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Distributed fiber-optic sensors for detection and localization of dynamic perturbations

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ABSTRACT

Distributed fiber optic sensors are very suitable for application such as monitoring of long pipelines for small leaks and damages, for intrusion detection and localization in perimeter security systems, structural health monitoring of large constructions, etc. Such fiber-optic sensors allow to measure spatial distribution of a parameter of interest (such as deformation or temperature) along a very long fiber-optic cables. Distributed sensing techniques based on Raman light scattering or Brillouin scattering in optical fibers are well developed and are commercially available. However, such systems are useful mainly for static parameter measurements because of extremely low level of back scattered light signals and long averaging time.

For measuring of dynamic perturbations, such as mechanical vibrations or rapid temperature changes, interferometric distributed systems based on Rayleigh scattering of coherent light and/or on reflection from serial array of ultra-weak fiber Bragg gratings are very promising because of much stronger optical signals in comparison with non-elastic light scattering can be obtained.

In this talk, two techniques for distributed fiber-optic sensors based on interferometric detection of dynamic perturbations will be presented. One technique is based on so-called phase-sensitive Optical Time Domain Reflectometer operating in a pulsed regime. Another one uses principle of Optical Correlation Domain Reflectometer. The second technique utilizes truly random probe signals generated with CW diode laser source without any light modulation. Principle of operation of both techniques, experimental realizations and results of field tests of the developed prototypes will be presented and discussed.