Dynamic Deformation Monitoring Based on Wireless Sensor Networks

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SUMMARY

As one of the most important technologies in the 21st century, the emergence of wireless sensor networks (WSN) has brought both opportunities and challenges for the development of deformation monitoring. Compared with traditional deformation monitoring techniques, deformation monitoring systems using a large number of low-cost sensor nodes, can get rid of cable shackles and achieve wireless, multi-hop and long-distance transmission of monitoring data, thus having advantages in automatic, continuous and real-time deformation monitoring. However, there still exist limitations of senor nodes in computing power, storage capacity and bandwidth. The present article reviews data acquisition and data processing techniques in deformation monitoring based on wireless sensor network. In terms of data acquisition, the paper focuses on the following issues: how to choose motes, sensors, and software systems to meet the needs of monitoring tasks; the influence of time jitters within and between nodes in data sampling and methods for time synchronization; the issue of data compression because of the large amount of data caused by high-frequency sampling; and the ways to deal with problems of data loss in the wireless transmission process due to environmental interference and other factors. For data processing, firstly the required data pre-processing techniques for acceleration monitoring data, such as static and dynamic tests, temperature calibration, and data de-noising are discussed. Then acceleration monitoring data analysis methods in time domain, frequency domain and modal domain are summarized. In time domain numerical integration is used to transfer acceleration to displacement. Power spectrum density function is calculated based on Fourier transform in frequency domain. As for modal domain, structural dynamics are utilized to identify the structure modal parameters such as natural frequencies, damping ratios and modal shapes.