THE CONCEPT OF USING ARTIFICIAL INTELLIGENCE AND A METROLOGICAL OBSERVER IN A SYSTEM FOR EVALUATING THE QUALITY OF OBJECT FUNCTIONING

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The rapid development of cyber-physical systems and automated control tools necessitates the implementation of intelligent solutions to enhance the accuracy, reliability, and adaptability of systems for evaluating the quality of technical object functioning. In this context, the integration of artificial intelligence (AI) methods with metrological support tools, in particular the use of a metrological observer as a component of the diagnostic subsystem, is considered promising. Artificial intelligence – especially machine learning methods, neural network modeling, and clustering algorithms – enables the analysis of large volumes of data, recognition of patterns, detection of anomalies in object operation, and forecasting based on trends. This opens up opportunities for creating self-adaptive quality evaluation systems that can modify their assessment criteria depending on the operational conditions and the state of the object. On the other hand, the metrological observer functions as a software-hardware or mathematical module that performs filtering, normalization, and refinement of measured data, taking into account measurement channel errors [1] and possible signal distortions. As a result, the reliability of input data for intelligent analysis is increased, and the likelihood of misinterpretation of the results is reduced.

The integrated combination of these two components – AI and the metrological observer – provides the foundation for developing a hybrid quality assessment system capable of:

- conducting multifactor evaluation of the technical condition of an object;
- promptly detecting and localizing deviations;
- adapting to changes in operational conditions;
- generating diagnostic conclusions with consideration of metrological reliability.

Such systems can be effectively applied across various fields: transportation [2], energy, industrial complexes, medical equipment, and more. This approach enables improved reliability of control, timely detection of performance degradation or faults, and optimization of system maintenance.

References:

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