Abstract

The thesis focuses on seismic tomography, more specifically on its variant related with seismic waves attenuation phenomenon i.e. on amplitude tomography. In coal mining industry seismic tomography is very often used to determine spatial distribution of physical parameters in the rock mass. Therefore it can be applied in solving various mining and geological problems, such as determination of lithological heterogeneity, fracture zones, stress distribution and impact evaluation of blasting on stresses in rocks. In the theoretical part of this dissertation the following issues have been discussed: mathematical description of elastic waves attenuation in rocks and inverse problem formulation of seismic tomography. Inversion methods were formulated as linear, non-linear and methods solved with probabilistic approach.

The following thesis was formulated and prooved: appropriate selection of regularization parameters increases accuracy of calculated transmission coefficients of seismic amplitude tomography and improves determination of faults and other geological structures existing in hard coal seam in real mining conditions.

The main objective of the thesis is application of Levenberg-Marquardt algorithm and regularization in seismic amplitude tomography to increase accuracy of calculated transmission coefficients of seismic amplitude tomography. The objective has been achieved by optimal selection of regularization parameters calculated on selected numerical models that that reflected typical geological structures found in coal seams. Six different models have been created, starting with the simplest one with one geological anomaly, ending with those rendering more complex structures. The optimally selected regularization parameters have been used in tomographic imaging applied to real mining conditions. Two types of regularization have been analyzed: Tichonov regularization and regularization of transmission coefficient variance. It has been concluded that regularization of transmission coefficient variance is not sensitive to the selection of the starting tomographic model and as a consequence has been chosen for further tomographic calculations. The presented method makes it possible to determine distributions of transmission coefficients and additionally to estimate its errors.

The amplitude tomographic imaging with the use of selected regularization parameters has been utilized to determine geological structures in 2 coal mines in

Upper Silesia region and one coal mine in Lublin. The tomographic images of transmission coefficient correlate well with geological heterogeneities in the active mining coal panels. The results of tomographic measurement confirm that the seismic amplitude tomography based the Levenberg-Marquardt algorithm and regularization with optimally selected regularization parameters provide more accurate spatial distribution of transmission coefficient.