Horizontal GEOSTRING

Inclinometer

System Overview

The GEOSTRING system is a string of closely spaced MEMS sensors ideal for geotechnical monitoring applications including:

- Monitoring ground movements induced by tunnel construction.
- Monitoring embankment settlement in roadways, levees and retaining walls.
- Monitoring under large diameter storage tanks.
- Monitoring landslide areas above dams, highways, and railroads to provide early warning of slope failure.

Operation

The system can contain up to 200 sensor nodes in a string installed in 85 mm or up to 50 nodes in a 70 mm inclinometer casing.

The casing provides access for subsurface measurements. The joints between sensors are robust, allowing the system to maintain a consistent orientation of all the nodes.

The GEOSTRING is typically installed in a horizontal casing that passes through a suspected zone of movement. The nodes are spaced at 50 cm and provide a reading resolution similar to a traversing probe. The system spans the zone of movement and when the ground moves, the casing moves with it, changing the inclination of the nodes inside.

Cumulating the deflections along the string produces a graph of the casing profile. Changes indicate settlement or heave.

The GEOSTRING system uses a data acquisition system to transmit readings to a data logger or cloud processing software that can trigger alarms based on displacements.

Advantages

Real Time Monitoring: The GEOSTRING system is ideal for continuous, unattended monitoring and can deliver readings in near-real time.

Single-Cable Installation: Each sensor connects to the previous sensor above, requiring only one signal cable for each string and making data logger wiring easy.

Convenient Shipping and Transport: GEOSTRING systems are made easy to ship. Five segments, each 0.5 m long, easily fit in a carton measuring approximately 64 x 64 x 64 cm and weighing less than 2.13 kilograms.

This makes the logistics of a GEOSTRING installation easy. You can send the packages to a job site through overnight mail, carry a GEOSTRING array in the trunk of your car, or even strap it to the cargo rack on an ATV and haul it to a remote job location.

We also offer placement rods to install at the end of the system, letting you save money by only monitoring the zone of interest.

Durable Components: Nodes, cables, connectors and gage rods are exceptionally durable, making it practical to remove the systems at the end of the project and redeploy them on other projects.

Data Reduction: The GEOSTRING system outputs the displacement as engineering units, requiring less computing power and a lighter load on your data acquisition system. No need to keep track of what node has what calibration coefficients or what order you installed the segments in – the data logger detects and configures this automatically.

Complete Solutions: Roctest offers complete monitoring solutions that include data loggers and web-based monitoring software that can check for alarm conditions in near-real time and can plot data immediately after retrieving the readings.

GEOSTRING System Configuration

A GEOSTRING system requires casing, GeoString Segments, a suspension kit, a bottom/terminal plug and a jumper cable.

Casing: Choose 70 mm or 85 mm diameter inclinometer casing.

GEOSTRING **Segments:** Choose the number of GEOSTRING Segments required, and casing diameter.

Suspension Kit: Order one suspension kit for each installation. The kit includes the suspension gate and hardware for securing the first segment.

Signal Cable: Each string requires a bottom plug to seal the end of the signal cable and a jumper cable to connect to the data logger.

Data Logger:

Campbell Scientific: The GEOSTRING system works with many Campbell Scientific data loggers. The CR6 or CR1000Xe can log two GEOSTRING systems per logger directly. The CR350 can log two GEOSTRING strings.

GTecLink Wireless Dataloggers: Use the GTecLink data loggers for easy wireless data monitoring. The GEOSTRING Node works with up to 50 GEOSTRING nodes with an external power source or 10 GEOSTRING nodes with internal power.

Data Reduction Software: Process the GEOSTRING data with a spreadsheet or the Sensly web-based monitoring system.

Sensors per Chain: The table below show nominal limits for chains of nodes.

Number of Nodes	Max Jumper Cable Length, m (12V Supply)	Max Jumper Cable Length, m (24V Supply)
10	320	-
25	122	-
50	52	215
75	24	139
100	5	97
125	-	69
150	-	47
175	-	28
200	-	12

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Specifications

Sensor type	MEMS (Micro Electro-Mechanical Systems) tilt sensor for inclination readings in two axes.
Requirements	Minimum supply voltage of 10 Vdc. Maximum supply voltage of 30 Vdc. Digital RS485 signal requires Campbell Scientific or GTecLink data logger.
Weight	0.426kg per 50cm gauge length.
Calibrated Range	±30 degrees from horizontal over a temperature range of -10°C to +40°C.
Resolution	9 arc seconds or 0.04 mm/m using the CR1000XE data logger.
Repeatability	±82 arc seconds or ±0.4 mm/m.
Required Casing	Fits 70 mm or 85 mm outer diameter inclinometer casing.
Waterproof	Waterproof to 2 MPa.

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