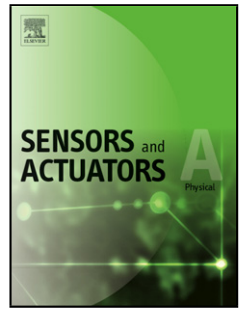


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# Bi-tapered Fiber Sensor using Visible to Near Infrared Light

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## Highlights:

- High signal to noise bi-tapered fiber system for visible-near infrared sensing.
- Application of bright, supercontinuum source using normal dispersion photonic crystal fiber.
- Sensitivity to signal phase changes to 0.01 radians or $2x10^{-5}$ RIU.
- Found Fourier amplitude correlation with small index changes in the signal.

**Abstract:** The spectral transmission properties of a bi-tapered optical fiber sensor are studied at wavelengths from 720 nm to 920 nm. The wavelengths of interest were generated using a fiber-based, supercontinuum light source that we constructed. The sensitivity of our fiber sensor was examined with water-glycerol mixture using different weight concentrations of glycerol. The wavelength sensitivity is boosted by an order of magnitude above our earlier design with reproducible results. We use the phase analysis of the data and also report a novel and strong correlation with the signal's Fourier amplitude.

Keywords: Bi-tapered optical fiber, supercontinuum, Fourier signal analysis, optical fiber sensor.

## 1. Introduction

Over the past several decades fiber optics has accelerated high data-rate communication applications, especially as they form the backbone of long-distance land and undersea systems [1]. This technology has spurred the development of ancillary applications which leverage the wide availability of materials and optical and electronic fiber-based equipment. The equipment used in fiber optics systems have become less expensive, which has reinvigorated research to develop new applications for optical fiber sensors [2, 3].

Ordinarily, optical fibers are designed to be immune to local changes in the environment. However, changes in physical conditions in or around the fiber inevitably disturb the passage of light as it propagates through standard optical fibers. For example, a temperature change or a strain on the fiber will alter the transmitted light properties, such as phase or polarization. Fiber sensors can be designed to detect the response to applied physical changes, such as applied electric or magnetic fields [4]. A fiber sensor has important advantages over other sensors, including high sensitivity, immunity to electromagnetic interference, compact size, low cost, remote signal acquisition, and a simple configuration for signal transmission and detection [3]. Fibers are simply modified in a number of different configurations to perform as sensors; for instance, they are adapted to measure magnetic field [4], temperature [5], pressure [5,6], strain [7], refractive index [7-10], and label-free biomolecule detection [11,12].