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ABSTRACTS

Monitoring of supporting structures with profile laser scanning

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Abstract

The monitoring of supporting structures is an important cornerstone for ensuring a solid technical infrastructure. Due to the ageing of supporting structures and the often increased mechanical load, the number of engineering structures to be monitored as well as the extent of the respective monitoring tasks are increasing. In order to cope with the resulting challenges, there is a need for an efficient acquisition of deformations under dynamic load.

The use of profile laser scanning for the monitoring of supporting structures can help to solve those challenges. The contact-free acquisition method of profile laser scanners reduces the expense for personnel and instrumentation compared to conventional sensors used for the monitoring of civil engineering structures. It furthermore enables the measurement of non-accessible areas of the monitored supporting structures. In addition, the availability of information along an entire structural profile can be used to flexibly deal with a wide variety of problems. With a measurement rate of at least 50 Hz, typical structural deformation signals can be recorded and sufficient data can be collected to characterize the underlying deformation processes dependably.

In addition to instrument-specific adaptations such as the sensor mounting, a special targeting accessory and an autonomous power supply, a universally applicable processing and evaluation concept was developed for the use of a profile laser scanner for the monitoring of supporting structures. The established processing and evaluation concept is based on the spatiotemporal resolution of the measurement data and is nearly automated due to the use of the wavelet transform. This enables the analysis of the measurement series in the spatial-frequency- or time-frequency-domain and thus performs the localization and characterization of discontinuities. The central components of the spatiotemporal processing scheme are:

- Automatic correction of erroneous measurements,
- The structure-oriented segmentation and approximation of the measurement profiles,
- The determination of the uncertainty of the measured time series.

Although the measurement noise of a profile laser scanner is higher in comparison to conventional sensors used for the monitoring of civil engineering structures, such as inductive displacement sensors, the use of the spatiotemporal processing scheme results in the derivation of comparable deformation signals.

Overall, an automated and efficient evaluation process is thus realized, which can detect and eliminate outliers by using the discrete wavelet transform. In addition to the derivation of displacements, a quality assessment with comprehensive integration of the redundant information is possible as an in-situ uncertainty determination.