EPFL-TTO

EPFL Innovation Park J
CH-1015 Lausanne
Switzerland
+41 21 693 70 23
http://tto.epfl.ch/

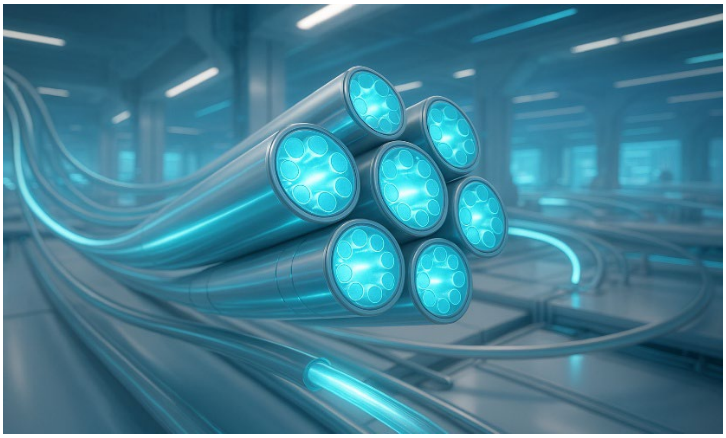
Research Contact

Christophe Moser
+41 21 693 61 10
christophe.moser@epfl.ch

TTO Contact

Mauro Lattuada
+41 21 693 35 63
mauro.lattuada@epfl.ch

Fluid-Based Thermo-Optic Effect-Manipulatable Optical Waveguide



Ref. Nr

6.2700

Keywords

Distributed Sensing, Photonic Crystal Fiber, Strain Measurement, Athermal Fiber, Thermo-Optic Compensation

Intellectual Property

EP25179600.9.

Publication

N/A

Date

20/12/2025

Description

Current optical fiber sensing systems suffer from strain-temperature cross-sensitivity, requiring complex solutions such as dual-fiber configurations (one strain-sensitive, one temperature-compensated), independent temperature measurements (e.g., Raman sensing) or mathematical decoupling using multi-parameter sensing mechanisms. These approaches increase system complexity, cost, and error susceptibility. No passive solution has yet achieved intrinsic athermal behavior for strain sensing.

This invention introduces a novel passive method for distributed optical fiber sensing that measures strain only, eliminating temperature-induced drift.
The working principle is based on filling the microstructured cladding of a photonic crystal fiber with a simple gas (e.g., nitrogen) at constant pressure. The gas's negative thermo-optic coefficient offsets silica's positive coefficient, stabilizing the effective refractive index against temperature changes.

The concept is tunable, uses commercially available fibers, and operates under standard lab conditions. It can also be adapted to nanofibers, planar waveguides, and hollow-core fibers, enabling programmable thermal responses.

Advantages

- Intrinsic athermal behavior: No temperature cross-sensitivity.
- Passive compensation: No active control or complex algorithms.
- Low-cost implementation: Uses standard fibers and benign gases.
- Versatile platform: Applicable to fibers, nanowires, and integrated photonics.
- Enhanced stability: Eliminates thermo-optic drift in interferometers and lasers.

Applications

- Distributed strain sensing in civil engineering and structural health monitoring.
- Frequency metrology links and precision clock delivery.
- High-precision timing of optical signals in telecom networks.
- Fiber laser stabilization and gyroscopes.

  On-chip photonic resonators and integrated optical circuits.