Volume 3, Issue 7, July 2013 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Forecasting the Demand of Pulpwood Using ANN and SVM

V.Anandhi[1]
Assistant Professor(Computer Science
Department of Forest Resource Management,
Forest College and Research Institute,
Mettupalayam 641 301,Tamil Nadu-India

Dr.R.Manicka Chezian[2]
Associate Professor,
Department of Computer Science,
NGM College, Pollachi-642001,
Tamil Nadu, India

Abstract— Machine learning is a type of Artificial Intelligence (AI) that provides computers with the ability to learn without being explicitly programmed. Machine learning focuses on prediction, based on known properties learned from the training data. Two machine learning methodologies, the Artificial Neural Network (ANN) and Support Vector Machine (SVM) were studied to compare the performance of each method in different scenarios. Wood Pulp is the most common raw material in paper making. The demand of pulpwood is forecasted with ANN and SVM and compared and results show that SVM outperforms ANN.

Keywords - Machine learning, Artificial Intelligence (AI), Artificial Neural Network (ANN) , Support Vector Machine (SVM), Wood Pulp, forecast

I. INTRODUCTION

Machine learning, a branch of artificial intelligence, is about the construction and study of systems that can learn from data. Machine learning is a type of Artificial Intelligence (AI) that provides computers with the ability to learn without being explicitly programmed. Machine learning focuses on prediction, based on *known* properties learned from the training data. Forecasting is a systematic effort to anticipate future events or conditions. Forecasts are more accurate for larger groups of items and for longer time periods. Many forecasters depend heavily on models to help in forecasting. Two machine learning methodologies, the artificial neural network (ANN) and support vector machine (SVM) were studied to compare the performance of each method in different scenarios.

II. LITERATURE REVIEW

Kim[1] applied SVM to predict stock price index and compared the performance with ANN. The study showed that SVM approach outperformed ANN method. Tay and Cao [2] compared the performance of SVM and ANN to forecast the financial time series, results indicated SVM had a better performance than ANN. Gutierreza et al [3] artificial neural network method to forecast the lumpy demand and compared the performance of ANN. The results showed that it out performed the remaining methods significantly. Karin Kandananond [4] compared the performance of SVM and ANN and results show that SVM outperformed ANN. The development of ANN models was based on studying the relationship of input variables and output variables. Support Vector Machines (SVMs) have been proposed as a novel technique in time series forecasting. SVMs are a very specific type of learning algorithms characterized by the capacity control of the decision function, the use of the kernel functions and the sparsity of the solution. Established on the unique theory of the structural risk minimization principle to estimate a function by minimizing an upper bound of the generalization error, SVMs are shown to be very resistant to the over-3tting problem, eventually achieving high generalization performance in solving various time series forecasting problems. Another key property of SVMs is that training SVMs is equivalent to solving a linearly constrained quadratic programming problem so that the solution of SVMs is always unique and globally optimal, unlike other networks' training which requires non-linear optimization with the danger of getting stuck into local minima. Basically, SVM use a hyper plane to separate two classes. For classification problems that cannot be linearly separated in the input space, SVM find a solution using a non-linear mapping from the original input space into a high-dimensional so-called feature space, where an optimally separating hyperplane is searched. Those hyperplanes are called optimal that have a maximal margin, where margin means the minimal distance from the separating hyperplane to the closest (mapped) data points (so-called support vectors). The transformation is usually realized by nonlinear kernel functions. Support Vector Machines (SVM) are a combination of instance-based and numeric modeling learning. The idea behind support vector machines is finding instances, called support vectors, that are at the boundary of the classes and creating linear functions that discriminate them as widely as possible. The biggest advantage of vector machines is that they can use linear, quadratic or higher order models to represent nonlinear boundaries between classes. This is in contrast to basic linear models that only represent linear boundaries. To construct nonlinear boundaries with linear models, support vector machines use nonlinear mapping, where the instance space is transformed, allowing a linear model to represent a nonlinear model in the previous space.

III. METHODOLOGY

Basically, the neural architecture consisted of three or more layers, i.e. input layer, output layer and hidden layer [5] shown in Fig. 1.

$$Y_J = F\left(\sum_i w_{ij} x_{ij}\right)$$

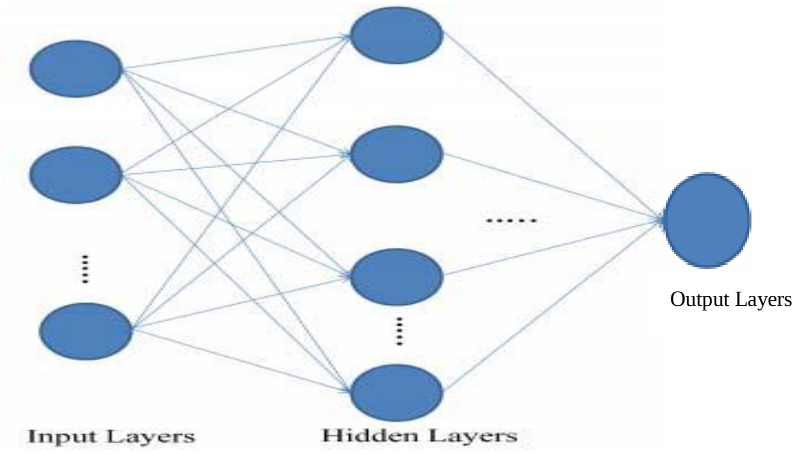

Fig.1 Architecture of Artificial Neural Network

where Yj is the output of node j, f (.), is the transfer function, wij the connection weight between node j and node i in the lower layer and Xij is the input signal from node i in the lower layer to node j.Artificial Neural Network (ANN) is a powerful method for generalized nonlinear regression. The training of an ANN establishes the input/output mapping in the form of connections between various units in the network. The training also computes the weights of input connections. The fitted model can be used to predict the values of the dependent variable Y for unseen data points.

The study is based on the data collected at the Tamil nadu Newsprint and Papers Limited (TNPL) in Karur District, Tamil Nadu. Over ten years of data are collected for the demand and the supply patterns of pulp wood. The data collected is normalized and a network is created using the newff function. It is trained using the activation function, the training function and the learning function. Back propagation is used as a tool for forecasting [6]. A supervised training is accomplished by presenting a sequence of training vectors, or patterns, each with an associated target output vector [7].The success in the application of ANN for forecasting lies in the fact that when these networks are properly trained and configured they are capable of accurately approximating any measurable function. The neurons learn the patterns hidden in data and make generalizations of these patterns even in the presence of noise or missing information. Predictions are performed by the ANN based on the observed data. The network has one input layer, one hidden layer and one output layer (Fig. 1). The forecast is carried out with several numbers of neurons in the hidden layer. Generally the addition of a hidden layer could allow the network to learn more complex patterns, but at the same time decreases its performance. Error data at the output layer is "back propagated" to earlier ones, allowing incoming weights to these layers to be updated[8]. MATLAB is a high-level language and provides an interactive environment that enables us to perform computationally intensive tasks faster than with traditional programming languages. A MATLAB interface for SVM is Libsvm [9]. Libsvm-mat-2.88-1 is integrated with Matlab. The data for forecasting are to be collected. The data need to be split the data set into two, one for training and other for testing. After collecting the data, we need to convert both the training set and testing set into SVM format. The SVM algorithm operates on numeric attributes. So we need to convert the data into libsvm format which contains only numerical values. The original data maybe too huge or small in range, thus we can rescale them to the proper range so that training and predicting will be faster. The main advantage of scaling is to avoid attributes in greater numeric ranges dominating those in smaller numeric ranges. After scaling the data set, we have to choose a kernel function for creating the model. The basic kernels are linear, polynomial, radial basis function, sigmoid. In general, the RBF kernel is a reasonable first choice. A recent result shows that if RBF is used with model selection, then there is no need to consider the linear kernel. The kernel matrix using sigmoid may not be positive definite and in general it's accuracy is not better than RBF. Polynomial kernels are ok but if a high degree is used, numerical difficulties tend to happen. A typical use of LIBSVM involves two steps: first, training a data set to obtain a model and second, using the model to predict information of a testing data set. SVM train trains a support vector machine. Set the SVM type to epsilon SVR. There are two commonly used versions of SVM regression, 'epsilon-SVR' and 'nu-SVR'. The original SVM formulations for Regression (SVR) used parameters to apply a penalty to the optimization for points which were not correctly predicted [10]. An alternative version of both SVM regression was later developed where the epsilon penalty parameter was replaced by an alternative parameter, which applies a slightly different penalty. Epsilon or nu are just different versions of the penalty parameter. In SVR, our goal is to find a function f(x) that has at most deviation from the actually obtained targets y_i for all the training data. Support vector regression is the natural extension of large margin kernel methods [11] used for classification to regression analysis.

IV. Results and Discussions

Compared to the popular artificial neural networks, SVM have several key advantages: By describing the problem as a convex quadratic optimization problem, they are ensured to converge to a unique global optimum instead of only a possibly local optimum. Additionally, by minimizing the structural risk of misclassification, SVM are far less vulnerable to overfitting, one of the major drawbacks of standard neural networks. The network is trained with the data (Table 1) and it uses the default Levenberg-Marquardt algorithm. During training, a training window opens as in Fig. 2. This window displays the training progress. The training stopped when the validation error increased for six iterations, which occurred at iteration 1567 for demand in Fig. 3. The results are forecasted with the one hidden layer. Several iterations are carried out for each neuron in the hidden layer.

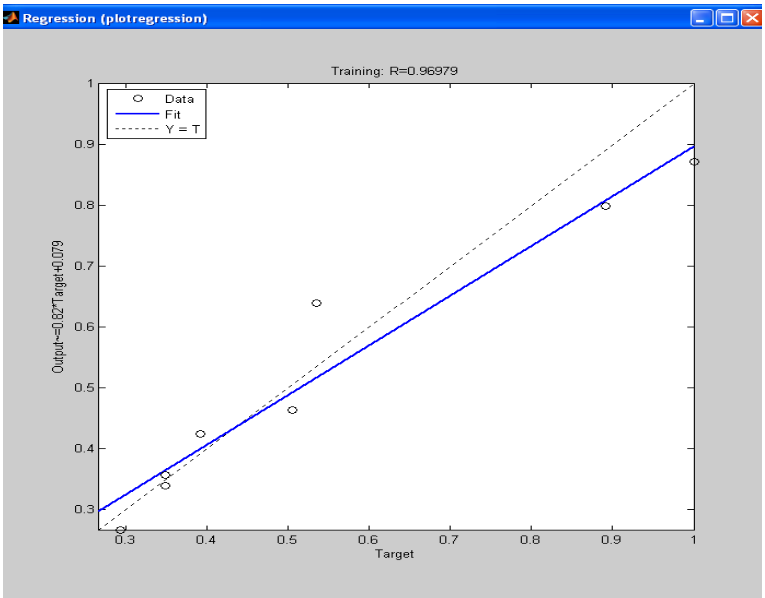

Fig. 2: Neural Network Training for Demand

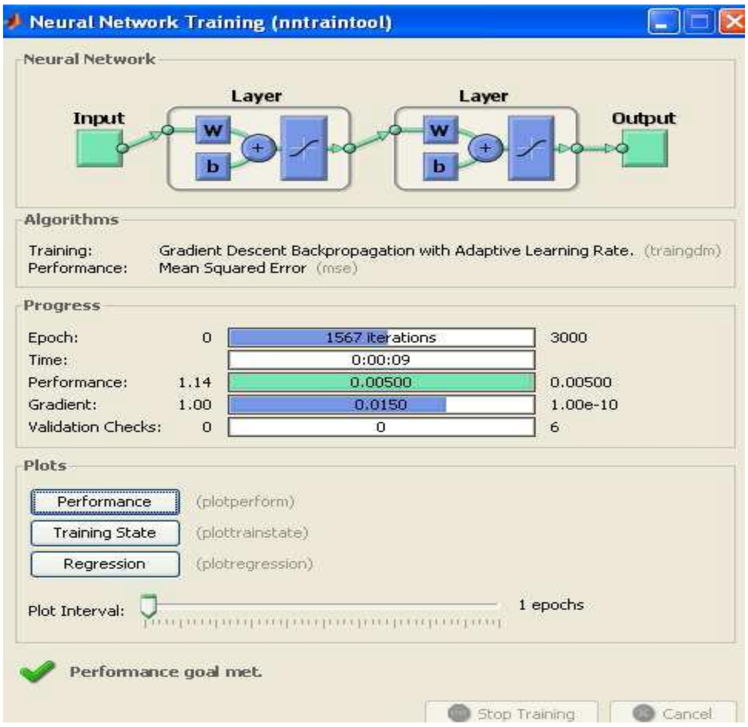

Fig. 3: Plot Regression for the demand forecast

The forecast of the demand of pulp wood is carried out and it is 4,90,000 MT for the forthcoming year for Tamil Nadu Newsprint and Papers Limited (TNPL). In SVM, increasing cost value causes closer fitting to the calibration/training data. Kernel *gamma* parameter controls the shape of the separating hyperplane. Increasing gamma usually increases number of support vectors. In training the regress which are predicted within distance epsilon from the actual value. Decreasing epsilon forcession function there is no penalty associated with point closer fitting to the calibration/training data. The demand is forecasted to be 5, 00, 000 MT for the forthcoming year for TNPL.

V. Conclusion

The study was conducted to create an awareness of the demand of pulpwood that are a supportive mechanism which demanded a systematic forecasting system similar to agricultural products. Support vector regression is a statistical method for creating regression functions of arbitrary type from a set of training data. Testing the quality of regression on the training set has shown good prediction accuracy. A Support Vector Regression based prediction model appropriately tuned can outperform other more complex models.

Acknowledgements

Sincere thanks to Mr. R. Sreenivasan, Assistant General Manager, Tamil Nadu Newsprint and Papers Limited (TNPL), karur, Dr. K. T. Parthiban, Professor and Head, Tree Breeding, Dr. P. Durairasu, Dean, FC&RI, Dr. M. Anjugam, Professor and Head, Forest College and Research Institute for their guidance and support.

References

[1] K. Kim, “Financial Time Series Forecasting using Support Vector Machines,” *Neurocomputing*, vol. 55, no. 1-2, pp. 307-319, 2003

[2] F.E.H. Tay and L. Cao, “Application of Support Vector Machines in Financial Time Series Forecasting,” *Omega*, vol. 21, pp. 309-317, 2001.

[3] R.S. Gutierrez, A.O. Solis and S. Mukhopadhyay, “Lumpy Demand Forecasting using Neural Networks,” *Int J Product Econ*, vol. 111, pp.409-425, 2008.

[4] Karin Kandananond , “Consumer Product Demand Forecasting based on Artificial Neural Network and Support Vector Machine”, World Academy of Science, Engineering and Technology 63, pp.372-375, 2012

[5] K. Kandananond, “"Forecasting Electricity Demand in Thailand with an Artificial Neural Network Approach," *Energies*, vol. 4, pp. 1246-1257, 2011.

[6] Gerson Lachtermacher, J. David Fuller, “Back propagation in time-series forecasting” , 2006

[7] V. Anandhi, R. ManickaChezian and K.T. Parthiban, “Forecast of Demand and Supply of Pulpwood using Artificial Neural Network”, International Journal of Computer Science and Telecommunications, pp. 35-38, 2012

[8] V. Anandhi, R. ManickaChezian, “Backpropagation Algorithm for Forecasting the Price of Pulpwood – Eucalyptus”, International Journal of Advanced Research in Computer Science, pp.355-357,2012

[9] C. C. Chang and C. J. Lin, *A library for support vector machines*, Technical Report, Department of Computer Science and Information Engineering, National Taiwan University, 2001.

[10] V. Anandhi, R. ManickaChezian, “Support Vector Regression to Forecast the Demand and Supply of Pulpwood”, International Journal of Future Computer and Communication, Vol. 2, No. 3, pp.266-269, June 2013

[11] K. P. Soman, R. Loganathan, and V. Ajay, “Support vector machines and other kernel methods,” Centre for Excellence in Computational Engineering and Networking Amrita Vishwa Vidyapeetham.

