**Spatial Analysis and Monitoring of Slope Stability using Persistent Scatterer Tecnique of Sentinel 1 Radar Images, Case Study: Sarcheshmeh Copper Mine**

**Extended abstract**

Slope instability is one of the major and serious problems in open-cast mines. This phenomenon has always been one of the most dangerous that can cause to collapse the walls of mines. Slope instability in open-pit mines can damage human resources, destroy equipment, and terminate mining operations. In order to increase and enhance the safety of such mines, it is necessary to monitor the behavior and the dangerous deformations of the slopes. Space-based geodetic techniques that can measure changes in the land-surface position have significantly advanced over the past two decades with the development of satellite-borne differential interferometric synthetic aperture radar (InSAR) techniques. The InSAR techniques can measure sub-centimeter ground displacements at high spatial detail over regions spanning. In this research, in the light of the importance of Sarcheshmeh copper mine as one of the largest copper mines in the world And reports of instability occurring, especially in parts of the western wall of the mine, In this research, it was tried to analyze and monitor the slope stability of this mine using Sentinel-1 radar images and applying Persist Scattering technique.

InSAR is a remote sensing technique that uses radar imagery to provide spatially dense measurements of surface displacements the satellite line of sight (LOS) with millimeter to centimeter accuracy. Multiple SAR images are used to generate sets of interferograms to form a time series after a joint inversion. InSAR time series analysis helps reduce the impact of several noise sources (decorrelation, orbital and DEM errors, atmospheric delays, phase unwrapping errors) on displacement rates estimates during the time period spanned by the full dataset with an accuracy for surface displacement velocity at the mm/yr scale. We prepared 10 SENTINEL1 radar images acquired by soyuz satellite. PSInSAR technique has been developed and patented at the Polytechnic of Milan in 2000. It is an extremely effective tool for the millimeter accuracy monitoring of earth surface deformation phenomena, based on the use of time series of satellite radar images. This approach is based on the observation that a small subset of radar targets, consisting precisely of permanent scatterers (PS), is practically immune to the effects of decorrelation. PS approach was used to process interferograms and invert for average displacement rates and evolution through time, as described in detail by 9 individual interferograms were generated using a modified version of the SARScape and the STRM 30-global DEM.

Based on the correlation diagram between the master and slave images (Fig. 5), the pair of appropriate images in terms of the shortest spatial and temporal lines is identified to produce the interferogram. As shown in Fig. 5, the maximum vertical baseline is obtained between -400 and -400. The obtained interferograms indicate the cumulative phase of the study area, which fluctuates between zero and 2ᴫ. Using StaMPS method on interferograms, 650 points were identified and selected as permanent scatter points in the study area. As can be seen in Figure 7, the cumulative displacement of the permanent dispersant points varies from + 45 mm to -45 mm. The displacements occur in the direction of the satellite's view so that the positive numbers Indicates surface approach to satellite and the uplift and the negative numbers indicate the surface's distance from the satellite and the subsidence. As shown in the figure, in the western part of the mine wall, areas of 100,000 square meters have been heavily subsided. The next area, which has high subsidence points, is in the eastern part of the mine wall with an area of 68,000 square meters. The third area is located in the northwestern part of the mine with an area of 17,000 square meters.

By measuring the amount of displacement of Persist Scatters points, the altitude changes occurred in the mining area. Based on the results, the altitude variation changes in the range of 45 mm to -45 mm per year. Accordingly, 3 subsidence area were identified in western, eastern and northwestern parts of the mine wall with an area of 100, 68, and 17 thousand square meters. Considering the importance of the subject and in order to prevent the destruction of the mine wall, more precise geotechnical studies are needed in these specified areas.

**Keywords**

Radar Interferometery, Times Series, Stability Analysis, Displacement Rate, Sarcheshme Copper Mine.