Design and Implementation of the Coastal Zone Ecological High Precision Monitoring and Assessment System

WANG Wei-Quan[1,a], ZHANG Xue-Ping[2], CAO Jun-Kuo[2]

[1] Department of Network management center, Hainan Medical University, Hainan, 571199, China

[2] Department of Information science technology, Hainan Normal University, Hainan, 571100, China

[a]email: Weiquanwang8809@163.com

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Abstract. The coastal zone is crucial to the development of human society and economy, the global economic wealth mostly produced in coastal areas, but the coastal zone due to interaction is affected by a variety of forces, there are frequent disasters, fragile ecological environment problems objectively. Monitoring of ocean ecological environment monitoring system of data transmission of marine monitoring system integration technology and the environment is special determines its transmission mode is different from the ordinary data transmission. We discussed how to according to a variety of marine environmental monitoring system and related ground handling characteristics and distribution station, data transmission network design for the different in the marine environment monitoring system, to achieve a variety of ecological environment monitoring system of automatic data transmission, and design and development of monitoring data transmission integrated system, complete the automatic acquisition and preservation of the marine monitoring system of the marine ecological environment monitoring data

Introduction

For with this amphibious interaction in coastal zone, is mainly studied from the global response to climate change in relative sea-level rise is generated, and with the vulnerability analysis and evaluation system for the coast less. The coastal zone is one of the high incidence area of natural disasters, but also the population gathered most of the region, vulnerability analysis of coastal ecological environment, building evaluation framework vulnerable coastal ecological environment, to carry out the protection of the ecological environment, since the important scientific significance for reasonable development of natural resources and to promote the coordinated development of environment economy in coastal zone. Wavelet neural network is a transferring function, a kind of BP neural network topology based on the wavelet function as the hidden layer, a neural network when signal is propagated, the forward error back propagate. Wavelet neural network in the experiments use 3 layers network: input layer, hidden layer and output layer [1-3].With Introduction into the field of neural network, monitoring and assessment theories and methods of forecasting produced a qualitative leap [4]. The traditional linear monitoring and assessment methods, such as Auto Regressive model, Moving Average in solving the problems of nonlinear models monitoring and assessment encountered great difficulties, and neural network in nonlinear monitoring and assessment has its unique advantages, it does not need to build complex nonlinear systems and mathematical model of explicit relationships, it can extracts data characteristics and internal rules through the training data samples. It makes the information distributed storage come true, resulting in associative memory. Thus the untrained samples can be

extrapolated to monitoring the effect so that it provides a powerful tool for nonlinear monitoring and assessment [5]. It was for the first time that carrying out forecasting by using neural network for nonlinear time series, pioneering the field of neural networks used to monitoring in 1987. After that, neural network had a rapid development in the application of monitoring and assessment. Wavelet analysis, a mathematical theory developed in recent years, is considered a major breakthrough since the Fourier analysis. Based on wavelet analysis, Wavelet network is a class of network to be constructed that combines time-frequency localization properties of wavelet transformation and self-learning ability of neural network. Wavelet neural network has received growing concern as a novel neural network. It is both possessed of time-frequency localization properties of wavelet and neural network's function approximation and generalization ability. And it has wined a strong advantage in the field of monitoring. Currently, as for the neural network to monitoring, there are two main forms: Trend forecasting and regression-based causality, corresponding time series monitoring and assessment and multiple regression monitoring and assessment. Neural networks, with distributed, associative, memorial and strong generalization ability, as well as self-learning ability and fault tolerance, can approximately approach nonlinear functions with arbitrary precision. It can not be matched by the linear monitoring and assessment method. For most monitoring give objects, especially data with non-linear relationship, using the neural network will get higher monitoring and assessment accuracy.

Proposed Method

Instability and sensitivity to external disturbance is a obvious characteristic of system vulnerability, and the stability and sensitivity, often make the system in the face of outside interference in an unfavorable itself and human on the development and utilization of the direction of development. Vulnerability assessment is on a natural humanity system, its structure, discusses the functions, prediction and evaluation of external stress on the system of natural and man-made possible effect, evaluation system of the ability to restore its external stress resistance, never benefit impacts, its purpose is to maintain the sustainable development of the system, reduce the external stress adverse effect on the system and provide the basis for comprehensive control strategy system degradation. The establishment of evaluation index system is one of the key steps to expand the vulnerability evaluation. A large number of experiments of neural network's monitoring and assessment model show that: the initial parameters of the network have a great influence on the monitoring results. When the network structure is determined, namely the number of neurons of the network's input layer, hidden layer and output layer, and the learning rate, training accuracy are determined, the monitoring results depend on initial parameters of the network. The initial parameters include network weights and threshold limit values and as for wavelet neural network it also comprises translation factor and scale parameters. The structure of the network is shown in Figure 1.

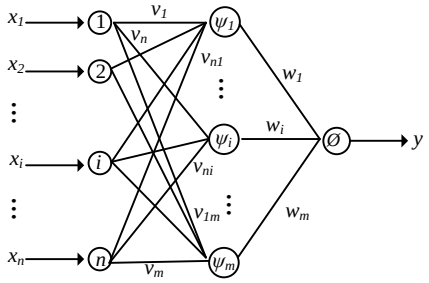

Figure1. Wavelet neural network's structure

Figure 1 shows the three layers structure of wavelet network. Wherein, xi is the network's input variable, outputting to be a neuron. In this paper the outputting y corresponds to coastal zone ecological; $\psi_i(t)$ is the wavelet function ($i=1,2,...,m$); v_{ni}, w_i are connection weights between input layer / hidden layer, hidden layer / output layers. The currently used mother wavelets have good locality and smoothness like spline wavelet and Morlet wavelet. These functions' flexibility and parallelism can constitute an orthogonal basis of L2 (R), generating the most precise wavelet series at approximation. The hidden layer in this paper adopts Morlet wavelet function, the expression is described as

$$\psi(x)=\cos(1.86x)\exp\left(-x^2/2\right) \tag{1}$$

Wavelet transformation corresponds to the Hilbert space of square integral L2 (R), if there exists a function

$$\psi(x)\in k^2(t), \int_t |\psi(k)|^2 dt \prec +\infty$$

And its Fourier transforms into

$$g_\psi=\int_t \frac{|\psi(\mu)|^2}{|\mu|} j\mu \prec +\infty \tag{2}$$

The function ψ (t) is a based wavelet, through the based wavelet's flexibility and parallelism, it can obtain a bases wavelet's function family

$$\psi_{a,b}(k)=\frac{1}{\sqrt{|a|}}\psi\left(\frac{k-b}{a}\right) \tag{3}$$

Wherein: a，b∈R，a≠0. a and b are factors of flexibility and parallelism. Wavelet transforms into

$$\begin{aligned}(\varpi_\mu t)(a,b)&=\langle t(k),\psi_{a,b}(k)\rangle\\&=\int_\mu f(k)\psi^*_{a,b}(k)dt\end{aligned} \tag{4}$$

Ψ (x) is the wavelet function. Formula (4) shows the change of wavelet is similar to the projection of the signal wavelet function on the based wavelet function, or a comparison between the signal and the wavelet in the associated position of a, b to transform into ($w\psi f$) (a, b), which described the degree of similarity in two aspects. The size of the projection reflects of the size of signal on the scale energy.

In Figure 1, the wavelet network structure consists of three layers: the input layer, hidden layer and output layer. Let three neurons, set as $n,m,1$ respectively, excitation function of each hidden layer's neuron is $\psi a,b(x)$, the excitation function of output layer neuron takes Sigmoid, then the output expression is

$$t^e(k)=\phi\left(\sum_{k=1}^{n} w_n\psi\left(\sum_{j=1}^{m} h_{ik}s_i^j\right)(k)-l_i)/g_i\right) \tag{5}$$

Wherein, $p=1,2,...,m$, p = 1, 2, ..., P (P is the number of samples). Let y be the actual value, $\hat{t}$ the monitoring value, then the training samples p, taking the error energy function:

$$L=\frac{1}{2}\sum_{j=1}^{p}\sum_{i=1}^{m}\left(\hat{t}_i^j-t_i^j\right)^2 \tag{6}$$

$$J_{ik}(s)=j_{ik}(s-1)-\eta_\mu\frac{\partial s}{\partial s_{ik}}+\partial\square s_{ik} \tag{7}$$

$$r_i(s)=r_i(s-1)-\eta_\varpi\frac{\partial s}{\partial r_i}+\partial\Delta r_i \tag{8}$$

$$a(s) = a(s-1) - \eta_a \frac{\partial r}{\partial a} + \partial \square a \tag{9}$$

$$b(s) = b(s-1) - \eta_b \frac{\partial r}{\partial b} + \partial \square b \tag{10}$$

Wherein: $\eta_\mu, \eta_\varpi, \eta_a, \eta_b$ are the learning rates, α is the momentum factor, by adjusting the parameters of WNN, make the formula (6) minimize.

Experimental Results

Structure improvement of seawall, the strengthening of existing seawall engineering revetment and biological slope protection, and to improve its ability to resist erosion and scour the storm tide. On the low-lying coastal section of new projects to heightening the starting height, lay the foundation, in order to effectively play the role of protection. The coastal area is and will be the implementation of a number of huge investment of resources exploitation and economic construction projects, its surrounding, ground elevation and the engineering design criteria determined, must explicitly consider the next few decades, even hundreds of years of relative sea level rise factor. The establishment of coastal zone ecological protective net in the appropriate coast area (including supernatural zone of vegetation of arbor shelterbelt and inertial protective belt). As for subsequence S1,2,3, in the 429 series data, using the data before seven days to monitoring he eighth day, and carry on recursion. Afterwards, it constitutes 422 sample set, take the first 300 samples to train neural network, the left 122 samples for test.

When the sub-series are monitoring, you can reconstruct wavelet packet, the results are shown in Figure 11, which is the contrast of the total monitoring actual and monitoring values. Final monitoring and assessment accuracy is 3.1454%; the maximum monitoring and assessment accuracy is -14.3672%; reconstruction time required is $0.8742s$. Overall monitoring and assessment accuracy is 15.6315% after BP network's reconstruction; the maximum monitoring and assessment accuracy is 40.0132%.

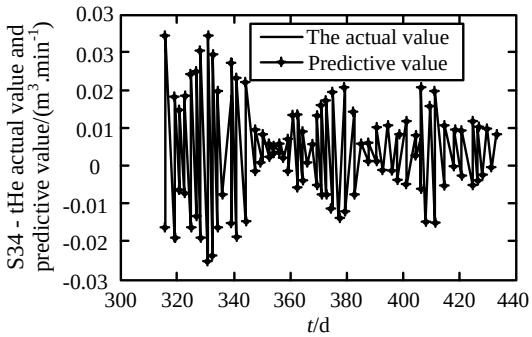

Figure2. S1 monitoring results

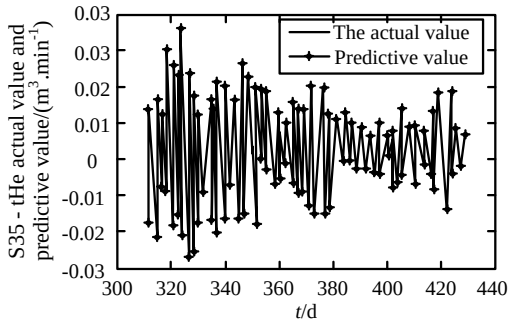

Figure3. S2 monitoring results

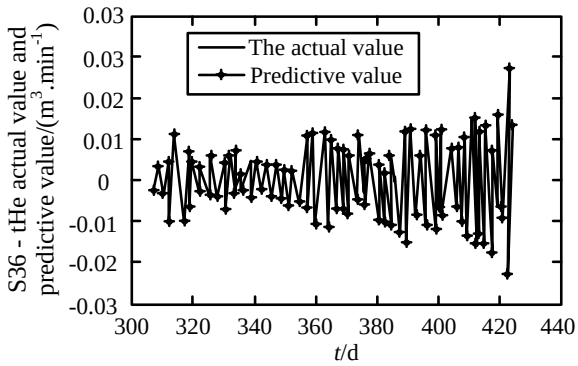

Figure4. S3 monitoring results

Conclusion

Through coastal zone ecological wavelet packet-Wavelet network forecasting examples, it shows that the method has not only both wavelet feature extraction capabilities, but also a series of advantages of BP neural network toolbox, such as higher speed of training, easier operation, applicability to large quantities of data for training and processing, data adaptability and robustness with a flexible, practical features. By controlling coastal zone ecological to get the best monitoring value, it is more convenient than optimized algorithms such as genetic algorithms, particle swarm algorithm. This method of wavelet neural network is of practical significance to promote the application of wavelet neural network. Coastal zone is connected by land and sea area, the ecological environment is complicated and requires even more planning management measures have much considering the rigorous science: (1) considering the definition of sea, coastal range should be comprehensive consideration of the need to position and area of land and sea into the system; (2) comprehensive consideration, in the use of belt resource conflict coast, must ensure that all important issues will affect the coastal zone exploitation into account; (3) the function of comprehensive consideration, each main body must comply with the management of coastal zone of mark and strategic decision making on the coastal zone of the intervention

Acknowledgement

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