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Abstract

The doctoral dissertation describes the application of four-valued state assessment in the process of diagnosing the operational features of complex technical objects. The aim of this type of diagnosis is to identify the state immediately preceding the occurrence of an inoperable state (failure) and to locate the element that generates this state.

Due to a progressive increase in complexity and tasks performed, the commonly used three-valued logic does not completely solve the problems of modern technical objects. Provision the user with fast and reliable information on the technical condition of objects is achieved by introducing multi-valued diagnostics with a greater number of recognised states (k>3).

The principles and rules of diagnosis presented here and their practical verification made it possible to obtain, in the process of inference, a significant increase in the diagnostic information of the four-valued assessment (4VL) in comparison with the three- and two-valued assessment (3VL, 2VL).

In the theoretical part, the ranges of changes in the values of features and their limits for individual states of a technical object in four-valued logic were determined. The scheme of classes and directions of changes in object states were defined including the criteria of the principles of the recognition of particular states in the process of classification. In order to evaluate the state of an object, evaluation indices were distinguished in the form of a quantitative measure of the acquisition of diagnostic information, an additional information gain function and the efficiency of technical maintenance.

In the practical part, a computer system for diagnosing complex technical objects was designed and implemented, one which carries out the process of inference in two-, three- and four-valued state evaluations. A complete diagnostic process was implemented in the system, consisting of such activities as: modelling the object, a functional and technical analysis of the object tested, measurements and analyses of signal characteristics and inference of the object state. Additionally, two test stands were created for the diagnosis of the control system of a spark-ignition petrol engine of the “Motronic” type and a low-power solar power plant.

The method presented in the paper, including the results of the experiments, unequivocally confirms the proposition contained the thesis, and it demonstrates that it is possible to diagnose complex technical objects using a four-value state evaluation.