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## SUMMARY

of doctoral thesis by Michał Jasiński

### *Application of cluster analysis and global power quality index for identification and assessment of different operating states of mining electrical power networks in terms of power quality*

The work concerns the possibility of using cluster analysis and global power quality index in order to identify and assess various operating states of electric power grids in the aspect of power quality. The work is performed in cooperation with KGHM Polska Miedź S.A. The investigations are based on real data obtained from the power network of the Polkowice-Sieroszowice mine, in which the gas-steam blocks are installed. The developed method was used to assess the impact of distributed generation on power quality in mining electrical networks.

The work contains the reviews of data mining techniques application in power engineering, describes the Ward algorithm and k-means algorithm as examples of hierarchical and non-hierarchical cluster analysis algorithms. Field studies were performed which consist of synchronous registration of power quality parameters at selected nodes of the mining network during planned changes in the generating units working conditions. The measurements systems used in mining network were reviewed that allowed to select power quality and dispatching information systems like WINDEX and SIDEM as suitable for application in the assessment process. On the basis of above review a method of assessment of the impact of distributed generation on mining power network was proposed. The method is based on the cluster analysis of a selected power quality parameters data set obtained from measurement points. Results of the method allow to identify the data clusters which are represented by different power quality level. Obtained clusters are connected with the data from WINDEX and SIDEM systems which inform about network condition. Clustering and connection enable to the working conditions of the examined power network by separated clusters. Additionally investigations of influence of input data set construction, type of algorithm, distance definition on data division into clusters were made in point of view of effectiveness representation of the recorded working conditions of the network by indicated clusters.

Obtained results include the application of the proposed method for effective division of the data into flagged and unflagged data within the meaning of IEC 61000 4-30. As the result of suitable selection of number of clusters and the structure of the input data, the data was divided into clusters representing different conditions of mine network operation, in particular switched on or off distributed generation, period of extraction or revision of machines and devices, reconfiguration of network connections. Global power quality indicators have been proposed for the comparative assessment of data in clusters. This approach allows you to omit the multiparametric evaluation for one numeric parameter assessment. The calculations of global power quality indices for separate clusters confirm the positive effect of gas-steam blocks influence on the qualitative working conditions of the examined power grid of the mining industry.

Keywords: data mining, cluster analysis, distributed generation, measurement and dispatching systems of mine network working, long-term data, global power quality index.

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