Geophysical Research Abstracts
Vol. 12, EGU2010-652-1, 2010
EGU General Assembly 2010

Landslide stability analysis on basis of LIDAR data extraction

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Currently, existing contradictory between remediation and acquisition from natural resource induces a series of divergences. With regard to open pit mining, legal regulation requires human to fill back the open pit area with water or recreate new landscape by other materials; on the other hand, human can not help excavating the mining area due to the shortage of power resource. However, to engineering geologists, one coincident problem which takes place not only in filling but also in mining operation should be paid more attention to, i.e. the slope stability analysis within these areas.

There are a number of construction activities during remediation or mining process which can directly or indirectly cause slope failure. Lives can be endangered since local failure either while or after remediation; for mining process, slope failure in a bench, which carries a main haul road or is adjacent to human activity area, would be significant catastrophe to the whole mining program.

The stability of an individual bench or slope is controlled by several factors, which are geological condition, morphology, climate, excavation techniques and transportation approach. The task which takes the longest time is to collect the morphological data. Consequently, it is one of the most dangerous tasks due to the time consuming in mining field. LIDAR scanning for morphological data collecting can help to skip this obstacle since advantages of LIDAR techniques as follows:

- Dynamic range available on the market: from 3 m to beyond 1 km,
- Ruggedly designed for demanding field applications,
- Compact, easily hand-carried and deployed by a single operator.

In 2009, scanning campaigns for 2 open pit quarry have been carried out. The aim for these LIDAR detections is to construct a detailed 3D quarry model and analyze the bench stability to support the filling planning. The 3D quarry surface was built up by using PolyWorks 10.1 on basis of LIDAR data. LIDAR data refining takes an important role during surface construction for further more precise analysis purpose. 3D geological model can be built based on the connection between surface model and geological data like borehole data in GOCAD. Regarding the bench stability analysis, LEM (Limit Equilibrium Method) analysis using Janbu and FEM (Finite Element Method) have been adopted during this analyzing task. A program was developed to convert GOCAD 2D section data directly into the FEM software. The meshed model is then used for stability analysis. In one quarry, 3 cross sections have been extracted on basis of LIDAR original data (original 3 cross sections). To evaluate the advantages of LIDAR data for slope analysis, the results of safety factor (SF) were compared to simplified slope models as they are used normally. The comparison showed that variations of the SF reach up to 9%. Additionally, conservative evaluation demonstrated by SF results based on simplified model is not adaptive for decision making of filling.