

Editorial: The Pseudolite Special Issue

Jinling Wang

School of Surveying and Spatial Information Systems, University of New South Wales, Sydney, NSW 2052, Australia
Email: Jinling.Wang@unsw.edu.au

In Global Navigation Satellite Systems (GNSS), such as GPS, Glonass, and the forthcoming European Galileo system as well as Chinese Compass system, four visible satellites are the minimum requirement for three-dimensional positioning. However, in some situations, such as in downtown urban canyons, engineering construction sites, and in deep open-cut pits and mines, the number of visible satellites may not be sufficient. In the worst situations, such as in underground tunnels and inside buildings, the satellite signals may be completely absent. Such problems with existing GNSS systems can be addressed by the inclusion of additional ranging signals transmitted from ground-based "pseudo-satellites" (pseudolites).

To promote the applications of pseudolite in engineering geodesy, a working group on pseudolite applications was set up in 2001 within the International Association of Geodesy (IAG) Special Commission SC4 (Application of Geodesy to Engineering 1999-2003). In 2003, the IAG established Study Group 4.1 (2003-2007) on "Pseudolite Applications in Positioning and Navigation" within the IAG Commission 4 Positioning and Applications. The objectives of the research activities within this Group were to study: (a) Pseudolite augmentation of GNSS; (b) Pseudolite-only positioning scenarios; (c) Integration of pseudolites with other sensors, such as Inertial Navigation Systems (INS). The website of the SG4.1 can be accessed at

<http://www.gmat.unsw.edu.au/pseudolite/>

which has listed pseudolite bibliography and some internet links to the pseudolite research groups and manufacturers.

As part of the efforts of the IAG Study Group 4.1, this pseudolite special issue has invited papers focusing on a range of research issues in this field. Martin et al., discuss the interference and regulatory issues in GNSS pseudolite applications; Heinrichs et al. present the first outdoor experiment results with real Galileo signals on the ground. Chen et al. describe the development of the pseudolite system designed for the European Geostationary Navigation Overlay Service (EGNOS),

which is a European Satellite Based Augmentation System (SBAS). In Japan, a new concept of augmenting the GPS system is to use a set of Quasi Zenith satellites. A test facility of such an augmentation concept is under way using the pseudolite approach (see Tsujii et al.). As the Galileo signal structure is significantly different from that of GPS, Abt et al. propose novel pulsing schemes for use in Galileo pseudolites. For terrestrial and airborne applications, the pseudolite signals travel only through the troposphere, which may cause a significant delay for ranging signals. As reported by Wang et al., such a delay can be compensated through an adaptive modelling method. Schlötzer et al. describe the developments of an array of self-calibrating transceivers towards autonomous navigation.

Some pseudolite designs have used the frequencies in the ISM band to avoid the concerns of using officially defined GNSS frequencies. A time-synchronized pseudolite *transceiver* developed by Locata Corporation has a significant advantage for many applications in that a precise single point positioning scenario, without the use of any reference station, becomes a reality. Barnes et al. discuss the use of Locata technology in structural monitoring applications whilst Montillet et al. demonstrate the centimetre accuracy of positioning operations with Locata in Urban canyons. Some researchers have classified such new pseudolites transmitting non-GNSS signals into terrestrial-based RF positioning technologies, while there is a general trend in the literature that the term of pseudolite is used to broadly describe radio-ranging signal transmitters and/or transceivers for positioning and navigation applications, which may include, for example, RFID and UWB based positioning systems.

Pseudolites are an exciting technology that can be used for a wide range of positioning, navigation and timing applications as an augmentation tool, an integral part of multi-sensor navigation systems, or even as an independent system. Some remaining challenging issues in pseudolite research and applications have been discussed in the Final Report of the IAG Study Group 4.1, which is available at the group website.