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Monitoring of geostructures using fibre optics

The LSM participates in the research project SOFO (Monitoring of Structures using Fibre Optics), whose aim is the development of a new system for the measurement of deformations. It should permit long-term, automatic and permanent monitoring of civil engineering structures with high precision and good resolution. It uses fibre optics, whose effectiveness has already been proven in several branches of engineering science and which present important advantages with respect to other traditional methods: low cost, insensitivity to electromagnetic fields (high tension lines, trains, storms) and to corrosion, small size, ease of use, large range of measurable parameters.

SOFO measurement system

The SOFO method is based on the principle of low coherence interferometry and measures the variation in length between two fibres (Figure 1). One of the fibres is mechanically attached to the structure (measurement fibre) and the other is free (reference fibre). The measurement system is made up of a gauge which is part of the structure, a coupler, a data logger and a portable PC. This system, conceived by the IMAC (Institute for the Measurement and Analysis of Stress, EPFL) in 1993, was developed by the LSM and several optical industries, contractors and civil engineering firms. One data logger adapted to all site conditions with user friendly software is used with different gauges whose range may vary

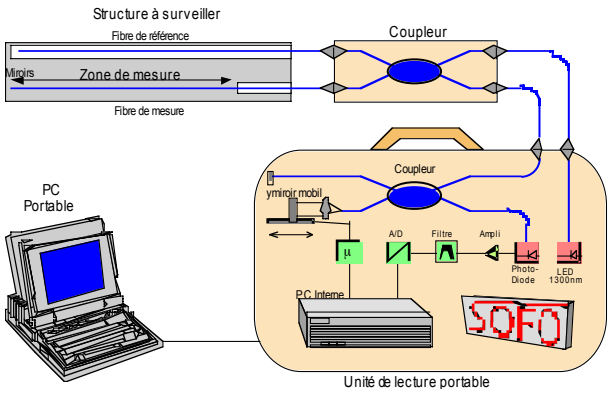

Fig. 1: Principle of the SOFO measurement system

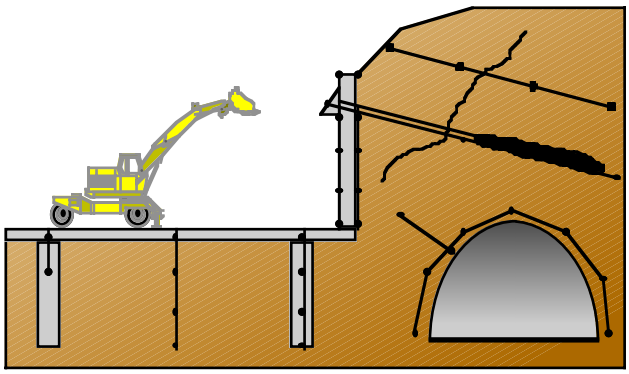

Fig. 2: Possible applications in the domain of geotechnical engineering

between 5 cm and 100 m. The developments in progress take several directions, such as the improvement and the industrialisation of the production of gauges, the development of multipoint gauges with up to 10 measurement points for one pair of fibres and the automatisation of the measurements, with the reading, reduction and interpretation of the data.

The LSM is especially working on the development of extensometric gauges for various applications in the domain of geotechnical engineering (Figure 2). Up to the present, the new gauges have been tested for different applications such as piles, anchored walls, tunnel linings and anchorages. The results obtained are very promising and show that fibre optics can also be effective and advantageous in the domain of civil engineering.

Publications

Vulliet L., D. Inaudi, A. Wyser, S. Vurpillot, L.Pflug. 1995. Monitoring geostructures with interferometric fiber extensometers. Field Measurements in Geomechanics 4th Int. Symp., Bergamo: pp. 447-454

Vulliet L., Casanova N., Inaudi D. Osa-Wyser A., Vurpillot S. 1997. Development of Fiber Optic Extensometers. Proc. XIVth Int. Conf. on Soil Mech. & Found. Engrg., Hamburg, Vol. 3, pp. 1527-1530

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