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Foreword

Positioning and telecommunications

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The growing rate of positioning related applications such as car and pedestrian navigation has led to a desire to have access to Global Navigation Satellite Systems (GNSS) everywhere. This wish has been moderated by GNSS availability and coverage (and sometimes also accuracy) for numerous applications where signals are obstructed. Alternative or complementary positioning systems have to be found in order to develop the global domain of location-based applications. Current efforts are being carried out to broaden the spectrum of positioning systems such as hybridization between GNSS and inertial sensors, GSM/UMTS, WLAN, UWB, pseudolites and other radio beacons, etc.

Thus, indoor positioning is a very important topic, mainly in terms of continuity of services, but is far from being the only one. The future developments of GNSS are likely to be the source of interference problems, either within the GNSS spectrum or with other systems. System interoperability must be carefully addressed, once again within GNSS and with other RF positioning systems. Among the proposed solutions, telecommunication networks are seen as potentially valuable candidates.

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Much works throughout the world is being carried out in the field of mobile networks and wireless local area networks, ranging from GSM to UWB. Furthermore, improvements in GNSS receivers are also needed in order to meet future integration and performance requirements. Thus, many activities are still ongoing and the forthcoming availability of the European Galileo, the Chinese Compass, the enhanced Russian Glonass, makes the competition towards the ultimate solution even more exciting.

This special issue features six papers focusing on both GNSS and telecommunication networks. The main purpose is to find new approaches in order to improve current GNSS capabilities, either through GNSS developments or network-based methods. A brief overview of each of the papers is provided below.

The first paper on “A non-coherent architecture for GNSS digital tracking loops” by Daniele Borio and Gérard Lachapelle describes a new architecture for GNSS tracking loops, able to operate at a low carrier-power-to-noise density ratio. A non-coherent phase discriminator, able to extend the integration time beyond the bit duration, is derived from the maximum likelihood principle and integrated into a Costas loop. This leads to a GNSS receiver capable of long integration times, resulting in an alternative to bit-estimation-based techniques.

The second paper on “Modelling of ionospheric high-order errors for new generation GNSS” by Rolland Fleury, Mercedes Clemente, Françoise Carvalho, and Patrick Lassudrie-Duchesne deals with the high-order terms of the ionospheric propagation delays that should be taken into account when precise positioning is required. The contributions of the second- and third-order terms typically amount to values in the centimetre to millimetre range, respectively. The paper focuses on the Galileo signals as

Galileo In-Orbit Validation Element (GIOVE) signals are now available for acquisition. A solution relying on the triple-frequency characteristics of a signal-in-space is investigated with results based on initial measurements of GIOVE-A signals.

The third paper entitled “RFI mitigation of GNSS signals for radio astronomy: problems and current techniques” by André Gilloire and Hervé Sizun addresses the fundamental problem of radio frequency interference (RFI), and more specifically that of GNSS signals in the radio astronomy domain. Highly sensitive radio telescopes permit the observation of extremely faint and distant radio sources which exhibit large amounts of red shift, hence overlapping with unprotected bands. Methods appropriate to mitigate RFI from GNSS signals are presented and results are discussed. The importance of cooperation between GNSS designers and astronomers is also pointed out.

The fourth paper on “A probabilistic approach to determine mobile station location with application in cellular networks” by Mirjana I. Simić and Predrag V. Pejović deals with positioning in mobile telecommunication networks. Data about the mobile location provided by independent sources such as timing advance and received signal level are collected in the form of two-dimensional probability density functions. Combining the probability density functions into a joined probability density function is then addressed. It is shown that the combined method provides better precision than the Cell-ID method without the requirement for additional hardware and with moderate computational burden.

The fifth paper on “Indoor Wi-Fi Positioning: Techniques and Systems” by Frédéric Lassabe, Philippe Canalda, Pascal Chatonnay and François Spies proposes a layered positioning system based on a model combining a reference point-based approach with a trilateration-based one. Several layers of refinement are offered based on the knowledge of the topology and devices deployed. It shows that a Friis-based calibrated model provides the best positioning accuracy when applied to homogeneous zones and when combined with reference point refinement. The authors deployed a Multimedia Guide (GuiNuMo), which confirmed the adequacy of combining positioning and prediction of mobility, predictive handoff, predictive cache management, and adaptive as well as on-demand rich media diffusion.

The last paper on “Positioning in WLAN environment by use of artificial neural networks and space partitioning” by Miloš N. Borenović and Aleksandar M. Nešković explores the position determination by the use of artificial neural networks (ANNs) in real WLAN networks. Approach that uses cascade-connected ANNs and space partitioning shows considerable advantages with respect to not only to the single ANN approach, but also to the other classical techniques described in the literature. Space partitioning increases the accuracy in terms of the median and average absolute position errors. When comparing to ANN with no space partitioning, the average absolute positioning error is reduced by 8%, while the median error is reduced by 28%.

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