Performance evaluation of integrity monitoring based on optical fibre distributed temperature and distributed acoustic sensing

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The global Transmission and Distribution network owners and operators have, in recent years, embraced the technical and commercial advantages of installing distributed and point based optical monitoring technologies for continuous monitoring of their cable and substation assets. In the area of distributed temperature sensing, end users have been able to take advantage of the ever increasing distance range, temperature measurement quality and the increasing reliability of such technologies. Such technology provides temperature data to server based Dynamic Cable Rating (DCR) or Real Time Thermal Rating (RTTR) systems. The adoption of these technologies and others within the industry has assisted and promoted the development of new capabilities regarding distributed optical sensing technologies. Distributed Acoustic Systems (DAS) are currently generating much interest in the electrical utility industry.

DAS offers a true acoustic response with a fully-representative detection of the acoustic field at typically every metre along a length of fibre. The DAS system is the true analogue to a synchronised microphonic array, and so can be used for beamforming (the phase-shifted addition of acoustic fields measured at different sensing points). This allows us to find the position of acoustic sources relative to the cable, and selectively listen to different points in the acoustic field. It does this by sending an optical signal into the fibre and looking at the naturally occurring reflections that are scattered back all along the glass. By analysing these reflections, and measuring the time between the laser pulse being launched and the signal being received, the system can measure the acoustic signal continuously. The technology measures from one end of a single standard telecoms fibre; there are no special components, such as fibre gratings, in the optical path. The DAS system is so sensitive that it allows digital recording of acoustic fields at every location with a frequency up to 100 kHz at short ranges. It has the capability to be deployed on existing singlemode and multimode fibre optic cable infrastructure.

This paper provides an explanation of the general principles of operation of an Intelligent Distributed Acoustic Sensor (iDAS) and focuses on the current areas of interest and applications of this technology within the industry. Currently the technology is mainly used for security monitoring of utility assets and third party intervention monitoring. The paper explores some of current applications with reference to existing installations. This paper also explores and provides information that will enable the potential for future applications e.g. into the area of acoustic monitoring of partial discharge events on distributed assets and locally based assets. We also provide insight regarding how this Distributed Acoustic Sensing technology can be integrated within utility network infrastructure.

Key words

Distributed Sensing, DTS, DAS, Integrity monitoring, Optical fibre, Asset management.