Inertial and GPS data integration for positioning and tracking of GPR

Simone Chicarella (1), Alessandro D’Alvano (2), Vincenzo Ferrara (1), Fabrizio Frezza (1), and Lara Pajewski (2)
(1) Dept. of Information Engineering, Electronics and Telecommunications (DIET), Sapienza University of Rome, Italy (vincenzo.ferrara@uniroma1.it), (2) Dept. of Engineering, “Roma Tre” University, Rome, Italy (lara.pajewski@uniroma3.it)

Nowadays many applications and studies use a Global Positioning System (GPS) to integrate Ground-Penetrating Radar (GPR) data [1-2]. The aim is the production of detailed detection maps that are geo-referenced and superimposable on geographic maps themes. GPS provides data to determine static positioning, and to track the mobile detection system path on the land. A low-cost standard GPS, like GPS-622R by RF Solutions Ltd, allows accuracy around 2.5 m CEP (Circular Error Probability), and a maximum update rate of 10 Hz. These accuracy and update rate are satisfying values when we evaluate positioning datum, but they are unsuitable for precision tracking of a speedy-mobile GPR system. In order to determine the relative displacements with respect to an initial position on the territory, an Inertial Measurement Unit (IMU) can be used. Some inertial-system applications for GPR tracking have been presented in recent studies [3-4]. The integration of both GPS and IMU systems is the aim of our work, in order to increase GPR applicability, e.g. the case of a GPR mounted on an unmanned aerial vehicle for the detection of people buried under avalanches [5]. In this work, we will present the design, realization and experimental characterization of our electronic board that includes GPS-622R and AltIMU-10 v3 by Pololu. The latter comprises an inertial-measurement unit and an altimeter. In particular, the IMU adopts L3GD20 gyro and LSM303D accelerometer and magnetometer; the digital barometer LPS331AP provides data for altitude evaluation. The prototype of our system for GPR positioning and tracking is based on an Arduino microcontroller board.

Acknowledgement
This work benefited from networking activities carried out within the EU funded COST Action TU1208 “Civil Engineering Applications of Ground Penetrating Radar.”

References