Methods check the piping using a neural network

Yu V Vankov, Sh G Ziganshin, E V Izmailova, T O Politova

Kazan State Power Engineering University, 51 Krasnoselskaya str., Kazan 420066, Russian Federation

E-mail: yvankov@mail.ru

Abstract. The paper discusses issues related to the control of pipeline transport. To control the pipelines on the analysis of acoustic signals propagating along the transported product, it is proposed to use the neural network modeling. An example of implementation of the program in LabView environment for detecting defects of various sizes.

1. Introduction

Reliability and efficiency of urban heating and heat supply of industrial projects largely depends on the actual technical state of pipelines, and in particular for corrosion of pipes.

To ensure trouble-free operation of the pipelines necessary to have reliable information about the actual technical condition of the pipe, on the basis of which to make timely replacement of the "old" sites.

The above causes the relevance of diagnosing the state of non-destructive testing of pipelines. Solving the problem of diagnosing the state of corrosion of pipelines will solve the problem of reasonable prediction of their no-failure operation time and destination of their resources in accordance with the actual state.

It is well known [1], [2], [3], that the appearance of defects such as a crack, the change in geometric dimensions, physical-mechanical properties of the materials of construction leads to a change in the spectrum of natural oscillation frequencies of the product. Since during operation products defects may appear at different locations of the construction, their detection and identification by analyzing the spectrum of natural frequencies is difficult challenging. During the processing of acoustic signals faced with analysis of arrays a large number of frequencies obtained through experiments.

The use of computers makes it possible to handle this amount of data, but there are difficulties in creating a software algorithm of recognition and classification of defects. The aim of the study is to develop a method for monitoring the technical condition of pipelines in the parameters of acoustic signals based on neural network modeling.

2. Simulation of the diagnostic process

Neural network to diagnose pipelines has been implemented based on software complex LabView.

For the problem of defective pipeline network model is selected with training on error back-propagation algorithm. The network architecture is presented in (Figure 1).

The main program consists of several sub-programs, each of which performs a specific task. The first sub-program starts the task table reads files with recorded frequencies of pipes varying degrees of

defects and a file with the frequencies of the tested pipe, and then the normalization of all vectors read. The second sub-program implements the method of learning by error back-propagation algorithm and classifies the defective pipe size of the defect. Sub-program is a neural network as a credential in it take the data from the tables of results of calculation of natural frequencies of membranes of different sizes, made by finite element method.
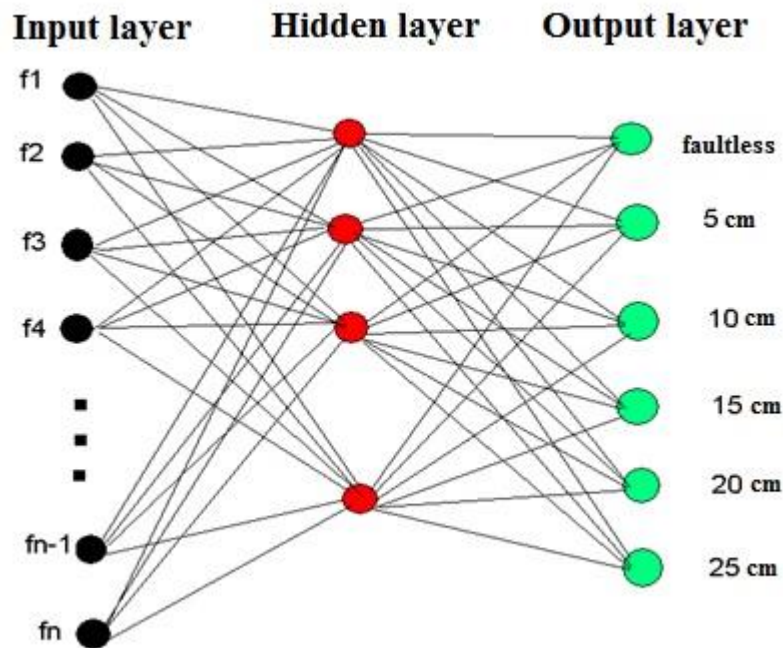

Figure 1. The architecture of the neural network training using the algorithm of back propagation of errors to diagnose the pipeline.

Established neural network consists of five output neurons, each of which characterizes the specific size defect. The program compares the training vector with diagnosable, and the output gives a result which of the classes (size) is defect. The input to the program of the samples submitted frequency sections of pipelines. The samples, in education, received frequency tube with known defects sizes 5x5, 10x5, 15x5, 20x5, 25x5 cm. As a result, the data output indicator lights on the front panel of the program (for the corresponding size of the defect, which corresponds to the maximum value of the likelihood and shows the numerical value of this probability). A typical report of the program is shown in Table 1.

Table 1. Probability distribution.

The true size of the defect	The probability values of the test sample				
	"Defect 5 cm"	"Defect 10 cm"	"Defect 15 cm"	"Defect 20 cm"	"Defect 25 cm"
5 cm	91,7	5,2	0,1	0,1	0,1
10 cm	5,2	90,1	4,2	2,3	0,9
15 cm	2,3	3,8	91,0	3,7	1,8
20 cm	0,5	0,7	4,1	90,5	7,2
25 cm	0,3	0,2	0,6	2,5	90,0

3. Conclusions

The results of the research can draw the following conclusions.

The method of classification of defects of pipelines using the technology of neural networks showed a high reliability of the results.

The results of the work helped to create a methodology to assess the technical condition of pipelines, including elements of solid mechanics, and a method based on the use of neural network analysis.

Analysis of experiments on the influence of defects on the oscillation parameters pipelines showed stable definition of the defect in the early stages of nucleation using neural network and confirmed the possibility of using the developed method for detecting defects of pipelines

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