Novel Learning Algorithm for System Model of Traditional Chinese Drug Fumigation

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***Abstract*—Using control method to explain medical phenomenon is currently a hot subject of research. The traditional Chinese drug fumigation steaming treat protrusion of protrusion of protrusion of lumbar intervertebral disc with steam generated by boiling medicinal herbs, and this process is a typical non-linear, multivariable, and strong coupling. Experienced nurse and doctor cure patient by their experience. So establish a model of this process can discover more factor of the disease, better treat to protrusion of protrusion of protrusion of lumbar intervertebral disc and reduce of energy consumption.**

The novel learning algorithm which is combined Ying learning algorithm with fuzzy neural network is proposed in this paper of traditional Chinese drug fumigation fume to cure protrusion of protrusion of protrusion of lumbar intervertebral disc. Proper data pretreatment can improve the accuracy of model. The new way handle of date pretreatment and create a new local space by K-Vector Nearest Neighbors to remove extraneous matter from learning set. This method automatically adjusts fuzzy rules and networks weights based on local space to fit sampling data. The identification model can reveals pathological mechanism of protrusion of protrusion of protrusion of lumbar intervertebral disc. The controller can adjust heater output power based on this model at the state of energy conservation. The simulation results show that the identification model is true and result is feasible. Compared with other methods, the new controller has better dynamics performance and anti-interference capability.

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***Index Terms*—Medical data mining, K-VNN, protrusion of protrusion of protrusion of lumbar intervertebral disc, Ying Learning algorithm, dynamic fuzzy neural network, nonlinear system,**

I. INTRODUCTION

The traditional Chinese drug fumigation fume or steaming treat diseases with fume in moxibustion or with steam generated by boiling medicinal herbs, and its process is a typical non-linear, multivariable, strong coupling. In addition, its characters are difficult to quantitative analysis. So the period of treatment is only determined by experience of doctors. Therefore, there is theoretical and practical significance in studying of traditional Chinese drug fumigation medical data mining.

Now days, medical data mining is new studying direction in interdisciplinary branch of science[1]. The paper [2] introduces the method of performing medical data mining. By applying the process of medical data mining, hospital can identify trends, orderliness and abnormity which are useful for clinical diagnosis, research and teaching. The integrated analysis method based on functional genome information and network topological structure information mining atherosclerotic risk disease gene in paper [3]. This method is helpful for accurately distinguishing the disease genes and non-disease genes in the protein-protein interaction network, and building relationship between two types of these genes. Paper [4] applies a new algorithm that deletes the redundant models and rules, meets the demand of the medical diagnosis and improves the effectiveness in the medical field. The paper [5] applies data mining techniques to pick up the hidden rule in the data warehouse and improve the utilization of medical information. A multi-Agent meta-learning framework is presented in paper [6] which incorporates multi-agent system and meta-learning method for the application of bio-medical named entity recognition. The experiments are carried on JNLPBA2004 test corpus with an F-sore of 77.5%.The results show that the brand-new multi-agent meta-learning framework is an effective approach and get promising results in bio-medical named entity recognition. Based on the breast ultrasound database, a study of data mining techniques for utilizing the diagnostic information of breast ultrasound and breast pathology was carried out in paper [7]. With the visual user interface of the system, the data of benignancy or malignancy diagnosed by ultrasound and pathologic examination, and the data on the diagnostic correlation of ultrasound and pathology were obtained, respectively. The qualities of data mining were 99.98%-100%.By means of the retrieval system, the users can secure numerous data from the breast ultrasound database rapidly and accurately.

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The traditional Chinese medical science has many fuzzy concepts, such as pain, twinge, and throe. On the other hand, it is medical theory through long time of cumulate experience and practice. Therefore, using fuzzy neural network to identification and analyze its course is feasible.

The fuzzy neural network in control has already become a hot topic at present [8, 10]. Applying the neural network in fuzzy systems can solve the fuzzy system knowledge extraction problem. Applying the fuzzy system in neural networks, the neural network is no longer a black box, and humanity's knowledge is very easy to fuse in the neural network. It is apparent that a fuzzy neural networks derives its computing power through, first, massively paralle1 distributed structure and, second, ability to learn and therefore generalize.

Though conventional methods have the ability to arbitrarily approximate linear or nonlinear mappings through learning, setting membership function parameters and the rules proposition are difficult issues in system design, especially for a multivariable system.

To solve these problems, Dynamic Fuzzy Neural Networks (DFNN) based on extended Radial Basis Function Neural Networks, which are functionally equivalent to Takagi-Surgeon fuzzy system, were first proposed in [11].They are termed "dynamic" because of their capability of recruiting or removing RBF units automatically so as to possess the capability to improve its performance over time by interacting with its environment. Many papers using DFNN in various nonlinear system [12,13]. However, all of them do not think about input and output messages. Input-output specimens with lots of futile noise have been collected by sensor in control system [14,15]. All this useless messages take nonlinear system more complicated, especially in the process of traditional Chinese drug fumigation.

In order to solve this problem, Lazy Learning Dynamic Fuzzy Neural Network (LL-DFNN) algorithm is first proposed in paper [17]. LL-DFNN not only has the characteristics of fuzzy neural network that does not require accurate model and strong robust features, but also has the characteristics of lazy learning that can make input-output space optimal. Furthermore, the process of traditional Chinese drug fumigation has thousands factors that is connected with sick and environment. The factors have different range so their useless message will have serious repercussions on identification and control. So, Ying learning algorithm is first proposed in this paper to solve this problem by setting up mathematic model of medical process.

The novel algorithm can be divided into five sections: handle of message pretreatment, establish local space, make sure of criterion, assign RBF unit parameters and choose pruning strategy.

Form theoretical analysis and factual examination, we can see that the Ying algorithm improve the training speed and precision, and the mathematic model is compact, and feasible.

II. THE TRADITIONAL CHINESE DRUG FUMIGATION

The illustration of the traditional Chinese drug fumigation machine is shown in Fig.1. Here, the type of machine is MJD-2003 and it has been used 6 years.

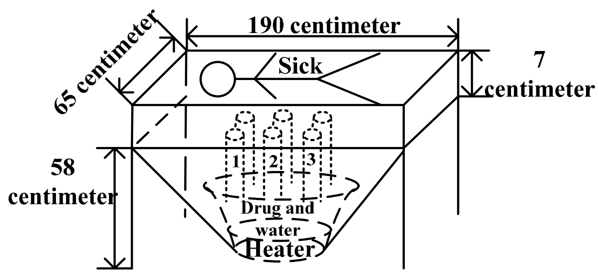

Fig.1 Drug Fumigation Machine

Doctor treats protrusion of Protrusion of protrusion of lumbar intervertebral disc with steam generated by boiling medicinal herbs at this machine. We collect 600 cases among 2000 outpatients and record those patients message some as table 1. The period of treatment is determined by seasoned doctors. However in practice inquisition, we find some nurse who work long time at this position can also neatly adjust strategy such as prolong or cut down fumigation time in different season. The curative effect is improved but the adjusting reason is multifarious and someone says that sense tell them to do that things.

In fact, nurse and doctor cure patient by their experience. So establish a model of this process can discover more factor of the disease and better treat to protrusion of protrusion of protrusion of lumbar intervertebral disc.

TABLE I.
THE PART MESSAGES OF PATIENT

Number	1	2	3	4	5
Sex	Man	Women	Men	Women	Women
Age	29	43	45	41	57
course of diseases(year)	0.75	6	10	4	12
Power of heater every time	830	900	700	1125	1000
Temperature of steam to body (Celsius Degrees)	40	41	39	40	42
Time of fumigation(minute)	33	36	28	45	40
Total time of therapy(day)	9	14	10	11	16
Extra ventricular temperature(Celsius Degrees)	29	19	16	20	14
curative effect	3	2	1	4	2

In medical evaluation methodology, 4 denote heal, 3 is tangible results, 2 means valid, 1 is invalid.

III. YING LEARNING ALGORITHM

A. Handle of message pretreatment

In this section, all messages are changed to standardized date. We can see that there are lots of ingredients through statistic in the hospital, and the ingredient denotes different means so there have different scope such as age's scope is from 20 to 71.

Let $A_k = [a_{k1}, \cdots, a_{kn}]^T$, and $X_k = [\frac{a_{k1}}{b_1}, \cdots \frac{a_{kn}}{b_n}]^T$, (1)

here b_i is the reference value of a_{ki} ,

so $X_i = [x_{i1}, \cdots x_{in}]^T$ is standardized date.

There are many way to get b_i , in the paper

$b_i = \max(a_{ki})$ (2)

such as $B = (a_{k1}, 100, 20, 1500, 45, 50, 30, 35, 4)$

After this work, we can see $|x_i| \le 1$, and all of date do not have dimension. So the messages are simpler.

B. *Local space*

Many real-world environments are time-varying. Many aspects of the learning problem can vary, including the mapping to be learned, and the sampling distribution that governs the input-space location of exemplars that make up the learning set. Lazy learning distinguishes itself from other types by learning that induces theories in the form of decision trees, rules and neural networks. The basic lazy learning algorithm simply stores the training instances and classifies a new instance by predicting that it has the same class as its nearest stored instance [18].

In this paper, K-Vector Nearest Neighbors (K-VNN) is proposed to learning set.

Define 1. Lets Ω_k is input sets which can be defined to local space as:

$$\Omega_k \equiv \{X_1, \cdots, X_K\} = \{X_i | D(X_i, X_m) < h\} \quad (3)$$

Where h is radius of local space (Ω_k), and data-window is changed by adjusting it. $D(A,B)$ is the distance function which is defined by (5), $X_1, \cdots, X_K$ are messages to input DFNN.

Define 2.

Lets $A = [A_1, \cdots, A_n]$ and $B = [B_1, \cdots, B_n]$,in the Euclidean space, gets distance and intersection angle：

$$\begin{cases} d(A,B) = \sqrt{\|A-B\|_2} \\ \theta(A,B) = \arccos A^T B / \|A\|_2 \bullet \|B\|_2 \end{cases} \quad (4)$$

According to (2), we can get the distance and intersection angle of X_i and X_d , from input-output specimen choice similar message to Ω_k .

If intersection angle of X_i and X_d greater than 90° , thinking X_i stray from X_d ,and define as follows:

$$D(X_i, X_d) = ae^{[-d(X_i, X_d)]} + b\sin[\varphi(X_i, X_d)]$$
$$(0 \le a \le 1/2, 0 \le b \le 1/2) \quad (5)$$

From (3), we can see, if X_i is more similar to X_d , $e^{[-d(X_i, X_d)]}$ and $\sin[\varphi(X_i, X_d)]$ are more similar to 1, use this method and get the new learning set

$$\Omega_k = \{(X_1, Y_1), \cdots, (X_K, Y_K) | D(X_1, X_d) > \cdots > D(X_k, X_d)\} \quad (6)$$

From this section, some similar messages are saved to fuzzy neural network. The Protrusion of protrusion of lumbar intervertebral disc has large range so we can choose more X_d according to patient's age.

In this paper, let $K = 100$ and

$X_{d1} = (W, 0.41, 0.2, 0.75, 0.89, 0.9, 0.37, 0.57, 1)$ (7)

$X_{d2} = (M, 0.52, 0.5, 0.84, 0.78, 0.9, 0.56, 0.4, 1)$ (8)

Using MATLAB 7.0 draw them in three-dimensional space, and fuzzy C-means clustering to recognize the sources of Protrusion of protrusion of lumbar intervertebral disc. The computer messages as follow:

Microsoft Windows XP
Service pack 3
Intel(R) Core(TM) 2 Duo CPU
2.39 GHz, 504MB

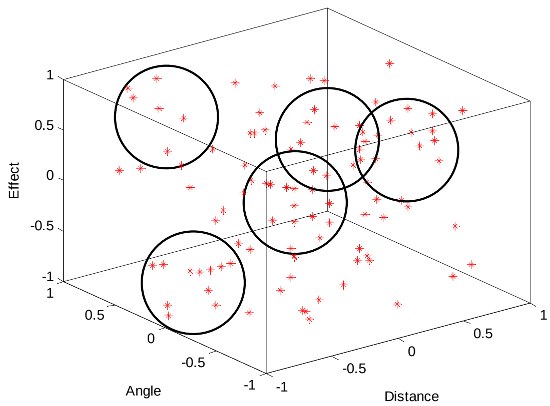

Fig. 2 Local space 1

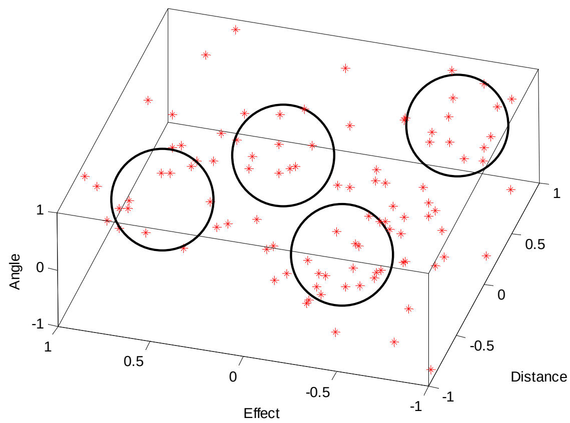

Fig. 3 Local space 2

From figure 2 and 3, we can see that the sick's average age is from 35 to 45, and young people can be easily cured in Protrusion of protrusion of lumbar intervertebral disc. So, it is necessary to do some medical with middle-aged people. In addition, the temperature of steam to body is 42 degrees Celsius

Secondly, work condition is an important factor to Protrusion of protrusion of lumbar intervertebral disc. For example, someone who always carry the heavy objects in work maybe turn into a patient of Protrusion of protrusion of lumbar intervertebral disc

Thirdly, at the time of therapy, smoking, drinking and damp living environment can also tamper with effect.

Finally, catching a cold, violent exercise and carrying heavy load can lead to Protrusion of protrusion of lumbar intervertebral disc. So, people with weak constitution should avoid to such things.

In this section, new message are selected to fuzzy neural network. Next point is how to reduce power. On the other hand, choosing excellent cases to find out the relationship of temperature and heater power is very important.

C. Dynamic Fuzzy Neural Network

In this section, select 100 patients which age is from 35-45 to studying. Use the way of section A to pretreatment. The dynamic fuzzy neural network put in figure 4, which include 5 layers:

Layer 1: Each node in layer 1 represents an input

$$X = [x_1 \cdots x_n]^T \tag{9}$$

Layer 2: Each node in layer 2 represents a member ship function (MF), which is in the form of Gaussian

$$\mu_{ij}(x_i) = e^{-(x_i - c_{ij})^2 / 2\sigma_{ij}^2} \tag{10}$$

Where $i = 1, \cdots, n$, $j = 1, \cdots, r$, μ_{ij} is the membership function of the input variable x_i , σ_j is the center of the Gaussian membership, c_i is the width of the Gaussian membership.

Layer 3: Each node in layer 3 represents a possible rule for fuzzy rules.

$$\phi_j = e^{-\sum_{i=1}^{n} (x_i - c_{ij})^2 / 2\sigma_{ij}^2} \tag{11}$$

Here , $i = 1, \cdots, n$, $j = 1, \cdots, r$.

Layer 4: Each node in layer 4 represents the then

$$\varphi_j = \phi_j \Big/ \sum_{k=1}^{r} \phi_k \tag{12}$$

Where $j = 1, \cdots, r$

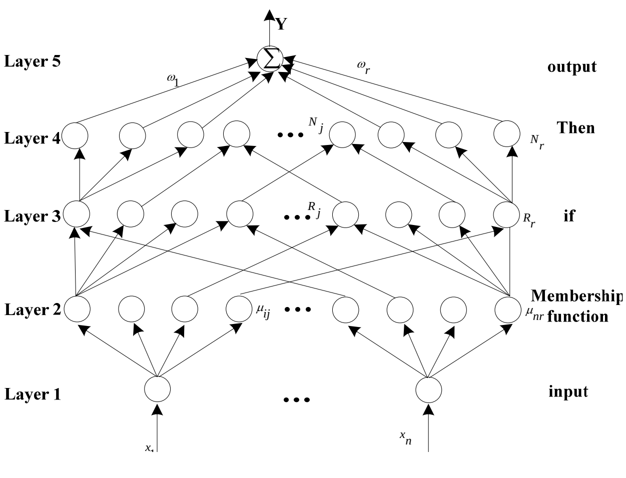

Fig. 4 Model of dynamic fuzzy neural network

Layer 5: Each node in layer 4 represents the output variable as a weighted summation of incoming signals.

$$y(x) = \frac{\sum_{k=1}^{r} \left[(a_{k_0} + a_{k_1} x_1 + \cdots a_{k_n} x_n) e^{-\sum_{i=1}^{n} (x_i - c_{ij})^2 / 2\sigma_{ij}^2} \right]}{\sum_{i=1}^{r} e^{-\sum_{i=1}^{k} (x_i - c_i)^2 / 2\sigma_j^2}} \tag{13}$$

Here, $k = 1, \cdots, r$.

1) Learning set

Make the local space Ω_k by the way of section B to be the learning set.

2) Criterion of neuron generation

From local space, (X_K, Y_K) is the data of the input-output set, and $\hat{Y}_i$ denote anticipant output.

Define $\|E_i\| = \|Y_i - \hat{Y}_i\|$ (14)

if $\|E_i\| = \|Y_i - \hat{Y}_i\| > E_e$ (15)

a new rule should be considered. Where, $E_e = cD(X_1, X_d)$ and c is coefficient of error which is decided by system.

On the other hand, calculate the distance of $d_k(q)$,

Let $d_k(q) = \|X_k - X_q\|$ (16)

Here, q is the amount of rules at $k-1$ times.

If $\arg\min(d_k(q)) \geq k_d$ (17)

Add one rule otherwise the X_K can be expressed by old RBF.

3) Allocation of RBF unit parameters

Let σ_j denotes the width of the Gaussian membership and it is important to generalization. Allocate these parameters based on space local message.

Let $C_1 = X_1, \sigma_1 = D(X_1, X_d)$ (18)

While messages were trained at the network, new parameters are defined as follows:

$$C_i = X_i, \sigma_1 = D(X_i, X_d) \tag{19}$$

4) Weight adjustment

By local space, fuzzy rules can be defined as

$$\varphi = \begin{bmatrix} \phi_{11} \cdots \phi_{1k} \\ \vdots \quad \vdots \\ \phi_{r1} \cdots \phi_{rk} \end{bmatrix} \tag{20}$$

The output is $Y = W\psi$, (21)

input is $X_j = [x_{1j}, \cdots, x_{nj}]$,

$W = [a_{10} \cdots a_{r0} \cdots a_{1n} \cdots a_{rn}]$,

$$\Psi = \begin{bmatrix} \phi_{11} \cdots \phi_{1q} \\ \vdots \quad \vdots \\ \phi_{r1} \cdots \phi_{rq} \\ \vdots \quad \vdots \\ \phi_{11}x_{n1} \cdots \phi_{1q}x_{nq} \\ \vdots \quad \vdots \\ \phi_{r1}x_{n1} \cdots \phi_{rq}x_{nq} \end{bmatrix}, W \in R^r , \quad \Psi \in R^{r \times q}$$

Let perfect output is $\hat{Y}_j = [\hat{y}_1, \cdots, \hat{y}_q] \in R^K$ (22)

Get the optimal function as $J = \|Y - \hat{Y}\|$ (23)

In order to reduce computing and minimize J using recursive-least-squares with forgetting factor λ get:

$$W^* = T(\Psi^T\Psi)^{-1}\Psi^T \tag{24}$$

So $W_i = W_{i-1} + E_i\Psi_i^T(\hat{Y}_i - \Psi_i W_{i-1})$ (25)

$$E_i = \frac{1}{\lambda}\left(E_{i-1} - \frac{E_{i-1}\Psi_i^T\Psi_i E_{i-1}}{\lambda + \Psi_i E_{i-1}\Psi_i^T}\right) \tag{26}$$

Where, E_i is covariance matrix of error, Ψ_i is column vector of Ψ, W_i is coefficient matrix after i time iterative learning algorithm. The local space is dynamic with input, so this method can avoid over-saturation [18].

5) Pruning strategy

From identification, we can see some rules will become less important at the end of train. In order to solve this problem, use ED to prune rules.

In the local space $\{(X_1, Y_1), \cdots (X_K, Y_K)\}$

Let $D = H\theta + \xi = \hat{Y}^T = \Psi^T\theta + \xi$, (27)

Here $H = (h_1, \cdots h_v) \in \Re^{q\times v}$ (28)

$$v = r\times(n+1) \tag{29}$$

$$\theta = W^T \in \Re^v \tag{30}$$

Apply of the eigenvalue decomposition (ED) in solution of pruning strategy.

$$\Phi_{HH}\theta = \Phi_{HD} \tag{31}$$

$$\Phi_{HH} = H^T H \in \Re^{v\times v} \tag{32}$$

$$H = \Psi^T = (h_1, \cdots h_v) \in \Re^{q\times v} \tag{33}$$

$$\Phi_{HD} = H^T D \in \Re^v \tag{34}$$

Using ED get

$$\Phi_{HH} = USU^T \tag{35}$$

Here, $U = (u_1, \cdots u_v) \in \Re^{v\times v}$ (36)

$$S = diag(\sigma_1, \cdots \sigma_v) \in \Re^{v\times v} \tag{37}$$

From ED $rank(\Phi_{HH}) = rank(S)$ (38)

$$I_{ED} = diag(U_a U_a^T) = diag(u_1 u_1^T + \cdots + u_a u_a^T) \tag{39}$$

So let

$$rank(\Phi_{HH}) = a \tag{40}$$

Then $\Phi^{(a)}{}_{HH}\theta^{(a)} = \Phi^{(a)}{}_{HD}$ (41)

$$H^{(a)} = \sum_{i=1}^{a}\sigma_i u_i u_i^T \tag{42}$$

$$\theta^{(a)} = \sum_{i=1}^{a}\frac{u_i^T D}{\sigma_i} \tag{43}$$

The algorithm described as follows:

step1. Calculate U, S by Jacobi method;

step2. Choose rules (the amount is a);

step3. Calculate I_{ED} by （39）;

Step4. Establish $H^{(a)}$ by (42);

Step4. Get $\theta^{(a)}$ by (43);

From this section, some rules that change to useless rules with the time passing can be discarded in time by prune strategy,

D. Stability of YL-DFNN

1) Equilibrium Point

Define 3. Let $Y_j(X) = \sum_{k=1}^{r}\varpi_k\phi_k,\ j = 1,\cdots q$ (44)

Where, $\phi_k, k = 1,\cdots q$ and:

（1） $|\phi_k(X_c)| \le M_j$, $X_c \in \Omega$, $k = 1,\cdots q$ (45)

（2） $|\phi_k(X_1) - \phi_k(X_2)| \le K_k|X_1 - X_2|, X_1, X_2 \in \Omega,$ $k = 1,\cdots q$, (46)

When $M_j \ge 0$, $K_k \ge 0$ system at lest have the equilibrium point.

Prove: if $X_S = [x_{1S},\cdots,x_{nS}]^T$ is equilibrium point of system, then $Y = W\Psi$, let map $F(X) = W\Psi$, from Define 3 the $\phi(X)$ is a mapping of $\Omega^n \to \Omega^n$, so $F(X)$ also is a mapping of $\Omega^n \to \Omega^n$.

Restructured in the define 2, and $\|X\| = \sqrt{\sum_{i=1}^{n}x_i^2}$ then $\|F(X)\| = \|W\Psi\| \le \|W\|\cdot\|\Psi\|$.

By Brouwer theory, $\exists X_w \in \Omega$, to $F(X_S) = X_S$,so X_S is a equilibrium point of system.

2) Stability of equilibrium point

Let $G = X - X_S = [g_1,\cdots,g_n]^T$, (47)

Use Lyapunov function:

Define 4. Exist the Lyapunov function L , meet demand: $V \ge 0$ and $V' \le 0$, then equilibrium point is steady.

Prove: form YL-DFNN algorithm get the Lyapunov function

$$L = \sum_{i=1}^{n} D(X_i, X_d)G_i^2 \ , \tag{48}$$

$D(\cdot,\cdot) \in (0,1)$ at (25) so $V \ge 0$

$$\begin{aligned}\frac{dL(t)}{d(t)} &= \frac{d\sum_{i=1}^{n}D(X_i, X_d)G_i^2}{d(t)}\\ &\le \sum_{i=1}^{n}[G_i[-G_i + \sum_{i=1}^{n}D(X_i, X_d)G_i]]\\ &\le \sum_{i=1}^{n}[[-1 + D(X_1, X_d)]G^2{}_i] \le 0\end{aligned} \tag{49}$$

Therefore, from theoretical analysis, the novel learning algorithm is feasible.

IV. APPLICATION OF YING LEARNING TO SYSTEM

In section Ⅱ, we have analyzed the record date of Protrusion of protrusion of lumbar intervertebral disc, and find out the relationship of temperature and heater power is very important to energy conservation. In order to solve this problem, the proposed novel YL-DFNN is applied to the dynamic modeling of power reduces system. Set up temperature system model by MATLAB. The modeling structure scheme used in this paper is shown in section Ⅲ, and the date are deal with by the way of section Ⅱ. In order to distinguish the effect of controller, use VF[19], DFNN and LL-DFNN to system.

A. Variable fuzzy control

Firstly, use the variable fuzzy controller to a quadruple inverted pendulum system.

Let $X_i = [-E, E](i = 1, \cdots, n)$ is the universe of input variable $x_i(i = 1, \cdots, n)$, and $Y = [-U, U]$ is the universe of output variable y. $\mu x_i = \{A_{ij}\}$ stands for a fuzzy partition on X_i ,and $B = \{B_j\}(1 \le j \le m)$ defines a fuzzy partition on Y .A group of fuzzy inference rules is formed as follow:

IF x_1 is A_{1j} and x_2 is A_{2j} and…and x_n is A_{nj} then y is B_j $j = 1, \cdots, m$

The fuzzy logic system can be represented as a nary piecewise interpolation function

$$y(x_1, \ldots x_t) = \beta(t) N \sum_{j=1}^{m} \prod_{i=1}^{n} A_{ij}(x_i(t) / \alpha(x_i(t))) y_j \qquad (50)$$

Generally speaking, the function $\alpha(x_i(t))$ can be called a contraction-expansion factor on $X_i = [-E, E]$.The so-called variable universe means X_i and Y can change with changing variable x_i and y [20].

The controller is defined as [21]

$$u_c(t) = C \sum_{j=1}^{m} \prod_{i=1}^{n} A_{ij}\left(\frac{e(t)}{\alpha(e(t))}\right) y_j \qquad (51)$$

B. YL-DFNN

Let $K = 100$ and $J \le 0.01$ .The novel algorithm described as follows:

step1. Handle of message pretreatment;

Step2.Form new message X_d , calculate the distance and intersection angle, if $\theta \ge 90^\circ$ abandon this message, otherwise adjust local space Ω_k with (6);

Step3. Let local space Ω_k to networks;

Step4. Criterion of neuron generation by (19);

Step5. Allocation of RBF unit's parameters by (24-26);

Step6. If error meets the system's demand, to step 7, otherwise gets $i+1$ to step 4;

Step7. Use pruning strategy by (43);

Step8. Keep down W and ψ , calculate output in $Y = W\psi$.

C. DFNN

Do not use lazy learning to make new local space, and use to quadruple inverted pendulum system [19]. Let $K = 80$ and $J \le 0.01$ .The novel algorithm described as follows:

step1. Build input set and output set to train;

step2. Let training set to networks;

Step3. Criterion of neuron generation by (19);

Step4. Allocation of RBF unit's parameters by (24-26);

Step5. If error meets the system's demand, to step 6, otherwise gets $i+1$ to step 3.

Step6. Keep down W and ψ , calculate output in $Y = W\psi$.

D. simulation

Select the 120 healed patients to analyze. From learning, we find the temperature of steam to body is focus on 42 degrees Celsius, so the controller should keep temperature at 42 degrees Celsius with any disturbs.

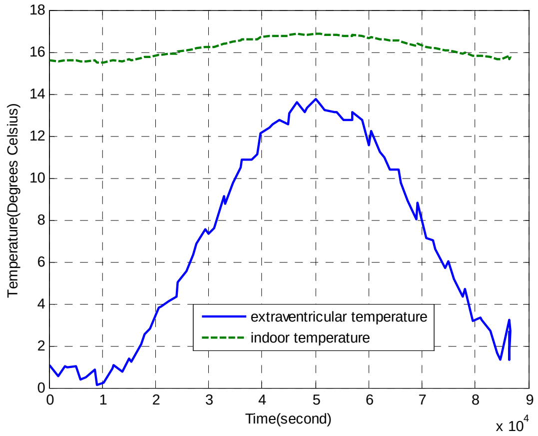

Fig. 5 Extra ventricular and indoor temperature

Record extra ventricular temperature (blue real line) and indoor temperature (green broken line) and draw them in the Fig 5(in the autumn). From the data, we can see that the fumigator outside temperature is changed with time, felicitously adjust heater output power can not only cure the patients but also reduce energy consumption.

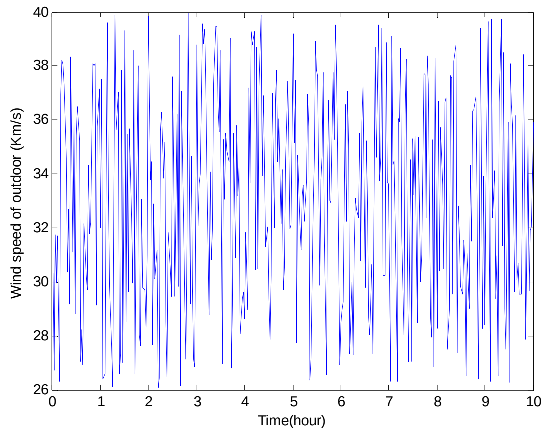

Fig. 6 The wind speed of outdoor

Record outdoor wind speed in 10 days and calculate the average value and draw in Fig 6. From analysis, we can see that the wind speed is one influencing factor to the Protrusion of protrusion of lumbar intervertebral disc. In other words, the level of wind can affect the patients to get back. The process of traditional Chinese drug fumigation is the black box, it mathematical model would be more correct by intelligent identification method.

Temperature control is a typical time delay question. Record the output power, temperature and time of fumigation at 2 conditions: male patient (case1)and female patient(case2) then draw in Fig 7. From the data, we can see female patient and male patient should take different treatment programs. Calculate the average value of output power and time of fumigation then draw in Fig 8. From analysis, we find that adjusting output power with time not only can keep temperature of system but also decrease energy consume.

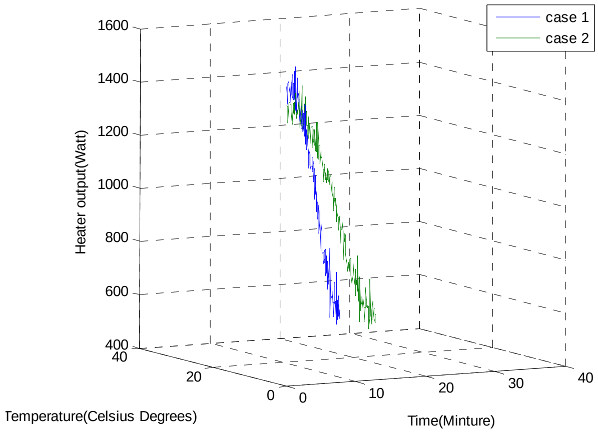

Fig. 7 Three-dimensional curve of power, time and temperature

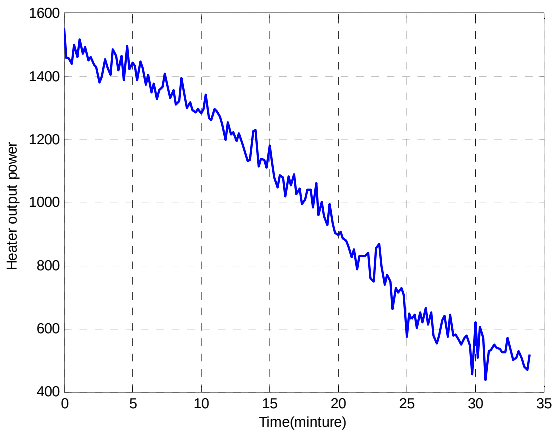

Fig. 8 Average output power of heater

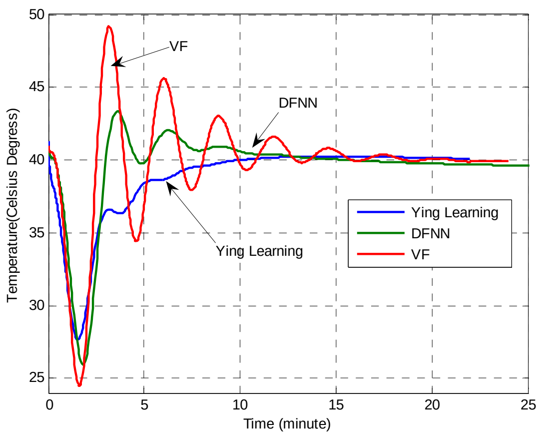

Fig. 9 Temperature（40 Celsius Degrees） of steam to body

Fig 9 is the temperature of steam to body by Ying learning (green real line), DFNN (red line) and VF (blue line). In this picture the aim is 40 Celsius Degrees. The temperature decrease when patient's posture is changed. Ying learning can avoid over fitting and after 8.589 minute make the temperature to 40 Celsius Degrees. On the other hand, after 11.583 minute and 21.938 minute DFNN and VF reach the targets. VF change control strategy by $\alpha(e(t))$ which can adjust universe of input and output, but can not pre-estimate output of system. DFNN can dynamic adjust weights and frame of network, but it can not deal with input and output so this method have memory but nor ability of imagination.

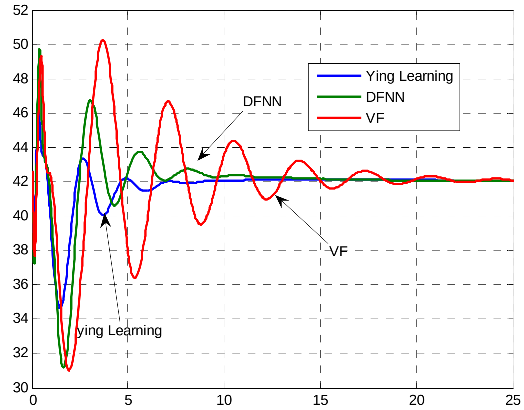

Fig.10 Temperature（42 Celsius Degrees） of steam to body

Fig 10 is the temperature of steam to body by Ying learning (green real line), DFNN (red line) and VF (blue line). In this picture the aim is 42 Celsius Degrees. The temperature increase when traditional Chinese drug is changed. After 8.825 minute, Ying learning makes the temperature to 42 Celsius Degrees. On the other hand, after 12.598 minute and 23.858 minute make the temperature to the goal by DFNN and VF.

V. RESULT

The traditional Chinese drug fumigation fume to cure Protrusion of protrusion of lumbar intervertebral disc is a typical non-linear, multivariable, and strong coupling system. In order to find out its hypostases in this paper Ying learning first proposed.

The novel algorithm have five parts: handle of message pretreatment, establish local space, make sure of criterion, assign RBF unit parameters and choose pruning strategy.

To solve fuzzy neural networks system over fitting and solve the knowledge extraction problem, K-Vector nearest neighbor algorithm is used to adjust learning space, so the local space has less noise and information interference.

On the other words, novel algorithm was found to be fast due to three sections: (1) dynamic local space, (2) normalization method of input and output message, (3) pruning strategy based on ED.

In practice, noise will invariably be collected. Hence, it is necessary that dispose of rubbish message form input sets.

Ying algorithm uses current data and history data to identify and control. Simulation results show that the new algorithm has faster convergence speed, lower error rate, smaller root-mean-square error than DFNN and VF.

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