THE IMPORTANCE OF FIBER OPTICS FOR TEMPERATURE, VIBRATION AND SOUND CONTROL

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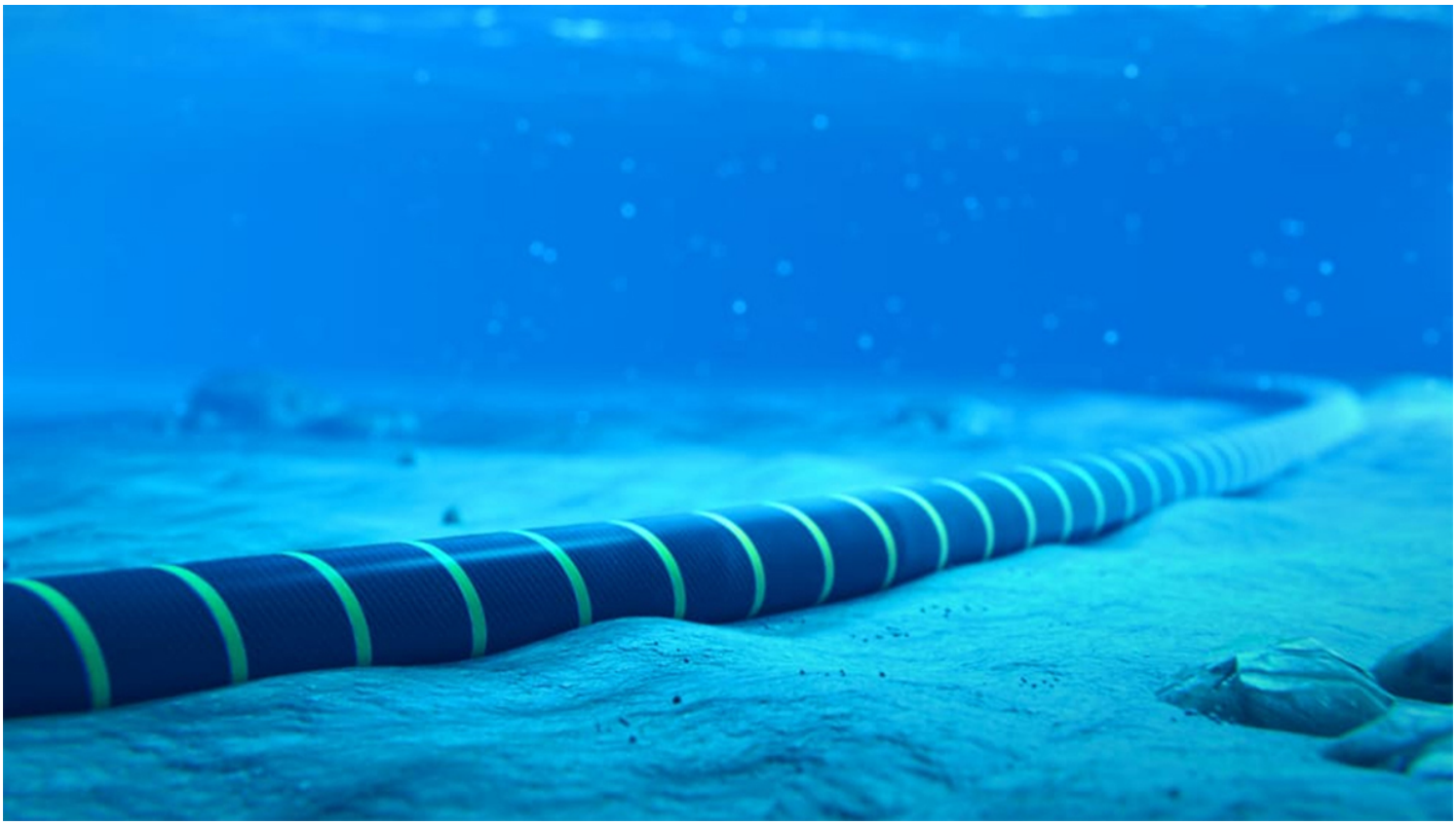


Category: Fiber Optic

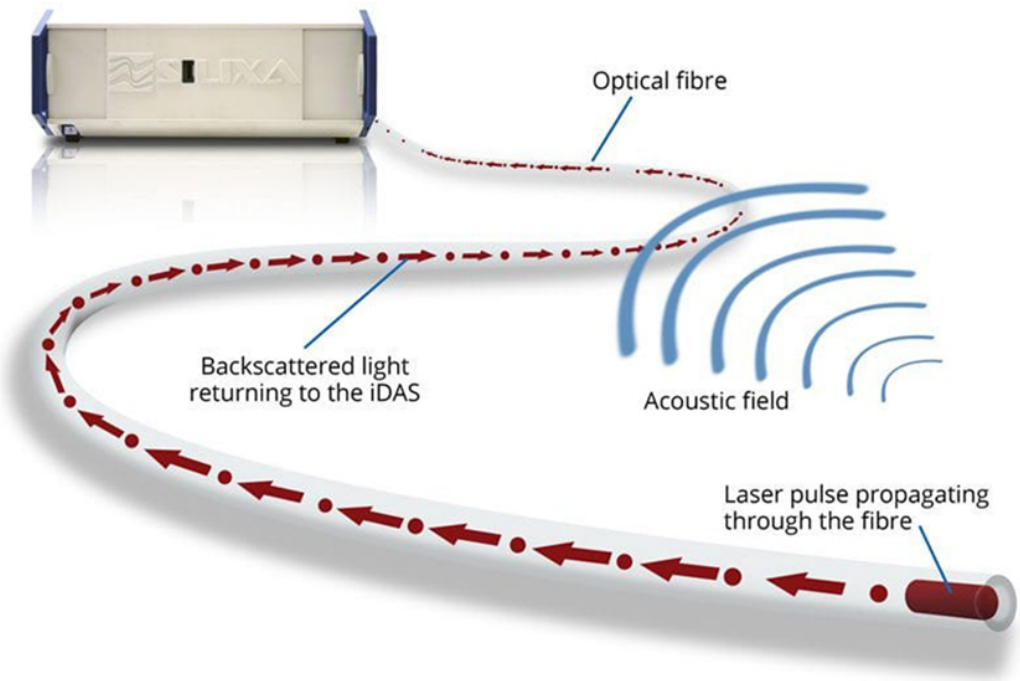
Other Applications of Fiber Optic Cables

We all know the benefits of optical fibers for telecommunications. Either for long distances for communications between cities, countries or even continents, as for short distances such as in a trunk of a building. We could not imagine telecommunications or internet access without the existence of optical fibers.
In recent years, applications have been discovered and designed that have nothing to do with

telecommunications and add unexpected and currently little-known functionalities to the fiber cables already installed. In this article we want to show some of these applications that are being worked on or even that are already being used.
The characteristics of optical fibers are sensitive to variations in physical quantities such as temperature or tension. In most cases, and provided that it is in reasonable ranges, these variations do not modify the performance at the level of transmission or attenuation rates significantly. The important thing is that they are measurable. This allows us to use the fibers as temperature and vibration sensors.
Sensors can be of the point type, that is, they measure a particular point, or distributed. In the latter case the parameter is measured at the rate of the entire length of the fiber, even if this more than 100km.

In the case of distributed sensors, we can differentiate two systems:

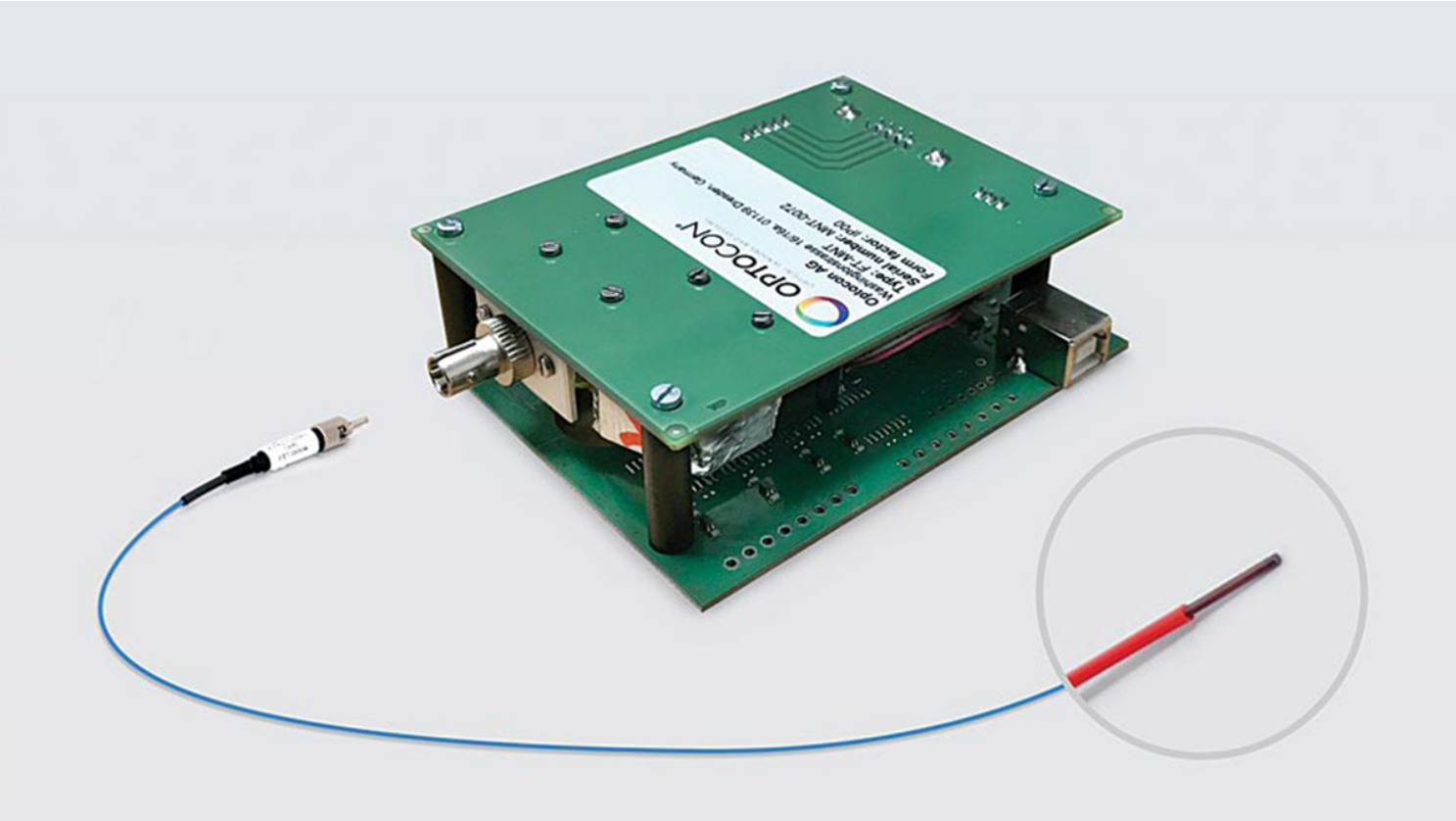
- DTS = Distributed Temperature Sensing
- DAS = Distributed Acoustic Sensing



DAS system

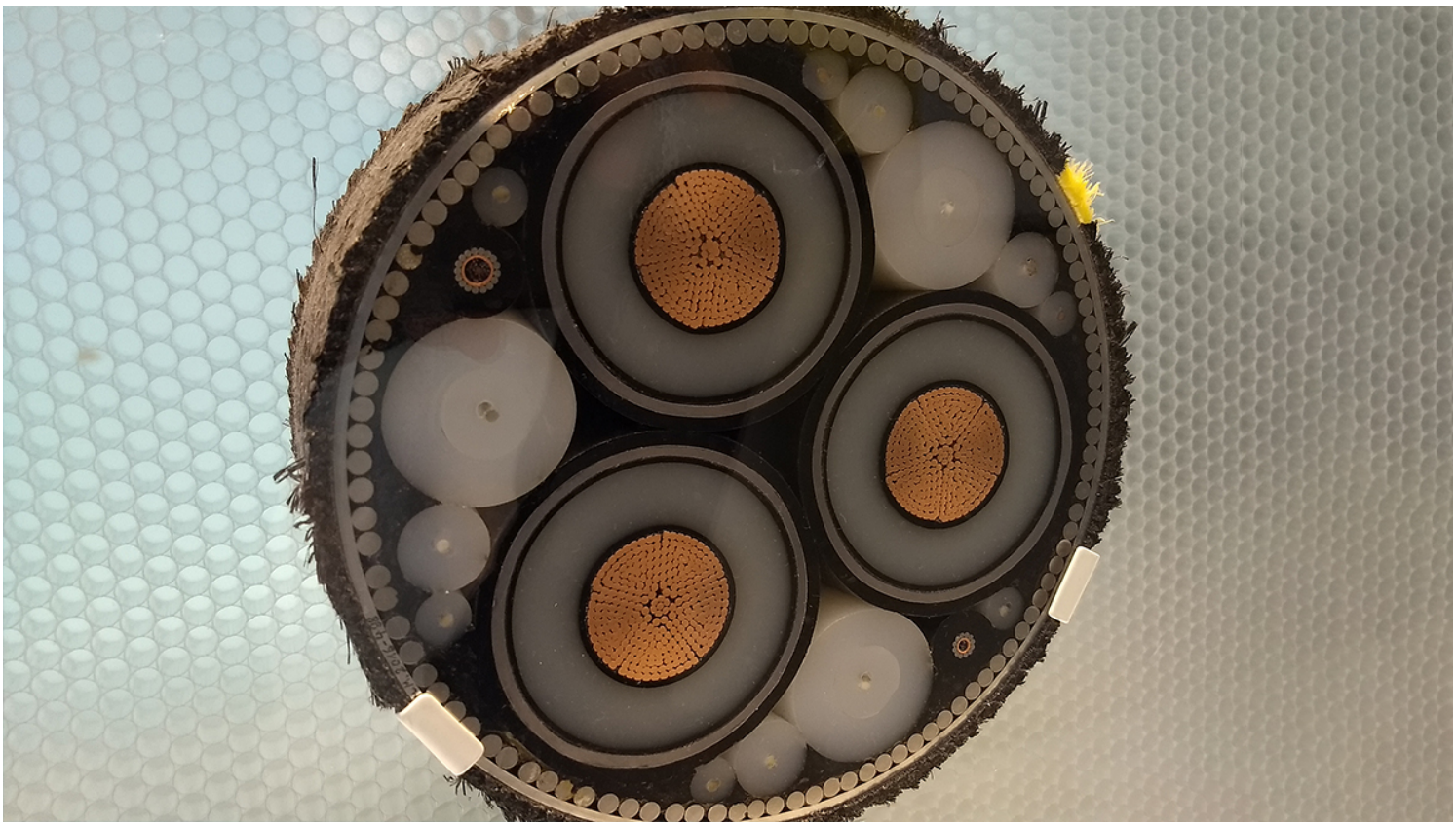
Fiber as temperature sensors
In the industry, fiber optic temperature sensors are used in places that are hostile to other types of sensors

taking advantage of the fact that they are immune to electromagnetic or nuclear radiation, they withstand very high or very low temperatures and since they do not carry electrical signals they can be used in ATEX environments.



Temperature point sensor

To use the fiber as a distributed sensor you can use fiber cables already instaladas or install a cable on purpose for it. Longitudinal resolutions as small as 12.5cm can be achieved in temperature measurements and in temperature resolutions of 0.01ºC. These characteristics can be used to detect, for example, fire in tunnels or buildings by means of fiber optic cables already installed. Another application, which is already implemented, is the monitoring of temperature along high voltage cables that carry a cable with built-in optical fibers with the aim of detecting possible failures before they are catastrophic.



High-voltage submarine cable with optical fibers

When fire is detected in a building, sprinklers from an entire area go off. These cover a very wide area soaking both the area that is being burned and areas outside it. This can lead to unnecessary deterioration of merchandise in a store. If we place a zigzag fiber optic cable we can form a fire detection structure with greater sensitivity and use only the sprinklers strictly necessary to put out a fire.

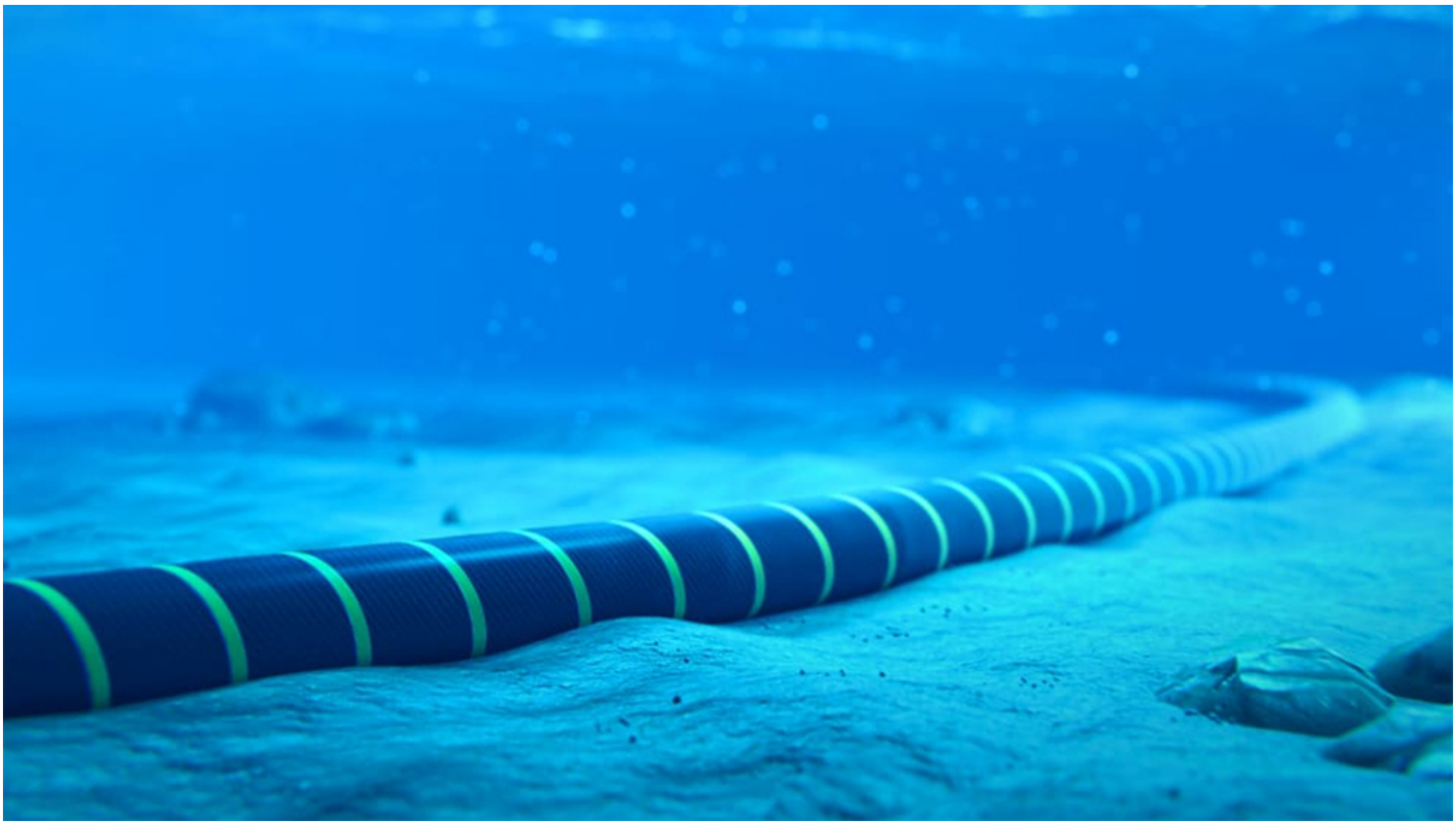
Fiber as vibration sensors

Distributed acoustic or vibration sensors have a very wide range of applications:

- By burying a cable in the perimeter of a farm, enclosure or installation we can use it for the detection of perimeter intrusion of any space since it detects small variations of pressure in the ground. In this way we can detect the entry of a person into a controlled space and trigger the appropriate alarms.
- We can use telecommunications cables installed in cities to detect excavators or hammers nearby to prevent accidental breakage or to detect improper access to manholes or cabinets.
- By attaching a fiber optic cable to a critical structure such as dams, bridges, tunnels, etc. we can detect deformations that may indicate a future failure of the infrastructure.

- Gas, water and oil pipeline installations are critical for multiple reasons. In water pipe installations, large amounts of water are lost due to breakages of an increasingly scarce good. Leaks in oil and gas pipelines are hazards for contamination and risk of fire and explosion. If a fiber optic cable adheres along the pipe, these leaks can be detected in addition to having fibers to use in other monitoring and control systems.
- Distributed acoustic sensors have application in the monitoring of rail and car traffic. With them we can detect the circulation of cars or trains, collisions and car entries in the opposite direction on highways.

Buried cables and cables placed on the seabed are being used as seismic detectors. In the marine case they serve to activate warnings of possible tsunamis. In a study led by the NPL (National Physical Laboratory) of the United Kingdom, which includes researchers from the University of Edinburgh, the British Geological Survey, the Istituto Nazionale di Ricerca Metrologica (INRiM) and Google, have tested this technique with considerable success on an intercontinental submarine cable with a length of 5. 860km between the UK and Canada. This study is included in the article "Optical interferometry–based array of seafloor environmental sensors using a transoceanic submarine cable" in the journal Sience. This study demonstrated not only the value of fiber optic cables as tidal sensors, but also demonstrated that underwater currents and variations in them due to climate change could be studied and monitored.



Conclusion

Fiber optic cables have more applications than mere data transmission in telecommunications systems. Every day new applications are being discovered for installed fiber optic cables, using them as distributed sensors, which allow to increase safety and perform preventive maintenance of critical installations and constructions.

Reference

https://www.science.org/doi/10.1126/science.abo1939