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Open-cast mine slope deformation and failure mechanisms interpreted from slope radar monitoring

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ABSTRACT

The monitoring of open-pit mine slopes using radar systems is becoming more and more common. The output from radar monitoring is the displacement of the full slope surface after each radar scan, allowing displacements, velocities and acceleration to be determined. The displacement trends obtained from radar monitoring are a representation of the deformation taking place within the mine slope. The research deals with the analysis of the displacement trends in order to understand the slope deformation behaviour. The main objectives of this research work were:

- To interpret the deformation behaviour and failure mechanisms of open-cast mine slopes based primarily on displacement data from radar monitoring; and
- To develop a method using the radar displacement data for predicting the time to failure of open-cast mine slopes.

The research established that slope failure is preceded by the gradual accumulation of deformation within the slope. Identifying where the deformation is taking place, the magnitudes and state of the deformation is crucial in understanding and interpreting the slope deformation and failure mechanisms. The main accomplishments of the research include:

- The interpretation of deformation and failure mechanisms from radar displacement data of both stable and unstable open-cast mine slopes. The interpretation of deformation was used in classifying the deformation behaviour of unstable open-cast mine slopes into five main stages, consisting of three pre-failure stages and two post-failure stages. From the displacement data, two types of deformation behaviour of stable slopes were also identified;
- The development of a simple model for estimating the threshold values for the cumulative rate of displacement. The cumulative rate of displacement threshold determines when mine personnel and equipment must evacuate the unstable area of the slope. The model can also be used to effectively identify the deformation state of open-cast mine slopes; and
- The development of a Slope Failure Prediction Model (SFPM) for estimating the time to failure of open-cast mine slopes. The model was effective in predicting the time to failure when validated with four case examples of open cast mine slope failures. The development of the SFPM is a novel approach which provides an automated prediction of time to failure.