Leica VADASE - First Autonomous GNSS Monitoring Solution for Fast Movements Onboard a Stand-Alone GNSS Receiver

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SUMMARY

Leica Geosystems is introducing Leica Velocity and Displacement Autonomous Solution Engine, or VADASE. For a first time such an autonomous GNSS monitoring solution has been integrated onboard a geodetic GNSS receiver and is now available for Leica GR10/25 reference station receivers and Leica GM10 monitoring receivers. Leica VADASE provides velocity and displacement information of a GNSS antenna's position – fully autonomously and in real-time. This enables highly reliable real-time displacement detection and waveform analysis of fast movements.

The algorithm used within the Leica VADASE solution had initially been described by the University of Rome, "La Sapienza", and referred to as VADASE ("Variometric Approach for Displacements Analysis Stand-alone Engine"). This innovative approach is based on high-rate (up to 20 Hz) GNSS data to obtain real-time estimated velocities and displacements on the order of some cm/s and cm, respectively.

This paper describes how this algorithm has been adapted and integrated into Leica GR10/25 and GM10 receivers allowing them to now also detect and output velocity and displacement information. Only GNSS broadcast information, i.e. raw observations, broadcast ephemeris and satellite clocks along with ionospheric corrections, is used to compute velocities which, if integrated over time, can then be interpreted as displacements or waveforms. Since no external corrections or state information is needed, the GR10/25 or GM10 can work fully autonomously – without the need of any real-time corrections or any subscription to a precise point positioning (PPP) service. Thus, no additional hardware and no service subscription are needed to use Leica GR10/25 and GM10 in order to monitor fast movements in real-time.

For different data sets including static and moving antenna, using different data rates, single or

multi-frequency GNSS observations, GPS and multi-constellation, the performance of the Leica VADASE solution is demonstrated. Besides, the sensitivity of the solution is analyzed and the solution is compared to differential RTK. Finally, Leica VADASE-based velocities and displacements of the Tohoku-Oki earthquake (March 11, 2011) are compared to a post-processed PPP solution.

By logging and streaming the data in NMEA style format using newly designed messages, simple information exchange can be realized. This allows using commercial products such as Leica SpiderQC or Leica GeoMoS, as well as custom applications to easily receive and analyze the information in real time or off line. Additionally, receiver onboard event information can be sent out by email to inform users about detected movements.

Leica VADASE helps engineers and scientists to quickly analyze site movements in various fields such as seismology, early warning and safety systems, structural geotechnical monitoring and 24/7 GNSS network reference station integrity monitoring.