EGU21-15309
https://doi.org/10.5194/egusphere-egu21-15309
EGU General Assembly 2021
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Laboratory test results of a new developed low-cost and open-source inclinometer based on MEMS technology

Giuseppe Ruzza, Paola Revellino, and Francesco Maria Guadagno
University of Sannio, Department of Sciences and Technologies, Benevento (BN), Italy

The stationary or in-place inclinometer is the main high-performance solution in landslide monitoring applications due to its capability of tracking real time displacement at different depth and supporting early warning. Despite that and the general need of data for understanding landslide behaviour, the high cost of in-place inclinometers, in most cases, limit or prevent their use. On this basis, we started developing a low-cost and open source, modular MEMS-based inclinometer that uses multiple Arduino boards as processing units. Although MEMS accelerometers have many advantages in comparison with traditional high-precision electromechanical sensors, they are very sensible to temperature variation (i.e. thermal drifting).

In order to compensating thermal drifting a specific thermal analysis and an associated simple compensation strategy were used. After the mitigation of thermal bias, the electronic devices were designed, built and assembled.

The developed inclinometer system is composed of two main electronic systems: 1) a multiple electronic device (i.e. a MEMS accelerometer, the IMU reading interface and a communication board) installed within each measuring module; 2) an external master control unit, based on the Arduino platform coupled with a dedicated developed interface board. The master unit reads tilt value from each measuring module through a communication interface. This unit was developed to allow interfacing of additional digital or analog sensors (e.g. water content, rain gauge, etc..), and control additional parameters.

A steel casing for measuring components was designed and built. For each measuring unit, a squared-section case, consisting of a 30 cm long tube equipped with 4 elements that allow the installation the instrument within a standard inclinometric tubes, was prepared and assembled.

After system assembling, displacement of the inclinometric column was first simulated by a laboratory test. In particular, we used a supporting frame that allowed to vertically align the modules. The auxiliary frame was specifically designed to drive displacement along a selected axis and to register the maximum displacement at the head of the inclinometric column. In this way, the lower module is kept fixed. This test permitted to obtain a number of different synthetic deformation curves that form a basis for checking the accuracy of the instrumentation measurement. Result obtained highlight the potential use of our system for real monitoring application. The next step will be to install the instrumentation on site to check its operation in real field conditions.