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NEURAL AND ARTIFICIAL NEURAL NETWORK MODELLING OF NON-LINEAR HYDROLOGICAL FACTOR

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ABSTRACT

The present study is aimed to observe the hydrological study by using neural network. The potential of an artificial neural network to perform hydrological transformations under controlled conditions is examined. The network is trained to recognize patterns of the daily meterological variables of India. The results of artificial neural network by Back Propagation Algorithm method are good in agreement with that of the food and agricultural organization modified Penman technique after sufficient training. The advantage of artificial neural network's ability to use famous parameters. The reported results demonstrate that neural networks are capable of modelling of hydrological processes and are therefore appropriate tools for hydrological modelling.

Keywords: Crystal growth, X-ray diffraction, Spectral analysis, Thermal analysis, Nonlinear optical materials.

1.INDRODUCTION

Testing is the process of and executing a program with the inrent of detecting errors. We know that while zhe compiler can detect syntactic and semantic errors, it can not detect runtime and logical errors that show up during execution of the program. Testing, therefore, should include necessary steps to detect the execution of the program. It is however, important to remember that impractical to find all errors.

Testing process may include the following two stages
1. Human Testings
2. Computer based testing

Human testing is an effective error detection process and is done before the computer based testing begins. Human testing methods includes code inspection by the programmer, code inspection by a test group. The test is carried out statement by statement and is analyzed with respect to a checklist of common programming errors.

2.PRINCIPLES OF NEURAL NETWORK

ANN s are based on the present understanding of the biological nervous system. (ANN s are basically massive parallel system composed of many processing elements, called neurons), connected by links of variable weights, which are derived from past learning experiences.

The advantage of Neural Network approach with respected to the current application is its ability to the generalize patterns through its associative memory, which is a result of the correct weight matrices between the layers of neurons. Of many ANN paradigms , Back Propagation network is by far popular and one of nhe most efficiently used learning rules in many applications (Robert, 1988; Hassocen,1995). In many real- world application computers are needed to perform complex problem Since our conventional computers are obviously not suited to this type of problem, features from the physiology of the brain is borrowed as the basis for new processing models. Hence the technology has come to be known as Artificial Neural Networks (ANN) .

ANNs are biologically inspired that is they are composed of elements that perform in a manner that ss analogous to the most elementary functions of the biological neuron. ANNs exhibit a surprising number the brain's characteristics. For example they Learr. from experience, generalize from previous examples to new ones, and abstract essential characteristics from inputs containing irrelevant data. ANNs are very powerful and flexible, going by the multitude of parameters that they provide to their users to adjust , like , the number of hidden layer, learning rules and coefficients, transfer functions and momentum. The hidden layer

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nodes(neurons) organize themselves to correspond to a particular class/ classes in the input data.

NEURONS

The neurons are the actual processing unirs in the brain. Like every processor an input ani an output. The input signals are electrochemical stimulus, which come from other neuron and are transmitted the neuron possess 10,000 of these input lines, in individual cases more than 1,00,000. When the sum of the input signals as electrical potential exceeds a limiting value, the neuron becomes active. Through an output line, the axon, it sends a brief, electic, needle- impules to the next connected neuron. One says , the neuron 'fires'

The neuron is thus a processor unit with the only ability of sending out electrical signals depending upon the input. The input is done via dendrites , the output via the only connection, the axon. In extreme cases, the axon can be up to one meter long and can have many branches, which then address further neurons. A schematic representation is given in fig.1. Between the input , the dendrites and the processor , the neuron, a cell is present which can strengthen or weaken the incoming potential. This cell is called synapse and is often present directly at the cell-body of the neuron. The change of the electrical impulse is done chemically, if the impulse is strengthened , the synapse is excitatory , else it is inhibitory.

Neural networks are computer system that emulates the neural reasoning behavior of biological neural systems (e.g. the human brain). Neural network consists of a series of nodes and weights connections that when presented with a specific input pattern can associate specific output patterns. It is essentially a highly complex non-linear mathematical relationship. Neural networks address problems that are often difficult for traditional computers to solve such as pattern recognition. One of the most significant strength of neural networks is their ability to learn from a limited set of examples. Once trained the neural nets can be used to predict and or forecast results from the new input data.

Learning from experience

Neural networks are particularly suited to problems whose solution is complex and difficult to specify but which provide an abundance of data from which a response can be learnt.

Generalizing from examples

With careful design a neural network can be trained to give the correct response to data that it has not previously encountered (and this is often described as the ability to generalize on test data) Developing solutions faster and with less reliance on domain expertise

Neural networks learn by example and as long as examples are available and an appropriate design is adopted, effective solutions can be constructed far quickly than is possible using traditional approaches which are entirely relay on experience . However neural networks are not wholly independent an human expertise which can be invaluable in choosing the optimal neural network design.

Computational efficiency

Training a neural network is computationally intensive but the computational requirements of a fully trained neural network when it is used on test data can be modest. For a very large problems speed can be gained through parallel process as neural networks are intrinsically parallel structures.

Non-linearity

Many other processing technique are based on the theory of linear systems in contrast neural networks can be trained to generate no-linear mappings and this often gives them an advantage for dealing with complex real-world problems.

Operation of a neural network

During operation of a neural network the inputs are presented at the input layer and every element or neuron of the neural network multiplies each of its input values by a weight before summing up the information and applying a transfer function to generate its output. For simple network the transfer function may a simple threshold function while on multilayer networks a differential function such as the sigmoidal is used. The outputs of one layer are then used as the inputs to the next layer until the output layer is reached. The topology and the weights define the generation of the artificial neural network in terms of the inputs, outputs, number of hitten layers.

3.RESULT AND DISCUSSIONS

A new approach has been developed for determining daily Evaporation and transpiration using the pattern matching ability of neural network. The daily reference crop evaporation has been estimated using FAO modified penman method for India metrological departments whether stationl, station2, station3. Daily reference crop evapotranspiration estimated using the FAO modified penman method for period fifteen years of the three weather station. Seasonal variation of Evaporation and transpiration can be seen from graph in which cyclic variation can be observed with, crests and toughs are during Nov.to Jan Average evaporation and transpiration for the chosen fifteen year period between 1979-93 is 5.2 mm/day and standard deviation is found to be 1.2 maximum daily evaporation and transpiration is 9.3 mm/day and minimum is 2.7 mm/day.

The four I/P parameter namely R.H maximum, and minimum temperature and wind speed along with the daily REF—ET are used to train the ANN model ,which employes B.P technique. These I/P and 0/P values for three years and then epoched in the developed N.N architecture. Validation is carried out for another two years of untrained data . Activation function used here in the sigmoid function, which 0/p s values bet -1 to +1. The tolerance limit for the developed ANN model is set as 10% difference between maximum(9.3 mm/day) and minimum (2.7 mm/day) values of validation set ,which is 0.63 mm/day.The n/w predicted daily Evaporation and transpiration for the validation set within the tolerance limit in 1356 sweeps, there by a good correction of the daily Ref-Et has been achieved using ANN model.

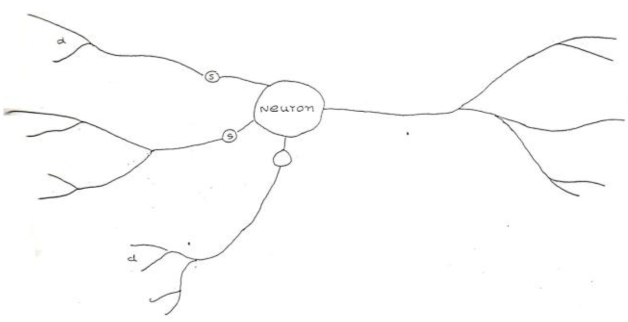

Figure - 3.1
DENDRITES, NEURON AND AXON AS INPUT, PROCSSOR AND OUTPUT

Comparative variation of daily RET-ET estimate using FAO modified penman method and daily-Evaporation and transpiration predicted using ANN model for the validation years has been shown in fig.6.6. It has been that estimate of daily REF-ET by developed ANN model and FAO modified penname method are similar. It can also be seen that the developed ANN model captures the seasonal variation and annual variation. Average Evaporation and transpiration for ANN predicted validation set is standard deviation is 0.94. Regression analysis between the Evaporation and transpiration values estimate by FAO modified penman method and ANN model is depicted in fig. RMS validation error (RMSE) is 0.629. coefficient of linear regression is 0.925.

The regression equation is given by
Y = 0.8611 x -0.2385

Where y -daily REF-Et predicted using ANN model and x-daily Evaporation and transpiration estimated using FAO modified penname method.

Regression analysis also proves that the daily Evaporation and transpiration predicted using artificial model are alomost similar to that of daily evaporation and transpiration estimate using FAO modified penneme method. Hence it can be concluded that the results predicted by artificial neural network model are appreciably accurate with fewer I/P parameters. The developed artificial neural network model is also economic as it utilizes only the basic metrological parametes for estimation of evaporation and transpiration.

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