Processing of acoustic emission test signals in determining the Kaiser impact point of rocks using discrete wavelet transform

Mohammadmahdi Dinmohammadpour[1], Majid Nikkhah[2]*, Kamran Goshtasbi[3], Kaveh Ahangari[1]

1- Dept. of Mining Engineering, Science and Research Branch, Islamic Azad University, Tehran, Iran
2- Dept. of Mining, Petroleum and Geophysics Engineering, Shahrood University of Technology, Shahrood, Iran
3- Dept. of Mining Engineering , Tarbiat Modares University, Tehran, Iran

* Corresponding Author: madjid.nikkhah@gmail.com
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Summary

One of the geomechanical parameters that is very important in the design and analysis of various rock engineering projects is the in situ stress state of the rock mass. In this research, acoustic emission signal processing has been used to determine the Kaiser effect point of the experimental data on Phyllite rock by discrete wavelet transform method.

Introduction

There are different methods to determine in situ stress. In this regard, direct measurement methods are the best and most accurate in situ stress measurement methods. However, these methods are very time-consuming and costly. Therefore, nowadays laboratory and indirect rock core-based methods for estimating in situ stress have been taken into consideration. One of the laboratory methods is the acoustic emission method based on Kaiser effect. In this method, determining the Kaiser effect point is usually done by the parameters of acoustic emission signals, which in some cases, determining the Kaiser effect point by parametric method are ambiguous and do not have sufficient clarity. Signal processing based on wavelet transform is a powerful tool to process acoustic emission signals, which has been used in several papers.

Methodology and Approaches

In this study some Phyllite samples were used to be loaded under indirect tensile loading (Brazilian test). The acoustic emission test consisted of two cycles. In the first cycle, the samples were preloaded to a predetermined level, and in the second cycle, they were reloaded until reaching the failure. Before using the discrete wavelet transform, the appropriate mother wavelet was selected. Then, the signals obtained from the acoustic emission test were processed using wavelet transform. The maximum approximation coefficient parameter was used as a suitable feature for the analysis. Using K-means method, the obtained data are clustered in five clusters. Then, the highest density of data in the fifth cluster was considered as the occurrence point of the Kaiser effect.

Results and Conclusions

The results show that according to the parameters of correlation coefficient and noise to signal ratio and the type of acoustic signals the mother wave db6 was suitable for analysis. Among the parameters that can be used for analysis, the maximum approximation coefficient parameter is also selected as a suitable feature for analysis. Also, the results of the discrete wavelet transform method were in good agreement with the results of the parametric method, so that the occurrence times of the Kaiser effect obtained from the two methods are mutually acceptable.