Optical fiber transmission quality can now be tested without the need to take measurements at both ends

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Light traveling in an optical fiber loses power over distance. A number of factors are responsible for this power loss, but one that is particularly important at high data rates is the loss that occurs due to changes in light polarization. Hui Dong at the A*STAR Institute for Infocomm Research and co-workers1 have developed and tested a method of determining this polarization-dependent loss (PDL) in an optical fiber cable by taking measurements from just one end of the fiber. The new technique avoids the difficulty of having to arrange and coordinate access to both ends of a fiber optic cable, which may be tens of kilometers apart.

In fiber optic networks, PDL predominantly occurs not in the fiber itself but in the couplers and filters used to regulate light in the fiber, and can have a significant impact on signal quality and network performance. Until now the measurement of PDL in cables has required an optical source attached to one end transmitting to a receiver at the other. A technique requiring access to only one end, however, was proposed theoretically by Italian researchers, but had yet to be verified experimentally.

The proposed technique requires the fiber optic cable to be birefringent at the end at which measurements are to be taken— that is, the cable must include imperfections that interact in different ways with the two perpendicular components of light polarization. This polarization-dependent interaction causes the two polarization modes to travel at

different speeds, splitting the light beam into two.

The technique then proposes estimating the PDL from the maximum loss encountered in a round-trip along the cable. This can be achieved by measuring light backscatter as photons of light emitted in four different polarization states bounce back from interacting with the molecular structure of the cable. Over a distance of ten kilometers, measurements taken with an experimental setup built by the researchers showed good agreement with measurement made using standard techniques with a light source and receiver at either end.

“We want to continue the experimental work on our PDL measurement in fiber links,” says Dong. “The PDL in a fiber link is a function of fiber length. Using our new technique, we should be able to measure the relationship between PDL and fiber length.” As PDL varies with environmental conditions such as temperature or stress on the cable, the new technique could also be used to sense these changes by detecting PDL variations.

More information: Dong, H., Shum, P., Gong, Y. & Sun, Q. Single-ended measurement of polarization-dependent loss in an optical fiber link. *IEEE Photonics Technology Letters* 23, 185–187 (2011).

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