Phase Noise Characterization in Optical Fiber-Based Sensors

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Optical fiber-based sensors are becoming more and more attractive over other types of sensors thanks to their ability to function in unconventional environments over long distances with a single fiber. These sensors have many applications such as protecting security sites and leakage detection in gas pipelines. We can infer about external events that occurred outside the fiber by comparing the input and the output laser's light parameters. For long-haul coherent detection systems, the putatively dominant noise source is the laser phase noise, an artifact of any laser system. To measure the phase noise, it is necessary to split the light source into two fibers with different lengths. Currently, when measuring over long distances, the process often becomes inefficient, and even infeasible. In this study, we designed a system that aims to measure the phase noise along multiple points in the fiber with a single measurement. We used a ring-shaped system to measure the noise of dozens of pulses at the output of the system when each traveled a different distance in the fiber. The significance of these results is immense. Using the system, applications that use optical fiber-based sensing, could measure the phase noise more easily and adjust their real-time measurement results related to the system's results. This is a significant leap forward in the field of distributed acoustic sensing using fiber optics.

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