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ZASTOSOWANIE MODELU NEURONOWO – ROZMYTEGO DO DIAGNOZOWANIA I PROGNOZOWANIA WYBRANEGO ZAGROŻENIA W PROCESIE PRODUKCJI GÓRNICZEJ

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ABSTRACT

Application of the Neural Fuzzy Model for diagnosing and forecasting a selected hazard in the mining production process

The mining production process involves a number of different types of hazards. Definitely the most dangerous are the natural hazards, caused by the imbalance in the rock mass as a result of mining. One of the most frequent and causing the greatest threat during underground hard coal mining is the methane hazard, which belongs to the group of ventilation hazards. Due to the great danger that methane presents to the mining production process, it is necessary to conduct research to reduce its negative impact on the mining production process. This area includes the subject matter of the work, the main aim of which was to develop a model and methodology for diagnosing and forecasting methane risk in the process of hard coal production with the use of neural-fuzzy structures and the results of actual measurements of ventilation parameters.

As a result of the research work carried out to a very wide extent, a model was developed for diagnosing and forecasting the degree of methane hazard in the mining production process. The basis for the development of this model was the application of artificial neural networks and fuzzy set theory. This led to the creation of a very advanced and classified as a group of intelligent solutions hybrid model, which allows for the analysis of large data sets. Based on this model, a methodology was developed for diagnosing and forecasting the degree of methane hazard in the mining production process. A very important element of this methodology, apart from the neural-fuzzy model, was also the development of a method for acquiring measurement data from the researched area and their adjustment as input data for further analysis.

Using the developed methodology and knowledge gained during the research, a tool in the form of an IT system was built to diagnose and forecast the degree of methane hazard in the mining production process. This system enables the determination of short-term methane-bearing capacity forecasting, which creates the possibility of current and effective control of methane hazard in the investigated area. The basis for determining the degree of methane hazard is the value of the methane hazard rate (WZM), determined according to the developed methodology by the IT system. This index defines the relationship between absolute and criterial methane-bearing capacity in the examined area. The developed IT system was verified on the basis of actual data from one of the hard coal mines. This process included determining the current and future degree of methane hazard, depending on the value of the methane hazard rate. In order to evaluate the quality of the results gained, they were compared with the results from other methods used to analyse large data sets. The comparative analysis has clearly shown that the system developed allows for much more accurate results compared to other tools. It should also be emphasized that the developed model has the ability to learn on the basis of new data supplied to the system, which allows for its dynamic and ongoing adaptation to the current conditions in the area of the existing mining production.

Thanks to the application of the developed tool, it is possible to better control ventilation parameters and methane concentration in excavations, also in terms of future values of these concentrations. This creates the possibility of taking preventive action to limit the occurrence of dangerous events in the area. Undoubtedly, this should also improve work safety and the efficiency of the mining production process.

The research carried out together with the gained results and formulated conclusions made it possible to achieve the assumed main scientific objective of the study, including the development of a model for diagnosing and forecasting methane hazard in the process of hard coal production using neural-fuzzy structures. The specific research objectives of the work have been also fully achieved.

Developed on the basis of the acquired knowledge, a tool in the form of an IT system for diagnosing and forecasting the degree of methane hazard in the mining production process, creates a very real possibility of quick practical use of research results. Therefore, it can be assumed that also the utilitarian purpose of the work has been fully achieved.

Based on the assumed and achieved, as a result of the conducted works, research and utilitarian goals, it can be stated that also the thesis of the work, concerning the possibility of diagnosing and forecasting the methane hazard in the area of the conducted mining production, based on the measurements of ventilation parameters with the use of neural-fuzzy inference, has been fully proved.