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## Tunnel deformation rate analysis based on PS-InSAR technique and stress-area method

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The permanent scatterer synthetic aperture radar interferometry (PS-InSAR) technique can detect the permanent scatterers (PSs) on the ground. But the deformation of PSs can't be used to analyze the deformation of underground buildings below the ground surface directly, such as tunnels. In this paper, the process of tunnel deformation analysis using PSs data and stress-area method is proposed. The deformation data of PSs are used to fit the surface deformation of tunnel by kriging interpolation method. The stress area method is used to calculate the deformation of the soil above the tunnel, then the deformation of tunnel can be acquired. This process was applied to calculate the deformation of a tunnel in Shanghai, China. The results show that the fitted surface deformation rate data are accurate, with the maximum absolute difference of 1.45mm/y and the minimum difference of 0.11mm/y compared with the level monitoring data. The tunnel deformation rate calculated by this process is close to the measured deformation rate of the tunnel with error level in millimeters. The surface and tunnel deformation rate curves are similar in the tunnel extension direction. PS-InSAR technique has the advantages of acquiring large area, historical data of surface deformation. Combined with the process proposed in this paper, Large-scale tunnel deformation analysis can be achieved.