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Real-time monitoring and early warning of transmission tower foundations under landslide disasters

ChenChen Huang, Kunlong Yin, and Xin Liang
China University of Geosciences, Faculty of Engineering, China (hcc1996yym@sina.com)

The Ultra High Voltage (UHV) power grids in China are playing an important role of large-region power supply, contain long-distance interconnected channels that have to span a variety of different geomorphic units. However, geological disasters around transmission lines can threaten the reliability of UHV system. Landslides, one of the most common geological disasters in China, can affect the stability of transmission towers by shearing their foundations or involving them to move overall. Once a power tower is destroyed catastrophically, it may lead to widespread power outages, which can result in serious social adverse effects and huge economic losses. This paper presents a multi-technology early warning system for monitoring landslide deformation and observing transmission tower stability. In this system, there are three categories of monitoring information, including landslide displacement, external hydrological conditions and the stability of tower, integrated that are critical to predicting slope stability. To implement this system, a variety of techniques are employed. Firstly, advanced aviation technologies, such as Interferometric Synthetic Aperture Rader (InSAR) and unmanned aerial vehicle (UAV) are used to monitor the overall deformation of the landslide. Absolute surface displacement, subsurface displacement and relative displacement of cracks are recorded by the Global Navigation Satellite System (GNSS), deep inclinometer cooperating with optical fiber sensors and surface crack meters respectively. Second, the two main factors influencing landslide deformation, rainfall and underground water level, are observed by rain gauge and pressure gauge respectively. Third, in order to evaluate the stability of tower, earth pressure sensors are installed on the four foots of the tower foundation and pylon inclinometer is installed on the tower body. This system has been applied to the Doupozi landslide, where a tower of 500KV Shen-wan UHV line is located. Compared with that of traditional methods, the recording process of the multi-technology system is automatic and continuous, which can save human resource cost. Besides, the integrated monitoring data obtained from this system can be used to analyze the interaction between geological disasters and power towers. The multi-technology early warning system is also suitable for risk mitigation of transmission lines, oil and gas pipelines, highways, railways and other linear projects in mountainous areas.

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