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Title

Distributed and quasi-distributed Optical Fiber Sensor technologies: Applications to Structure Health Monitoring.

Abstract

After three decades of R&D, Optical Fiber Sensors (OFS) now offer the same functionalities as conventional technologies: sensing, monitoring, alarm... Moreover, they provide additional benefits such as those provided by the fibers (small size and mass, wide bandwidth, low attenuation, immunity to electromagnetic perturbations, good resistance to ionizing radiation...), and those coming from the measurement systems (metrological performances, multi-sensing parameter …)

In addition, everybody knows that 'optics' if often considered as relatively expensive, but multiplexing of many (tens, hundreds, up to tens of thousands) sensors on a unique remote system, drastically reduces the cost of the measurement point, the optoelectronic system being the main cost of the instrumentation.

Nowadays, two complementary OFS families are available: the first one called "quasi-distributed" *i.e.* locally sensitive (the most well-known technology, due to their unequalled performances, being the "Bragg gratings"), and second the "distributed sensors", *i.e.* continuously sensitive along the fiber, providing a profile of the wanted parameters (temperature, strain, curvature ...) along a single optical fiber or cable. Optoelectronic systems belonging to this former category are based on scattering phenomena in silica fibers: Raman, Brillouin and now Rayleigh. These effects, combined with, time or frequency-based reflectometry (respectively OTDR and OFDR) provide the user with the desired sensing profile all along fiber(s) under test.

Nowaday, they are many market sectors for these techniques, and there is no industry which may not be concerned by an application or another. Many applications are often defined as "Structural Health Monitoring" of materiel and structures. Today, "distributed" and "quasi-distributed" sensors have already begun to penetrate several industrial sectors: civil engineering, oil & gas, energy, security... as well as those involved in composite materials (marine, aeronautics, railway,... industries).

It is now obvious that, risk reduction, security, and lower costs, are main motivations for end users who, more and more, consider as a matter of concern both quality and health of the structures they manufacture, use or manage (buildings, bridges, tunnels, dams, pipelines, transportation means ...) . As a conclusion, the economy is now the main driver for OFS, and underlies many of their achievements.