Self–Calibration of a Lecia HDS7000 Scanner

Khalil Al-Manasir (China, PR) and Derek Lichti (Canada)

Key words: Laser scanning; Laser Scanning; Terrestrial; Self-Calibration; calibration model, phase-based.

SUMMARY
Terrestrial laser scanners are widely used for metric applications of 3D modelling of buildings, bridges, tunnels and other structures. In common with any measurement system, the calibration of the laser scanner is of paramount importance to achieve the maximum possible accuracy. Even if a calibration certificate of the scanner is provided by the vendor, the scanner should be checked from time to time for any systematic errors using special equipment and facilitates. This process is time consuming as the scanner needs to be sent to vendor for long time. The self-calibration method provides a very flexible yet rigorous solution that allows scanner users to calibrate instruments themselves. This paper uses the self-calibration approach to develop and establish a calibration model for Leica HDS7000 phase-based terrestrial laser scanner. The calibration process and a calibration field of signalised targets designed to perform the calibration are described. The final results show the importance and potential of the self-calibration method, especially when high-precision measurements are required. Two highly-redundant (nearly 5000 degrees-of-freedom) calibrations of the scanner were conducted on separate dates. Statistically significant angular errors (collimation axis, trunnion axis and vertical circle index) were found in both datasets. A small (0.6 mm) but significant rangefinder offset parameter was also estimated. The improvements gained as a result of the modelling were 24% and 32% in the horizontal angle direction residuals and 38% and 49% in the elevation angle residuals for the first and second datasets, respectively.