FUSION OF GPS AND L1 PSEUDOLITES FOR STRUCTURAL DEFORMATION MONITORING

Joel Barnes, Chris Rizos, Mustafa Kanli, Anuj Pahwa
School of Surveying and Spatial Information Systems
University of New South Wales, Sydney, NSW 2052, Australia
joel.barnes@unsw.edu.au
Dorota Grejner-Brzezinska
Civil and Environmental Engineering and Geodetic Science
OhioState Univeristy
Columbus, OH 43210, USA

Abstract: The Global Positioning System (GPS) has been used for many years for the deformation monitoring of man-made structures such as bridges, dams and buildings, as well as geodetic applications, including the measurement of crustal motion, and the monitoring of ground subsidence and volcanic activity. The very precise carrier phase measurements can deliver cm-level positioning accuracy. However, when using GPS, the accuracy, availability, reliability and integrity of the position solutions is very dependent on the number and geometric distribution of the available satellites. In some situations, such as the monitoring of structures in built-up urban environments, the availability of GPS satellites may be insufficient for positioning requirements. Also, due to the geometric distribution of the GPS satellite constellation and the fact that GPS data below approximately 15 degrees are typically not used, the accuracy of the height component is generally 2 or 3 times worse than for the horizontal components. Additionally in mid and high latitude areas (>45 degrees) the accuracy in the North/South component is worse than the East/West component, due to the 55 degree inclination of GPS satellites.

One option to improving the satellite geometry is to use ground-based transmitters of GPS-like signals (called "pseudolites" or PLs). PLs can be optimally located to provide additional ranging information, and therefore improve the positioning precision. In addition, with enough PL devices (four or more) positioning without any GPS satellites is possible. In this paper the use of L1 PLs for structural deformation monitoring type applications is proposed. The paper will discuss the issues associated with using L1 PL devices, integration with GPS measurements, and present experimental results. It will be shown that by using pseudolites to improve the existing satellite constellation that similar precision (sub-cm) can be achieved in both horizontal and vertical position components.