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Testing innovative power-supply systems for GPS monitoring in landslide areas

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GPS technology is widely used to monitor ground displacements in landslide areas. Compared to conventional deformation sensors, the main advantages of GPS is that it requires no line-of-sight between the stations, and that it achieves an accuracy of few millimetres over baselines of several kilometres. For these reasons GPS has become increasingly used for large-scale monitoring of slow-moving landslides. Nowadays, however, although new hardware and software procedures have been developed to enhance GPS equipment, some weakness still remains in field deployment and long-term maintenance of GPS monitoring stations.
In the framework of the WISELAND research project (Integrated Airborne and Wireless Sensor Network Systems for Landslide Monitoring; Italian Ministry of Education, 2007) we designed and tested a GPS rover station specifically tailored for the autonomous monitoring of landslide areas. The work aimed to:
1) design a compact GPS rover station characterized by low power consumption, low weight and small size
2) make the installation of the GPS station faster and easier
3) test new power-supply systems in addition (or as alternative) to the conventional solar panel-battery systems
The GPS station built for the project has a weight of 4 kg (metal box included), a size of 30x20x15 cm and an overall power consumption of only 6 Wh including the GPS antenna, the serial-LAN converter, and the wireless apparatus for the communication with the GPS master station. The whole station (cabinet and antenna) can be quickly mounted on a single support pile screwed into the ground (Palovit). The GPS antenna is a single-frequency Leica GMX-901 which provides a planar accuracy of few millimeters with daily sessions of 3 hours.
As regard power supply, two alternative power-supply systems are currently under testing: a methanol fuel cell (EFOY 600) and of a hydrogen fuel cell (Plug & Power 100). The fuel cells are used to charge a lead acid battery (12V 15A) which in turn supplies the GPS station. As these technologies are still new, extensive work was required before field deployment: laboratory tests on reliability and fuel consumption; design of a suitable field case; implementation of microloggers for the measurement of air temperature and humidity (which can affect the fuel cells performance).
In July 2009, three GPS rover stations (and a master station) were installed at Silla-Montecchi landslide (Nortern Apennines, Italy). One station is powered by the methanol fuel cell, the second by the hydrogen fuel cell, the third by a traditional solar panel-battery system. During the first year of testing the methanol power-supply system operated well: the fuel cell worked in a wide range of air temperature (from –6° to +50°) and air humidity (from 14% to 100%) without malfunctioning. The autonomy of the system with a 5 liter methanol tank (and 3 hours GPS sessions/day) is about 3 months. The hydrogen fuel cell, instead, worked properly in the lab but not in the field. The main problem was related with the range of air temperature in the experimental site, which exceeds the typical working range for hydrogen fuel cells (from +5° to +35°). Some possible solutions are being investigated in collaboration with FZSONICK, a Swiss company working in the field of hydrogen fuel cell technology.