References

1. Kutlugun V., Eyupoglu C. Artificial intelligence methods used in computer vision. *2020 5th International Conference on Computer Science and Engineering (UBMK)*. 2020. P. 214–218. DOI: 10.1109/UBMK50275.2020.9219385.

2. Nerubatskyi V. P., Plakhtii O. A., Hordiienko D. A., Syniavskyi A. V., Philipjeva M. V. Use of modern technologies in the problems of automation of data collection in intellectual power supply systems. *Modern engineering and innovative technologies*. 2022. Issue 19. P. 38–51. DOI: 10.30890/2567-5273.2022-19-01-058.

3. Song F., Qin D., Xu C. A survey of application of artificial intelligence methods in SDN. *2022 IEEE 2nd International Conference on Software Engineering and Artificial Intelligence (SEAI)*. 2022. P. 237–242. DOI: 10.1109/SEAI55746.2022.9832340.

4. Nerubatskyi V., Hordiienko D. Analysis of the control system of a wind plant connected to the AC network. *Power engineering: economics, technique, ecology*. 2023. No. 1. P. 87–91. DOI: 10.20535/1813-5420.1.2023.276028.

5. Marian C. V. Artificial intelligence-based algorithm for resources allocation. *2022 14th International Conference on Electronics, Computers and Artificial Intelligence (ECAI)*. 2022. P. 1–4. DOI: 10.1109/ECAI54874.2022.9847517.

***NERUBATSKYI V. P.**, PhD, AssociateProfessor*
***HORDIIENKO D. A.**,Postgraduate*
Ukrainian State University of Railway Transport
Kharkiv, Ukraine

REMOTE MONITORING OF CONTACT NETWORK CONDITION FOR MOTION HIGH-SPEED ROLLING STOCK

One of the infrastructure objects, the requirements for which increase during high-speed traffic, is the contact network. The safety and uninterrupted operation of trains depends on the mechanical strength, geometric parameters and technical condition of its elements [1, 2]. The contact network of railways includes contact suspension and supporting structures, auxiliary units and devices. Traction current is collected from electric rolling stock using a contact wire. Sagging and sudden changes in suspension height cause changes in contact resistance, arcing and can lead to burnout of the contact wire or pantograph strips.

Most suspension malfunctions result in changes in the position of the weights on the anchor supports. For example, when a support cable or contact wire breaks, the load moves downward with acceleration. Sagging of the support cable or contact wire beyond the permissible limits as a result of improper adjustment, foreign objects falling

on the cable, broken wires, freezing of the load can also be detected by the movement of the load, since a change in the tension of the support cable causes the load to rise or fall [3, 4]. To record the linear movements of the supporting cable, a mobile recorder can be installed on the load compensator at the place where the load is attached. Its body contains vibration, temperature, acceleration sensors, and a magnetometer. In addition, the mobile recorder is equipped with a microcontroller and a unit for receiving and transmitting measurement information in the data transmission system.

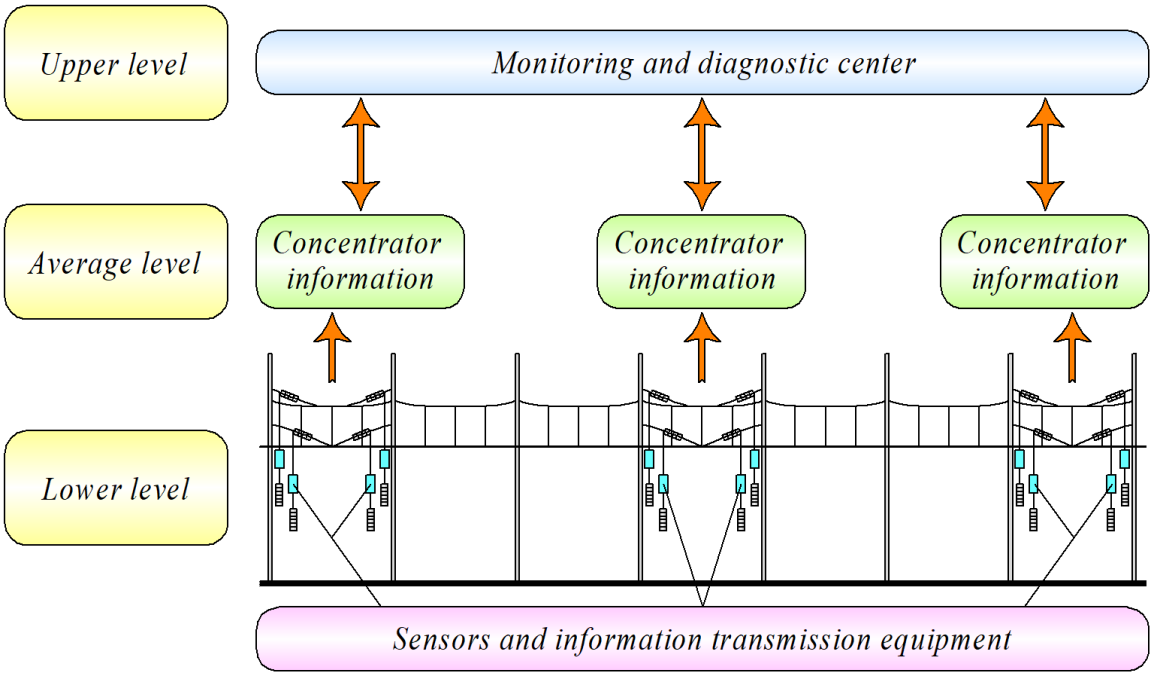

Fig. 1. Structural diagram of the contact network condition monitoring system

The information received from the sensors must be processed, analyzed, and based on the results of this analysis, it is possible to prevent the failure of the contact network and its consequences. This implies the need for a three-level structure of the monitoring system, as shown in Fig. 1.

The lower level is formed by the described sensors. Sensor signals are processed by an analog-to-digital converter, the resulting values are transmitted via a communication channel to concentrators, the purpose of which is to collect information from sensors, short-term data storage and exchange with the upper level of the system. Concentrators can be located at railway stations, where it is possible to place equipment and power supplies. At the average level, the central diagnostic and monitoring post ensures the collection, long-term storage and centralized processing of incoming information, as well as automatic monitoring of the functioning of the contact network in real time. An automated workstation is installed here, designed to display the received information, identify failures and pre-failure states in the catenary, log events, and store regulatory and reference information. Based on the data obtained and the forecast of changes in the technical condition of the contact network, operational

personnel ensure planning of maintenance and repair of the contact network, organizing troubleshooting.

For a comprehensive analysis of the functioning of technical means of the energy supply system on the road, correct and timely decision-making, the upper hierarchical level of the diagnostic system must be created - a road center for monitoring the energy supply system. At this level, information is provided to dispatch personnel, and an automated workstation is also installed here.

Using a mathematical model, measurement results are interpreted into events. Thus, the end user works with an event-information model, which automatically recognizes and displays messages on the screen about the following events: the passage of a train; passage of a high-speed train; cargo pumping; breakage of the support cable core; complete break of the supporting cable; falling objects onto a support cable or contact wire; the occurrence of resonant oscillations; assessment of the impact of climate impacts. The user interface provides for the display of data in real time with reference to the anchor section, support number, indicating the main technical characteristics of the system and its elements.

Thus, continuous automated monitoring of the state of the contact network makes it possible to identify the boundary values of the controlled parameters, and therefore take measures to eliminate the prerequisites for the occurrence of a failure.

References

1. Herold C., Thielecke L., Kurner T. Generation of realistic railway based mobility scenarios. *2020 14th European Conference on Antennas and Propagation (EuCAP)*. 2020. P. 1–5. DOI: 10.23919/EuCAP48036.2020.9135690.

2. Nerubatskyi V., Plakhtii O., Hordiienko D., Khoruzhevskyi H. Study of energy parameters in alternative power source microgrid systems with multilevel inverters. *International scientific journal «Industry 4.0»*. 2020. Vol. 5 (3). P. 118–121.

3. Mahatmanto B., Nasution A., Madina R., Apriono C. Design and analysis of optical fiber network for railway communication lines. *2020 7th International Conference on Information Technology, Computer, and Electrical Engineering (ICITACEE)*. 2020. P. 267–271.

4. Nerubatskyi V. P., Plakhtii O. A., Hordiienko D. A., Syniavskyi A. V., Philipjeva M. V. Use of modern technologies in the problems of automation of data collection in intellectual power supply systems. *Modern engineering and innovative technologies*. 2022. Issue 19. P. 38–51. DOI: 10.30890/2567-5273.2022-19-01-058.