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Editorial

Editorial for Multi-Constellation Global Navigation Satellite Systems: Methods and Applications

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This is a great era of significant changes and innovations in the field of geodesy and navigation with the emerging multi-constellation Global Navigation Satellite Systems (GNSS). While just about a decade ago, the US Global Positioning System (GPS) was the only fully operational constellation and took on a major role in positioning and navigation around the world [1–4]. But the situation has changed and now three other constellations have been attracting global attention. Besides GPS, Russia has renewed and managed to maintain fully operational of GLONASS after the 24th satellite was launched into orbit in 2011 [5]; China and Europe are building their own independent global navigation systems BeiDou and Galileo as well. As an assistance of GPS, Satellite Based Augmentation Systems (SBASs) are also built to improve the position accuracy, reliability and availability of GPS performance [6]. In China and Europe the analogical systems are named National BDS Augmentation Service System (NBASS) [7] and European Geostationary Navigation Overlay Service (EGNOS) [8,9], which function as SBASs but are designed for BeiDou and Galileo respectively.

We believe it will be a promising vision that high precise positioning may be available even in GPS-adverse environments when all these global constellations are finished in the near future. GNSS is no doubt a significant tool not only in people's daily life but also in research filed and military. It has redefined the concept of positioning and navigation. With the advent of multi-GNSS, a variety of applications utilizing GNSS have been thriving including location based services [10,11], GNSS seismology [12–14], GNSS deformation monitoring [15–18], etc. In these fields GNSS works as a reliable and effective approach to provide position-related information and as a supplementary of traditional methods.

Undoubtedly, some existing or emerging problems are inevitable and need to be worked out before obtaining high precision multi-GNSS position. These problems involve the compatibility and interoperability among multi-GNSS, precise orbit determination, ambiguity resolution, inter-system biases, atmospheric modelling and so on. But it is encouraging that increasing researchers, professionals and students are devoted to this area to pursue better performance of GNSS positioning and its affiliated applications and some significant progress has been made.

So we pick out 45 publications in these two years from our journal (Remote Sensing) and intend to print into a book dedicated to the methods and applications of multi-GNSS. These publications cover the rapid developments that have been taking place in the area of multi-GNSS in recent years and its diverse usages in relevant fields.

This book is organized as follows: The first part focuses on the methods of multi-GNSS data processing to achieve high precise positions and some studies on multi-frequency biases [19,20], augmentation services [7] and ambiguity resolution [21,22] will be introduced; The second part will present how to carry out GNSS precise orbit determination and some refined models [23–25]; The third part deals with some studies on troposphere and ionosphere features using GNSS observables [26–29]; And the last part of this book will vividly present the applications of GNSS in various areas ranging

from deformation monitoring, seismology to the integration with inertial navigation systems used on UAV and urban environments [30,31].

We hope this book will help readers to dig into the basic theory behind GNSS data processing and have new ideas on GNSS scientific applications. By the way, we believe multi-GNSS will bring us new probabilities and opportunities to our life with the fully operational of BeiDou and Galileo systems in the near future.

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