STRAIN SENSING COMPARISON BETWEEN SINGLE AND MULTIMODE FIBERS USING OPTICAL LOW COHERENCE INTERFEROMETRY

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ABSTRACT

Fiber loop ring-down (FLRD) is a potential new generation of fiber optic sensor (FOS) which sensing mechanism is based on the ring-down time change of the fiber loop. FLRD takes advantage of cavity ring-down spectroscopy with high detection, fast response, and insensitivity to light source fluctuation for fiber optic sensing features of low cost, light weight and small footprint. FLRD strain sensing was characterized by the mechanical deformation from the fiber ring head sensor, which correlated the additional optical loss of a fiber ring with ring-down time. With this technique, the strain measurement could be demonstrated in a time domain by the ring-down time. Strain sensor with FLRD technique would be studied in this thesis.

Optical low coherence interferometry is one of the accurate optical sensing technologies and widely utilized in various physical sensing properties. The system principle is to characterize the relative interferogram movement distance caused by the various strain on a sensing arm. An interferometric strain sensor from two-stage Mach-Zehnder interferometer was demonstrated for double sensitivity improvement. The strain performance comparison between single and multimode fibers will be analyzed for fiber sensing applications.

The stepper motor was set up with a movement distance of 20 nm in every step and the velocity could achieve 10000 step/s. The fiber strain was characterized as 22.22 με on a 9-cm length. The experimental results demonstrated the multimode fiber sensitivity is higher than single mode fiber. Repeatability of both single and multimode are uncertain. The interferogram movement distance from the multimode fiber was higher than a single mode and demonstrates higher sensitivity.

Keywords: FLRD, low coherence interferometry, strain sensor