A Four Day Displacement Monitoring Trail Using Locata Technology

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ABSTRACT:

Locata Corporation's positioning technology "Locata", provides centimetre-level accurate position solutions (95% confidence interval) with millimetre-level precision for static positioning using carrier phase measurements. This provides an advantage for monitoring structural deformation over other technology used for such applications. The Locata network can be deployed in or around a structure to ensure optimal network geometry under site constraints. Previous investigations have demonstrated the applicability of Locata in displacement monitoring applications. This paper describes a displacement monitoring trial conducted at the Locata Corporation's Numerella test facilities outside Canberra, Australia.

A four day experiment was conducted to analyse Locata's performance for long term displacement monitoring. A LocataNet was set up, comprising six LocataLites (the ground-based fixed stations broadcasting positioning signals), a Locata receiver, a weather station and a GPS receiver for time synchronisation with GPS time. The Locata receiver was mounted on top of concrete pillar 1.5m high with a base of 1m. The receiver was operated continuously for four days. Locata pseudorange and carrierphase measurements, and other signal quality data along with atmospheric parameter data were collected. Coordinate solutions were generated using an adaptive fading Kalman filter (AFKF), and displacement detection was performed using the CUSUM algorithm. The CUSUM algorithm was configured so as to detect 3mm movement.

Results confirm that Locata can deliver millimetre positioning precision. The AFKF generates sub-centimetre-level accuracy horizontal positioning but only centimetre-level accuracy vertical position component determination. The AFKF position solutions are correlated in time, which violates the precondition of using the CUSUM algorithm. To remove this autocorrelation, an autoregressive model was developed to estimate the correlation characteristics. Using the autoregressive model, autocorrelation is removed, and in the CUSUM algorithm can then be applied in order to identify displacement. For the horizontal position components there were only three occasions when the CUSUM algorithm identified that the process was out of control – implying displacement. However, these incidents were not continuous and hence they could be treated as outliers.The vertical position component had centimetre-level accuracy as the network geometry (VDOP) was weaker than for determining the horizontal components (HDOP). In this case study there no significant movement was observed.

This case study extends the previous work on the applicability of Locata for displacement monitoring and confirms that Locata can provide the required coordinate precision and accuracy.