3564	4.613
9	1.1060	1.7398	2.4253	4.5587
10	1.0383	1.7351	2.4246	4.6444

Table 4. NN Relationship weighting after head massage.

No./Factor	TP	VLF	LF	HF
1	2.3816	3.8566	4.5205	1.1473
2	2.3823	3.8219	4.0698	1.1315
3	2.4138	3.6847	4.0477	1.0597
4	2.5102	3.7923	4.4012	1.1604
5	2.5807	3.6348	4.6009	1.0967
6	2.4963	4.1892	3.0151	1.143
7	2.4532	3.8816	4.0653	1.059
8	2.5097	3.9010	4.5214	1.0557
9	2.4306	3.9764	3.3305	1.2603
10	2.4838	3.6290	4.7484	1.2215

In this study, total 24 women with long-term work stress are chosen as the test subjects, who are averaged from 25 to 55 year old. All subjects are without symptoms or histories of cardiovascular or other diseases. After acupuncture point massaging experiments applying the above stated method on all subjects in four weeks, the HRV data are obtained to observe the changes of the activity status of autonomic nerves before and after massage. Note that the data is not shown here due to the space limit.

B. Application of NN Data Analysis

To understand the status change of the autonomic nervous system after the head massage, the proposed NN data modeling method is applied on the measured data. First, we take the mean of the data in 4 weeks as our analyzed data base, and Table 1 and Table 2 respectively show the averaged data of 4 weeks before and after the head meridian acupoint massage for each subject. Here the PSI is taken as the major sequence factor, i.e., the output of the NN data model. Meanwhile, the TP, VLF, LF, and HF are taken as the influencing sequence factors, i.e., the input of the NN data model. According to the NN model in Fig. 1, we let the factors as y = PSI, x_1 = TP, x_2 = VLF, x_3 = LF, and x_4 = HF. Before applying the NN based data modeling, the measured data in Tables 1 and 2 are pre-formulated to meet the discussed region of the NN model. The output of the NN y should be confined to 0~1 due to the use of the sigmoid activation function, while the regions of input data x_i are confined to -1~1. By feeding the transformed data sequences into the NN model, each influencing sequence factor is multiplied with a relationship weighting which means the relationship between the influencing sequence factors and the major sequence factor. The relationship weighting w_i will describe the influence level from physiological factors of HRV to the stress potency. Also, the relationship weighting can represent the characteristic of the resultant physiological situation for the massage. This means that the change of relationship weighting of the NN data modeling structure before and after the test can point out the effectiveness of the head acupoint massage.

On the other hand, the input layer of the neural network has 4 neurons, the hidden layer is set with 15 neurons, and the output layer has only one neuron. Initially, the weights w_i, w_{ij}^h, and w_j^o are set with random values in [-1, 1]. The learning rate is chosen in 0.6, while the momentum parameter is set to $\gamma = 0.97$. Then, the backpropagation learning method (7)-(9) is used, such that the NN model is adjusted to emulate the data behavior. Each learning process is totally carried out in 500 learning iterations. After the learning process, the measured influencing factors x_i, for $i = 1,2,...,4$, are fed into the NN model for testing the accuracy of the NN model. To justify the performance of the NN model, we define the averaged percentage of the learning error below:

$$\bar{e} = \frac{1}{L}\sum_{k=1}^{L}\left|\frac{\hat{y}(k) - y(k)}{y(k)}\right| \times 100\%$$

where $\hat{y}(k)$ is the re-constructed value of the main factor PSI from the trained NN model output. In this study, it is accepted that the desired error percentage is below 7%. If the error percentage is not below 7% after 500 learning iterations, the NN model will be re-initialized and re-trained by the backpropagation method until the tested error percentage is acceptable. Then, the relationship weighting is recorded. Since the initial values of the weights will affect the learning result, several series of the relationship weighting are recorded to represent the physiological characteristic of the head massage. Finally, total 10 series of the relationship weighting are recorded as shown in Table 3 and Table 4 for the data before and after the head acupoint massage, respectively. By taking the average of Tables 3 and 4, the relationship weightings of physiological factors for the pre-test and after head massage treatment are given in Table 5. Accordingly, the importance rank of influence factors is obtained in turn from the values of the relationship weightings (from small to big). Based on these NN data analysis results, the action rules of the head massage can be indicated and discussed in the next section.

Table 5. The results of NN modeling analysis.

Weighting	TP	VLF	LF	HF
Before	1.05741	1.73017	2.41659	4.59292
After	2.46422	3.83675	4.13208	1.13351

IV. Results and Discussion

After using the NN data mining method, the detailed action principle of massaging of head and shoulder acupuncture points can be obtained from the analyzed result in Table 5. First, the NN relationship weighting of each physiological index has obviously changed after acting massage from the acupuncture points EX-HN5 to GB21 of head and shoulders through four weeks. According to the NN relationship weighting, the head and shoulder meridian acupoint massage has high influence to the autonomic nervous system of subjects. This is one powerful proof for the effect of head and shoulder meridian acupoint massage. Furthermore, since the influencing level is inversely proportional to the NN relationship weighting, the importance of the influencing factors is changed before and after acting the massage from Table 5. The importance rank of the physiological factors before the head massage is sequentially

$$\text{TP} > \text{VLF} > \text{LF} > \text{HF}$$

The importance rank of the physiological factors after the massage follows

$$\text{HF} > \text{TP} > \text{VLF} > \text{LF}.$$

The fact that the influencing level of HF becomes larger indicates the activity of parasympathetic nerves is enhanced. The activity of sympathetic nerves is reduced due to that the influencing levels of LF and VLF factors become lower. As a result, the balance of the autonomic nervous system is improved after performing the meridian acupoint massage at head and shoulders. This implies that the capability of subjects for coping with stress is increased. Thus, from the above quantitative description, the acupuncture point massage links a strong relationship between the physiological changes of the autonomic nerves, parasympathetic nerves, and stress regulation.

To run cross validation, the physiological change can be also observed from averaging each factor data of all subjects. Figure 2 illustrates the averaged PSI value of subjects during four weeks, where the effect of meridian massage is obviously observed from the PSI reduction. Moreover, the relaxation effect of PSI is averaged 28.4% with respect to the pretest PSI

59.8. This effect matches the big change of the relationship weighting in the NN data models before and after massage. In other words, the stress is able to be reduced by massaging acupuncture points EX-HN5 through GB21. In terms of total power (TP), the total power value has been increased after the massage as shown in Fig. 3, so that subjects will feel vital and relax tiredness caused by long-term fatigue.

From Fig. 3, the averaged HF value of the HRV after the massage is higher than that of the value before the massage, where this phenomenon satisfies the influence level change of HF in the NN model analysis. This means that the activity of parasympathetic nerves is increased. Meanwhile, Fig. 3 illustrates that the LF has reduction, which implies that the sympathetic nerve comes down. In other words, the stress relief of massaging head and shoulder meridian acupoints is achieved by regulating the activity balance of sympathetic and parasympathetic nerves. Thus, the statistic results match with the NN data analysis, i.e., the NN data mining method is significant. In addition, the above result can be a reference for stress relief by massaging meridian acupuncture points of Chinese medicine.

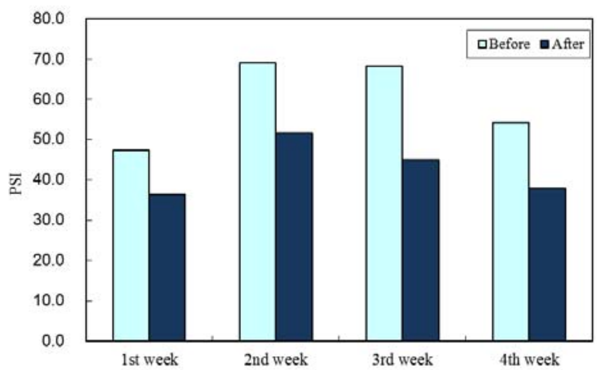

Fig. 2 The averaged PSI of all subjects during 4 weeks.

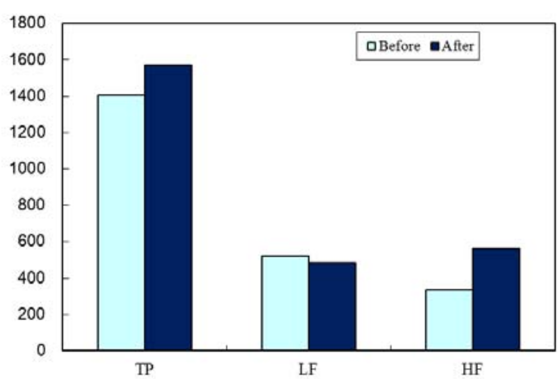

Fig. 3 The change of the averaged TP, LF, and HF.

V. Conclusions

In this paper, the neural network data mining method is proposed and applied on analyzing the effect of massaging acupuncture points on the head and shoulders. Different from traditional neural networks, the relationship weighting is involved in the data model such that the influence level of inputs to output can be observed. Moreover, the relationship weighting can be found in an easy learning method. In the application on analyzing the effect of massaging the acupuncture points from EX-HN5 to GB21, the results match with the statistical method, where the physiological stress is relaxed and the autonomic nervous system is improved. In addition, we have explored the detailed action of autonomic nervous system due to acting head and shoulder massage. The result offers clear explanation of the physiological changes for head and shoulder meridian acupoint massage which was not scientifically studied in previous health care. Consequently, the NN data analysis is significant.

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