ТЕЗИ СТЕНДОВИХ ДОПОВІДЕЙ ТА ВИСТУПІВ УЧАСНИКІВ КОНФЕРЕНЦІЇ

HIGHLIGHTS OF REPORTS AND PRESENTATIONS OF PARTICIPANTS TO THE CONFERENCE

UDC 004.9:681.5:656.2

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ACCOUNTING FOR DEPENDENT FAILURES IN A TECHNICAL SYSTEM

The issue of accounting for dependent (interrelated) failures in complex technical systems of railway transport is considered. Dependent failures, in particular those caused by common causes (operational, design, or environmental), result in an excessive concentration of malfunctions and underestimation of reliability estimates when classical independent models are employed. An approach to the systematic accounting of such failures is proposed.

Current research focuses on three areas: (1) modeling dependencies between components (multivariate distributions, copulas, Bayesian networks, common cause failure models — CCF); (2) methods of data collection and processing to identify event correlations (event logs, SCADA/CBM data, time series); (3) practical approaches to integrating information into maintenance systems (CMMS/ERP, condition-based maintenance analytics).

Based on the research carried out in [1], it has been shown that the use of models that take into account dependent failures allows for more accurate prediction of intervals between failures, optimization of maintenance intervals, and reduction of the risks of mass failures of elements of a complex technical system. Criteria for classifying dependencies between elements and a procedure for identifying group events have been developed.

An information and analytical system consisting of three levels has been proposed:

Data collection: unified event log, telemetry from sensors, repair records; time stamps.

Processing and detection: pre-processing modules (filtering, normalization), event correlation algorithms (temporal correlation, spatial-topological relationships), clustering and CCF pattern detection; application of mathematical apparatus using recurrent relations on sets to assess dependencies.

Analytics and integration into O&M: interface for engineers with recommendations for preventive measures, automatic triggers for changing repair priorities, reports for logistics planning.

The implementation of a dependent failure accounting system increases the accuracy of diagnostics, allows for the adjustment of maintenance policies, and reduces the risk of simultaneous multiple failures of elements of complex technical systems. Further research should focus on testing algorithms in real operating conditions and optimizing modeling coefficients, taking into account local failure statistics.

References:

1. Hryshechkina, T. S. Improvement of the maintenance system for railway transport technical objects, taking into account the dependent failures of their elements: dissertation Candidate of Technical Sciences: 05.22.20. Dnipro, 2021. 164 p. 0421U103001.

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IMPROVEMENT OF TECHNICAL DIAGNOSTICS OF RAILWAY AUTOMATION SYSTEMS

In the current conditions of martial law and a shortage of staff for the timely maintenance of railway automation systems, improving the technical diagnostics of these systems is a relevant task. Technical diagnostics of railway automation systems are classified according to several criteria [1]:

– by purpose and functionality (performance monitoring, technical condition assessment, fault detection (localization), residual life prediction);

– by object of diagnosis (component level, node level, system level);

– by timing (scheduled (periodic) diagnostics, continuous (non-stop) diagnostics, operational (emergency) diagnostics, test diagnostics);

– by level of automation (manual (visual), automated).

Modern railway automation systems strive to use continuous automated diagnostics at all levels to minimize the human factor and detect malfunctions before they lead to traffic safety violations [2].

Finding (locating) faults in railway automation systems is a critically important and highly organized process that combines automated monitoring and actions by maintenance staff.

In modern signaling control systems (especially microprocessor-based ones), this process is divided into several stages:

– detection and registration of faults (automatic recording, dispatcher control, hardware journal of object status changes);

– remote preliminary localization (analysis of damage reports, parameter checks, power supply checks,