Object Recognition using Wavelet and Neural Network Approach

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ABSTRACT
This paper represent a method for recognition any object moving in space with the help of wavelet transform and neural network. in this a small wavelet pulse is send towards the target moving in the sky ,this pulse strike on the target and reflect back to the earth, it having necessary information regarding target. This set of information then trained in neural network to identify what the object exactly.

Keywords:
Neural Network, Wavelet transform, radar

1. INTRODUCTION
Here to recognize object, we apply wavelet thresholding for removing automatically ground and intermittent clutter (airplane echoes) from wind profiler radar data. Using the concept of discrete multi resolution analysis and non-parametric estimation theory, we develop wavelet domain thresholding rules, which allow us to identify the coefficients relevant for clutter and to suppress them in order to obtain filtered reconstructions.[1]

These reports on an investigation into the use of neural network approaches for the initial recognition of objects within images. This research considers the initial identification of the objects as a visual rather than cognitive process. It is analogous to the classification problem in image processing and requires that characteristic image signatures are identified for particular object classes. The general applicability of the method is still to be determined but the initial results are promising.

The problem of neural network learning is presented in this report. The back propagation algorithm and the genetic algorithms is used. The increase of the neural network learning efficiency is shown. neural network is used for the object recognition based on radar signals. . The report presents the problem of the learning process coefficients evaluation, which determines the network run.

Wavelet transform: wavelet is a mathematical function which divide a given frequency into a number of components that is high frequency component and low frequency component. in this a frequency range is selected and all frequency components are compared with this range to know whether a component is use full or a noise. In this way noise components are removed from signal frequency.[2]

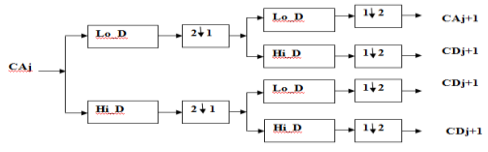

Fig 1: Multi level 2D wavelet decomposition

1.1Neural Network
The commonest type of artificial neural network consists of three groups, or layers, of units: a layer of "input" units is connected to a layer of "hidden" units, which is connected to a layer of "output" units. The activity of the input units represents the raw information that is fed into the network.The activity of each hidden unit is determined by the activities of the input units and the weights on the connections between the input and the hidden units.The behavior of the output units depends on the activity of the hidden units and the weights between the hidden and output units.[1]

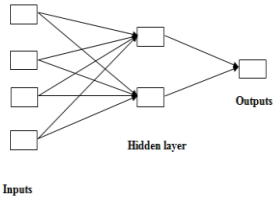

Fig2: Network layers

This simple type of network is interesting because the hidden units are free to construct their own representations of the input. The weights between the input and hidden units determine when each hidden unit is active, and so by modifying these weights, a hidden unit can choose what it represents. We also distinguish single-layer and multi-layer architectures. The single-layer organization, in which all units are connected to one another, constitutes the most general case and is of more potential computational power than hierarchically structured multilayer organizations. In multi-layer networks, layer, instead of following a global numbering, often numbers units.

1.2 The Wavelet Transform
The Discrete Fourier Transform (DFT) may be thought of in general terms as a matrix multiplication in which the original vector X_k is decomposed into a series of coefficients X_n Both k and n are integers which range over the same value N.

$$\begin{pmatrix} x_0 \\ . \\ . \\ x_{N-1} \end{pmatrix} = \begin{pmatrix} . & . & . & . \\ . & W_{kn} & . & . \\ . & . & . & . \\ . & . & . & . \end{pmatrix} \begin{pmatrix} X_0 \\ . \\ . \\ X_{N-1} \end{pmatrix}$$

In the above we may derive the transformed coefficients X_n by inverting the matrix.

The form of W_{kn} has many possibilities but physically we would like the option of forward and backward transforms ie., an inverse ought to exist.

The Discrete Wavelet Transform (DWT) generates a matrix W_{kn} which is now widely used for image compression instead of the FT since it is able to localise preserve photographic detail such that many of the coefficients may be ignored (tantamount to filtering) and yet the reconstruction remains effective. For certain types of problems the filtering may be much more aggressive than corresponding FT coefficient filtering.[2]

DWT's are particularly effective in analysing waveforms which have spikes or pulses buried in noise. The noise may be more effectively removed than with FT filtering and the shape of the pulses preserved. Conservation of Energy similar to a Parseval theorem would also be nice.

2. SIMULATION AND RESULT

Operation: The objective of radar object recognition system is to assign observed input vector to one of several types. In general an object recognition system has two stages, extraction stage and recognition. The purpose of the feature extraction stage is to reduce the complexity of the input space by mapping raw inputs into feature vector in a feature space. This is designed to preserve type discriminate information while ignoring information that is orthogonal to the discrimination task. This is done by either reducing the dimensionality of input vectors or by mapping a large number of inputs into a relatively small number of feature vectors.

Radar object recognition system based on wavelet transform and neural network shown in figure is simulated in MATLAB 7.7.0(R2008b). A three-layer back propagation neural network is used as the recognizer, which has 4 neurons in input layer, 16 neurons in hidden layer and 1 neuron on output layer.The learning process containing 10000 epochs. Output of the neural network is picture, which is associated with one of recognized radar object. Recognition is simulated four kinds of objects called object 1 through 4. These simulated backscattered signals from objects, which are represented by signal x,(i) after preprocessing, are shown in fig.

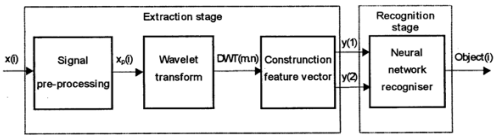

Fig.3:Block diagram of experiment setup for object recognition

There are four objects to be recognized:

Car

Helicopter

Group of persons

Aero plane

There are four transmitters, transmitter 1 to 4 that transmit four signals. These signals strike on the targets and four scattered signals are received at the receiver for each transmitter. Than recognizer recognize the target by processing these scattered signals from these targets

Fig.4.System GUI

Neural network training tool:

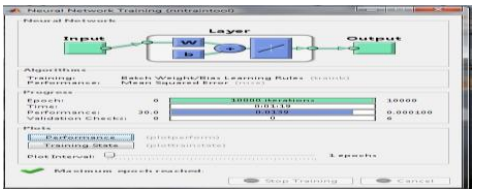

Fig.5: Neural network training tool

Neural network training tool perform training for object recognition. To achieve this 10000 calculations are performed for each object using back propagation learning method

Transmitter 1:

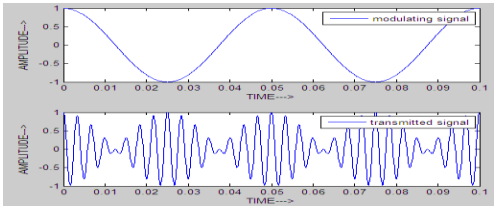

Fig.6: modulating and transmitted signal of transmitter – 1

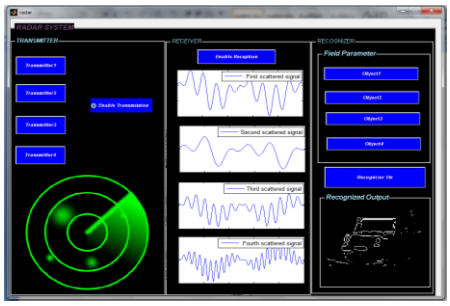

Fig7: first recognized object (car)

Received/scattered signals and first recognized object:

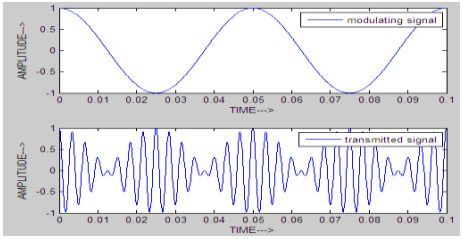

Fig.8: modulating and transmitted signal of transmitter – 2

Transmitter-2 :

Received/scattered signals and second recognized object :

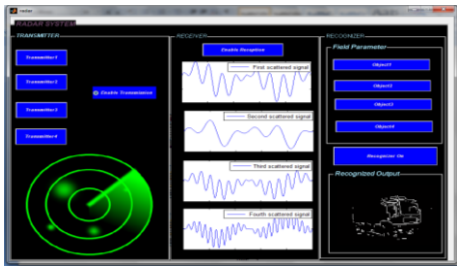

Fig.9: second recognized object (helicopter)

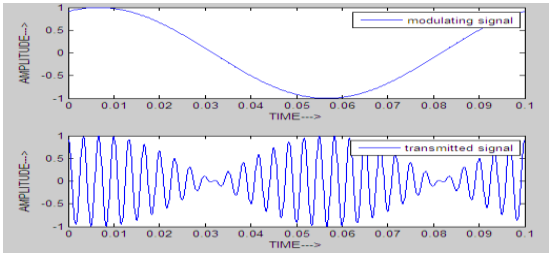

Fig.10: modulating and transmitted signal of transmitter – 3

Transmitter - 3

Received/scattered signals and third recognized object :

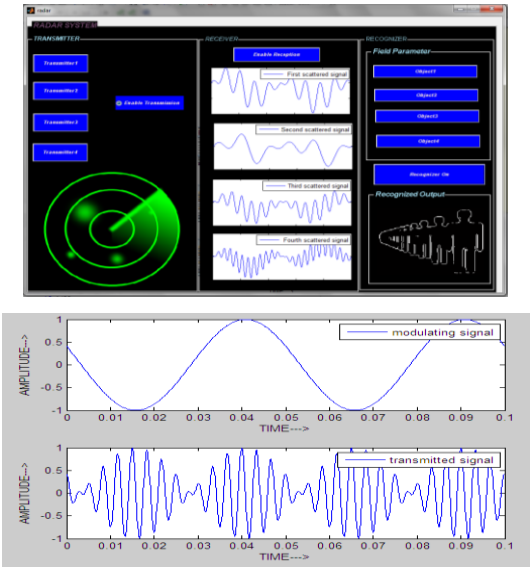

Fig.11: third recognized object (group of persons)

Transmitter – 4:

Received/scattered signals and fourth recognized object

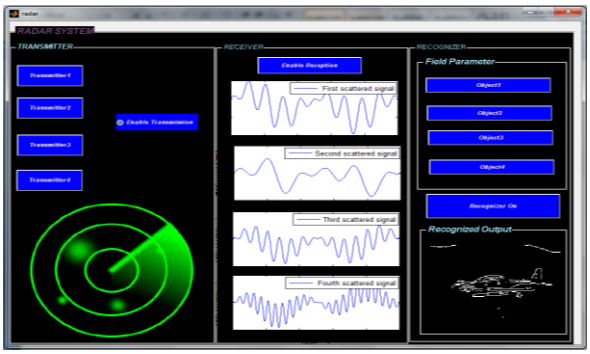

Fig.12: fourth recognized object (aero plane)

3. CONCLUSION

The object recognition method based on wavelet transform and neural network is described here. A wavelet based recognizer is not computationally intensive and produces reliable recognition results that are, under certain measurement scenarios, superior to those of other recognizer. This report presented radar object recognition method based on wavelet transform and back propagation neural network. Wavelet transform and pre-processing of input vector by the algorithm presented above, we can decrease dimension of feature vector, which feed the neural network recognizer. The simulation results suggest that, with a further sophisticated a truly practical system will be developed. Some issues are addressed in the future in particular, strategies for recognition of low SNR.

4. FUTURE SCOPE

Object recognition is a very important method specially for security purpose in military by making use of this method a practically very advance RADAR security system can be implemented that can enhance security system of our country. It can recognize enemy weapons entering in the country and can also sense speed, dimension and direction of that. It can also useful at airports for correct information about the position of flights which can reduce accidents and make sure safe landing etc.

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