Quasi-Distributed Intrinsic Fabry-Perot Interferometric Fiber Sensor for Temperature and Strain Sensing

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Abstract

The motivation of this research is to meet the growing demand for the measurand high-resolution, high-spatial resolution, attenuation insensitive and low-cost quasi-distributed temperature and strain sensors that can reliably work under harsh environment or in extended structures. There are two main drives for distributed fiber sensor research. The first is to lower cost-per-sensor so that the fiber sensors may become price-competitive against electrical sensors in order to gain widespread acceptance. The second is to obtain spatial distribution of the measurand.

This dissertation presents detailed research on the design, modeling, analysis, system implementation, sensor fabrication, performance evaluation, sensor field test and noise analysis of a quasi-distributed intrinsic Fabry-Perot interferometric (IFPI) fiber sensor suitable for temperature and strain measurement. For the first time to our knowledge, an IFPI sensor using a different type of fiber spliced in between two single-mode fibers is proposed and tested. The proposed sensor has high measurement accuracy, excellent repeatability, a large working range and a low insertion-loss. It requests no annealing after the sensor is made, and the sensor is calibration-free. The sensor fabrication is low-cost and has a high yield rate. The goal for this research is to bring this sensor to a level where it will become commercially viable for quasi-distributed sensing applications.