Smart RTS

Limitations in sampling rate and the detection of outliers impede use of the Robotic Total Station (RTS) for highly dynamic applications. The need to meet such requirements motivated the author to adjust and improve an existing system. Testing proved the feasibility and usefulness of this prototype in terms of performance, operational functioning and the removal of outliers.<P>

Over the last twenty years the survey industry has witnessed a great increase in methods and instruments. Tracking total-stations have been traditionally used for recording the position of a reflector mounted on a moving object. But limitations primarily related to low and variable sampling rate, as well as sensitivity to outliers, has meant objects had to be quasi-static or move very slowly. Experimental work over recent years has revealed the advantages of the Robotic Total Station (RTS) for many novel engineering applications, such as metrology, industrial surveying and machine guidance. Some benefits of RTS are automatic target recognition, monitoring moving objects, and the possibility of measuring indoor and autonomous operation.

Prototype
The prototype designed by us was originally developed to operate with Leica Geosystems instruments (TCA 1800, TDA 5005) and operates directly from a laptop via serial communication. The software, developed in VC++ and relying on the GeoCOM protocol supplied by Leica Geosystems, carries out the following tasks:
-configuration control of recording system (station/reflector parameters, tracking functions, COM settings, data manipulation etc)
-performance monitoring of system operation (QC/QA of recorded observations, battery status etc)
-various forms of data processing and visualisation.

Based on MS Windows, the system can operate both in tracking (TRK) mode and rapid tracking mode (RTRK) and can actuate controls/corrections pertaining to servomotor operations. However, the greatest single asset is the ability to measure at increased sampling rate and the accurate time stamping. Operating the instruments (TPS 1000 series) in standard mode it is normally possible to achieve 1Hz sampling rate and 1-second time stamping. Using the tracking controller, sampling rate can reach 6Hz and time stamping of observations equals the resolution of the instrument's internal clock (0.001 sec). These features are important for high-dynamism applications, as the system is capable of recovering the movements of harmonic frequencies up to about 3Hz (following the Nyquist sampling theorem). More recently, the tracker has been modified (using VC++ and Geo/L programming) to make it compatible with Trimble RTS systems (5605 DR200+).

Testing
To monitor the highly dynamic behaviour of a chimney more than 150m tall and subject to wind load, a cyclic prism was mounted on its top. The prototype was then positioned at a well-protected site about 150m distant from it. Data was collected on several days and in various wind conditions, at a sampling interval of 5Hz to 6Hz. The raw observations were examined against outliers, whilst clean data was post-processed in both time and frequency domains. Despite the relatively large zenith angle (84 grad), the tracker revealed a high (>95%) percentage of valid observations (inliers) and the amplitude of movements was estimated to lie between ±1 cm and ±3 cm.

Concluding Remarks
The high sampling rate, coupled with high accuracy, render the new generation of RTS systems a viable option for many applications, including dynamic structural monitoring.

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Further Reading
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