Fiber optic temperature sensor using intermodal interference for linear infrastructures monitoring.

Frédéric **MUSIN** (1), Patrice **MEGRET** (1), Henri **GRANDJEAN** (2), Jan **CALLEMEYN** (3), Jean-Christophe **FOHAL** (3), Marc **WUILPART** (1)

1 University of Mons - FPMs - SET, Mons, Belgium, frederic.musin@umons.ac.be, patrice.megret@umons.ac.be, marc.wuilpart@umons.ac.be
2 ORES, Louvain-la-Neuve, Belgium, henri.Grandjean@ores.net
3 CERISIC, Mons, Belgium, jan.callemeyn@cerisic.be, jean-christophe.fohal@cerisic.be

Asset management for electricity transmission system operators (TSO) pushes the need for intensive cable and substation monitoring to protect investments, guarantee supply in safe conditions and optimize the lifetime. In this context, temperature monitoring plays a key role to check sizing, installing techniques effectiveness and cable power capacity in its underground environment. Two measuring approaches are already on the market to meet all TSO's requirements at different cost level: local and distributed sensing.

The localized approaches use point sensing for strategic control like in cable joints at an affordable cost. Their efficiency is proven but in case of a fault appearing in an unmonitored zone, the network operator will not be warned. It is clear that point sensing does not enable a complete awareness of the performance and state of the infrastructure.

On the other hand, the distributed approach offers a wide range of opportunities using distributed network of sensors (quasi-distributed approach) or a continuous sensor (fully distributed approach) but is very costly. With this technique, the state of the whole infrastructure can be assessed and faulty conditions can be detected anywhere in the structure.

Fiber optic-based measurement techniques are widely used for quasi-distributed and distributed temperature sensing and present some advantages like electrical insulation, low-loss transmission and high sensitivity. Commercial solutions for distributed fiber optic temperature sensing are available on the market but are mainly focused on electricity production and transport due to their high cost.

In this context, we have developed a low-cost fiber optic temperature sensor technique especially designed to meet electricity distribution needs. This quasi-distributed sensor measures temperature deviation all along a fiber and allows for hazardous conditions detection. Based on intermodal interference pattern analysis, the technique is sensitive enough to detect joint failures and soil drying scenarios.

This paper presents the results of the proposed technique applied to the monitoring of TYCO MXSU 95-240mm² joints. The validation is achieved by comparing the conventional and optical measurement techniques when estimating the thermal behavior of industrial electrical junctions of good and bad quality. The possible extension of the technique with fully distributed functionality is finally introduced.

Key words

Optical fiber sensor, distributed thermal sensing, intermodal interference pattern, image processing.