



ase
ADVANCED SLOPE ENGINEERING

**UNIVERSITÀ
DI PARMA**
SPIN OFF



INNOVATIVE TECHNOLOGIES FOR MONITORING

“We monitor the present with the instruments of the future”



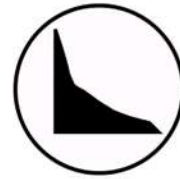
OUR SERVICES

ASE s.r.l. produces and commercializes innovative instrumentations designed for geotechnical and environmental monitoring. Our systems are fully automated, while the data management involves the acquisition, storage, elaboration of data along with their representation through a web-based platform. We have introduced the Internet of Things principles in the geotechnical field, what we define the Internet of Natural Hazards.



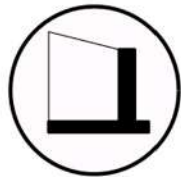
INNOVATIVE TECHNOLOGIES FOR TUNNEL MONITORING

ASE s.r.l. produces innovative instrumentations for the near-real time monitoring of deformations occurring during and after underground excavations. Main products are **Cir Array** and **Rad Array**. The first tool is installed at the contour of the tunnel section to monitor its convergence. The array identifies the deformations of the rock mass both during the excavation and the operational phases. It could be used to control existing tunnels as well, especially when subjected to external instability phenomena. Rad Array measures the deformations some meters inside the rock mass along radial perforations. Both systems are based on MUMS technology. A new system, called **PreConv Array**, permits the measure of pre-convergence, which is a key parameter for the convergence control.



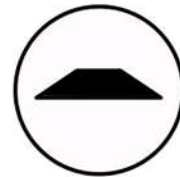
INNOVATIVE TECHNOLOGIES FOR LANDSLIDE MONITORING

The monitoring of landslides with remote control is possible through **Vertical Array**, the instrumentation designed for the automatic control of natural and/or artificial slopes. The tool is based on MUMS technology and could be customized according to the required resolution, frequency of measures and geometry of the slide. The Array is a modular system of sensors, which are placed inside nodes (Links) connected at fixed positions along an aramid fibre cable and a single quadrupole electrical cable. Sensors can be 3D MEMS, 2D electrolytic cells, piezometers, barometer and thermometers, respectively used to monitor deformations, water level, pore pressure, atmospheric pressure and temperature variations. System installation is simple, fast and economic.



INNOVATIVE TECHNOLOGIES FOR GEOTECHNICAL STRUCTURES MONITORING

ASE s.r.l. produces and commercializes high-resolution instrumentations for the monitoring of geotechnical structures deformations, like diaphragms and retaining walls, sheet piles, piles and micro-piles, etc. The proposed system is based on MUMS technology and custom designed for the specific application. Main products are **Vertical Array Structure** and **In Place Array**.



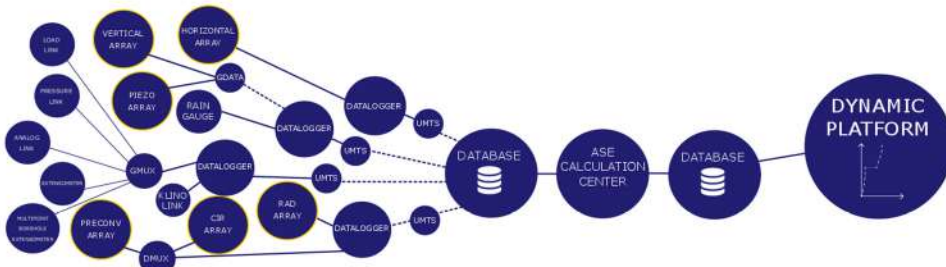
INNOVATIVE TECHNOLOGIES FOR SETTLEMENTS AND SUBSIDENCE MONITORING

Horizontal Array is the tool developed to monitor the subsidence and settlement of soil. It could be applied to embankments, levees, viaducts or bridges and every situation where it is possible to face differential subsidence. System is based on MUMS technology and it is customizable according to the required resolution, frequency of readings and site geometry.



INNOVATIVE TECHNOLOGIES FOR TEMPERATURE MONITORING

Therm Array is the tool developed to monitor the temperature of soil, rock or water, with high resolution ($\pm 0.0078^\circ$) and repeatability ($\pm 0.015^\circ$). System is based on MUMS technology and it is customizable according to the points of measure required, frequency of readings, geometry of the site. Its ideal application is the monitoring of low enthalpy geothermal plants.





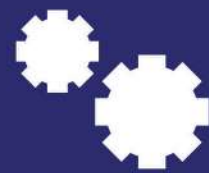
**INNOVATIVE TECHNOLOGIES
FOR ROCKFALL BARRIERS MONITORING**

ASE s.r.l. produces innovative monitoring systems, developed together with **Incofil Tech**, for the monitoring of rockfall and debris flow barriers, snow fences and avalanche protection barriers. **RockFall Safety Network** is the system designed for the control of rockfall barriers: it is composed of a master datalogger placed in a safe position and radio connected with modules that can be easily installed on the upper end of steel posts. Each module is self-powered through lithium batteries and it is equipped with two tilt sensors for the control of the inclination. A load cell could be easily integrated for the measure of upstream ropes forces. The system provides useful data about the working rate of the structure together with information about slope most active sections. A Trigger system could activate alarms.



**INNOVATIVE TECHNOLOGIES FOR
MUSEUMS & HISTORICAL BUILDINGS MONITORING**

Musa is a system realized in collaboration with University of Bologna to monitor museums, exhibitions, libraries, historical buildings, where it is imperative to preserve the integrity of artworks, books and cultural heritage in general. The proposed technology is designed for the near-real time control of various parameters, including illuminance, atmospheric pressure, humidity, temperature and CO₂. The system is composed by a master datalogger that queries sensors installed wireless at different measurement points with a user-definable frequency. The results provided include the psychrometry and spatial representation of monitored physical entities.



TECHNOLOGY

The technologies that ASE is proposing are at the base of the development of a completely new monitoring concept and innovative system in the fields of geotechnical engineering, rock mechanics and rock engineering, tunnelling and landslide control and prevention, environmental monitoring. The main feature of these systems relates to their complete automation and remote managing and control. The technology is a combination of sensors, embedded in specifically moulded nodes (Links), connected along an aramid fibre cable and an electrical cable to form an arbitrarily long chain. The nodes can be organized in different combinations of distances and types, to adapt the chain to any specific monitoring needs. Links can be connected along a single cable with the distribution and configuration that most accurately fit the monitoring purpose. Each node can be equipped with MEMS sensor, MEMS and electrolytic cell, Piezometer, Barometer, High-Resolution thermometer. Several links make the custom-made chain, which is delivered directly to the installation site on a practical reel or a box. MUMS can also be installed in boreholes equipped with standard inclinometer pipes that cannot be accessed with the manual probe due to excessive deformation.



HISTORY

Advanced Slope Engineering (ASE) s.r.l. was born in 2013 as a Start Up - Spin Off company of the University of Parma (Italy) and now it is a PMI. The partners founded the firm with the aim to develop, build and distribute a new monitoring system, named Modular Underground Monitoring System (MUMS), which is a patent of ASE, based on innovative micro-technologies. Most of ASE activities are about R&D in the fields of new technologies and data recover, management and analysis. All the members and employees have Ph.D or Master's degrees in engineering (Civil, Environmental or Electronic) and some are academics. In the framework of the 4th industrial revolution, ASE idea is to provide automation, big data application and Internet of Things approach in the management of the environment, with particular attention to the decisional support for critical conditions related to hydrogeological hazards or to the construction and operational phases of new and large infrastructures in sensitive contexts or difficult areas.



APPROACH

The Modular Underground Monitoring System (MUMS) approach is developed around a new concept of landslide monitoring, coming from several years of researches carried out at the Dept. of Engineering and Architecture (DIA) of the University of Parma, Italy. This concept foresees the need to develop an automated system that is accurate, reliable, and durable, although having relatively low installation and maintenance costs. The technology provides a semi-continuous monitoring of deformations and other significant physical entities along the whole length of the MUMS instrument, carried out with predefined and easily modifiable frequency.

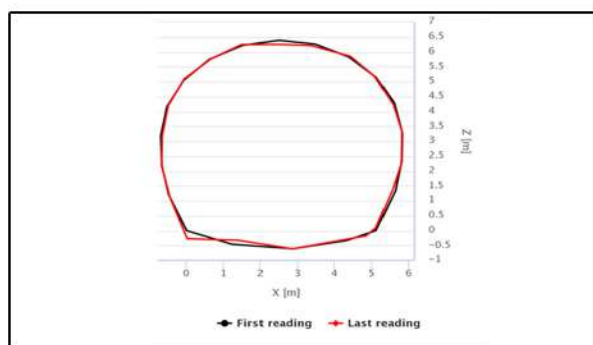
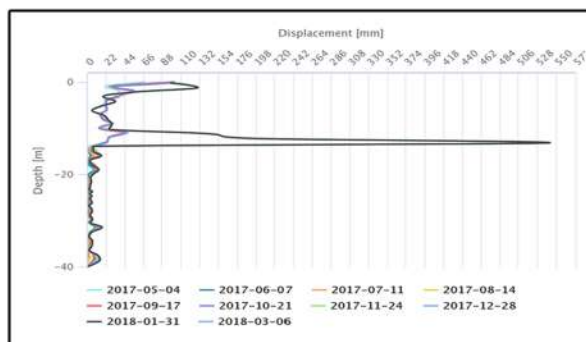


DATA MANAGEMENT

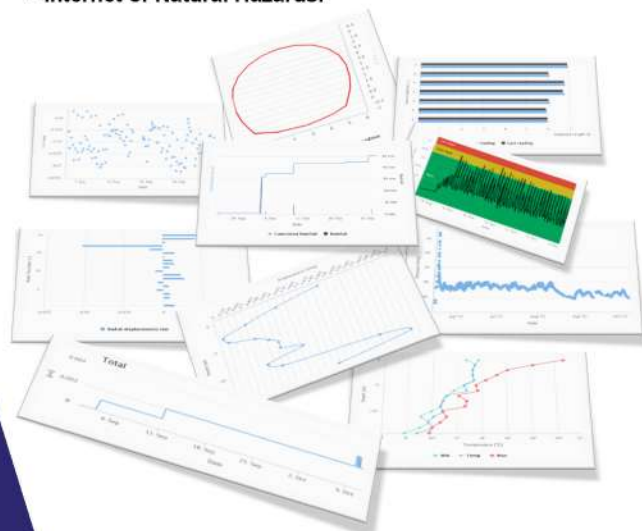
Control Unit records data of different sensors on site, it saves them on a volatile memory (SD) and send the raw data to the mainframe server that stores them on a MySQL secure database. Upon arrival on this server, the raw data (electric signals) are automatically elaborated and transformed into physical units by coupling them with calibration coefficients through a specific numerical process that differs for each application. Results are then stored in a "parallel" database from which they can be visualized, analyzed and recovered through a controlled access website. During the data elaboration, the mainframe server analyses the results using statistical tools and, where requested, controls the possible overcoming of predefined thresholds. Some automated algorithms are applied in order to control the quality and the variation of data trend and a preliminary automated validation is provided. Results are available in a few minutes on a web platform with private access. If the customers wish to use their own platform or have a copy of the elaborated data, it is possible to configure an automated FTP transfer that will occur every time a new dataset reaches the elaboration centre. ASE801 data logger, in addition to our systems, can also read every type of sensors available on the market (4-20 mA, mV/V, 0-5 V, Hz, PT100, NTC, etc.) enabling integration of third-part sensors within the proprietary data management platform.

WEB PLATFORM

Main results are graphed on a dedicated and dynamic web-based platform with secure controlled access, exploiting IoT principles. It is possible to control the monitoring outcomes anytime, using multiple devices (PC, Smartphone, Tablet, etc.). The platform displays the monitoring data related to the desired period using graphs and tools. The perception of the occurring events is therefore immediate and the system allows for a direct correlation of various sensors. It is possible to export results using common formats (.csv, .xls, etc.) while the graphs can be saved as images (.jpg, .png, .pdf, .svg) with a simple and straightforward procedure.



- Fast record and visualization of results;
- Remote Monitoring Automation;
- Dynamic representation;
- Access from multiple devices;
- Ability to represent different types of third-part sensors;
- Correlation of various sensors;
- Cause-Effect correlations;
- Historical data display;
- Export of results through text files, images or via FTP;
- Internet of Natural Hazards.



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