

Keynote Presentation
Conference on Researches, Results and Reviews in Geomatics
(R3 in Geomatics)

State-of-the-art, Challenges and Perspectives
for Indoor PNT Applications

Guenther Retscher

Abstract

PNT (Positioning, Navigation and Timing) applications require nowadays ubiquitous user localization not only outdoors where GNSS (Global Navigation Satellite Systems) signals are available but also in complex urban, transitional and indoor environments. To deliver robust localization solutions also in these environments all currently available positioning technologies and techniques have to be utilized and fused. Apart from infrastructure-based systems, such as infrared, ultra-sonic signals, Bluetooth, ZigBee, Radio Frequency Identification (RFID), Ultra-wide Band (UWB) or other radio frequency (RF) based systems, a major role play nowadays all available and receivable wireless signals for indoor localization. These are referred to as so-called signals-of-opportunity. Most of these RF signals were firstly not intended for positioning whereby the positioning technologies range from the usage of mobile telephony, FM radio, digital television to the most prominent signal-of-opportunity, namely Wireless Fidelity (Wi-Fi). The presentation provides an overview about the state-of-the-art of the most common positioning technologies and techniques for challenging environments. Starting from the identification of the requirements for PNT applications, the challenges in indoor positioning are identified and perspectives for future developments discussed. The main part of the presentation covers localization of mobile users with Wi-Fi. Wi-Fi positioning has become very popular starting with signal strength based methods, i.e., where the Received Signal Strength Indicator (RSSI) is measured. In this case, location fingerprinting is the most commonly employed and reliable positioning method. New Wi-Fi hardware is now available where Round Trip Time (RTT) measurements of the signals can be performed. These developments enable then (tri)lateration for positioning providing a significant increase in terms of achievable positioning accuracies. A differential approach termed Differential Wi-Fi (DWi-Fi) is proposed for further performance improvement. Reference stations which are at the same time Wi-Fi Access Points are employed as in Differential GNSS (DGNSS). Then from a network solution an improvement of the Wi-Fi positioning solution is obtained similar as in a Continuous Operating Reference Station (CORS) GNSS network. In the case of continuous positioning requirements for smartphones, a major step forward is achieved due to the integration and sensor fusion with the embedded inertial sensors, such as accelerometers and gyroscopes, as well as other sensors, such as magnetometers and barometric pressure sensors. In several case studies the potential of these solutions are demonstrated. Presented research works include developments made at TU Wien – Vienna University of Technology, Austria, and in international collaboration with colleagues from the joint IAG and FIG Working Group on Multi-sensor Systems.

Biography

Dr Guenther Retscher is Associate Professor in the Department of Geodesy and Geoinformation at the TU Wien – Vienna University of Technology, Austria. He holds an undergraduate and graduate degree in Surveying, a PhD and a Habilitation (*venia docendi*) in Applied Geodesy from TU Wien with the focus on Mobile Multi-sensor Systems for Personal Navigation and Location-based Services. Guenther's research interests include positioning and navigation with GNSS, location based services, indoor and pedestrian navigation, applications of multi-sensor systems and sensor fusion.