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Real-Time GPS 3D Monitoring System

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REAL-TIME GPS 3D MONITORING SYSTEM

THE NEED

The timely identification of deformation derived from geologic hazards can save lives, avert large financial liabilities and avoid severe damages. In this point of view, assessment of susceptibility to damage of civil infrastructures such as buildings, dams, bridges, oil platforms, and power facilities has become important issues.

Until recently, monitoring the response of construction structures for the purpose assessing effects of severe disasters has been dependent on measuring some responses by periodic optical surveys or by using electronic sensors (accelerometers, tiltmeters, TDR, electrodes, etc). However, these traditional systems have provided some limitations; high cost of maintenance, and labor intensive and time consuming data processing. Recently, a remote sensing hardware and software package based on Global Positioning System (GPS) for monitoring construction structures comes up to the market in this field.

FIGURE 1 UNITED STATES GEOLOGICAL SURVEY LONG VALLEY CALDERA, MAMMOTH LAKES, CA
(COURTESY OF CONDOR EARTH INC.)

THE TECHNOLOGY

GPS vendor Trimble, and Condor Earth Technologies Inc. have partnered to provide real-time GPS - based systems for monitoring civil infrastructures and natural hazards.

The systems are used for monitoring the structural integrity of dams, bridges, buildings, oil platforms and power facilities as well as the movement of landslides, volcanoes and other natural hazards.

This technology provides scientists, engineers, facility managers, as well as others tasked with monitoring structural integrity or natural hazard movement, valuable lead-time to mitigate potentially hazardous situations. The technology also eliminates the need for costly, time-intensive data post processing.

Condor's 3D Tracker® is a Windows NT software package that allows you to simultaneously compute 3D positions in real-time for deformation monitoring application computing millimeter position for dozens of GPS receivers deployed on large engineered structures. Also, this software can monitor natural hazards such as volcanoes, landslides, and ground subsidence.

Another important issue of GPS 3D monitoring systems is the alarm and data transmitting to users. Data from GPS receivers deployed on the target structure is transferred via modem, wireless radio or network connection to a personal computer which processes the data in real-time. The 3D positions are displayed through an easy-to-understand graphical-user-interface (GUI) at an office location in real-time. Various outputs including maps, charts and numerical data for easy understanding and providing comprehensive information are composed of this GUI.

In addition to the GUI representation of the information, the Condor Monitoring Software allows the operator to define alarms for each site being monitored. Once these individual alarms have been configured, the software provides audible and visual warnings as each alarm threshold is exceeded. The software can provide for immediate notification by pager, email or cell phone when motion parameters are exceeded (see Figure 2).

FIGURE 2 IMMEDIATE NOTIFICATION

Operators can have full remote control over the system from anywhere in the world. Condor's 3D Tracker system has been quickly adopted by some of the largest utilities, private industry and government agencies in North America.

FIGURE 3 INSTALLATION OF REMOTE RECEIVER ON PIPELINE STRUCTURE IN DEEP CANYON

BENEFITS

- Information in real-time which eliminates the need for costly post-processing of data
- High-precision continuous monitoring due to elimination of procedural error
- Easy-to-understand Graphical-User-Interface in real-time
- Comprehensive information
- Valuable lead time to mitigate potentially hazardous situations
- Immediate notification by full remote control over the system
- Continuous, year-round information on the target structure
- A wide range of applications providing complete support for surveying and GIS work in addition to real-time monitoring

STATUS

Condor Earth Technologies, Inc. has been awarded a contract to install a 3D Tracker real-time GPS deformation monitoring system to monitor movement of Libby Dam in Northwest Montana. Libby Dam is operated by the US Army Corps of Engineers and spans the Kootenai River 17 miles upstream from the town of Libby, Montana. Libby Dam is 422 feet tall and 3,055 feet long. The system consists of six remote GPS receivers located on the crest of the dam and reference stations located at the right and left abutments. The system is designed to provide continuous measurements of the dam with accuracies at the millimeter level. The system complements existing equipment while providing a new ability for users to see sub-centimeter data in real-time.

Another project which the 3D GPS monitoring system by this company is used in is the evaluation process project, the City of Long Beach. In this project, this system is involved in the design and implementation of

a plan that will result in the establishment of ongoing leveling surveys using a combination of fixed and mobile GPS. This system named as Long Beach Wilmington field deformation monitoring system consists of numerous continuously operating fixed GPS receivers that provide more timely information, more accurate information, and are cost effective compared to the existing leveling regime.

BARRIERS

- The location of GPS receivers on the target structure is limited due to areas with good sky visibility and few local obstructions.
- Initial cost for installation of instrument can be higher than that of traditional systems.
- Lack of familiarity for maintenance by practicing engineers may cause higher cost and lower productivity than expected.
- Comprehensive data analysis is required
- Service and maintenance contract with original system supplier can be required.

POINT OF CONTACT

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REVIEWERS

Peer reviewed as an emerging construction technology

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