Optical fiber 3D Shape Sensing

Supervision:

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Industrial Partner: Maurizio CHIANI, Dimione systems

Scientific context:

Conventional intrinsic distributed optical fiber sensing configurations use scattering phenomena (Raman, Brillouin, and Rayleigh) to obtain measurements. The different measurements (like: strain, pressure, temperature...) are acquired by monitoring the resulting changes in the intensity, phase, polarization, wavelength or transit time of light within the optical fiber. Distributed monitoring gives engineers unprecedented insight into the behaviors of the structure/designs that that legacy technologies simply cannot offer. The major challenge for the optical fiber distributed solution is related to the position sensing, which means finding the fiber geometrical shape in 3D coordination system.

Three-dimensional shape measurement (or position sensing) of mechanical objects using distributed optical fiber sensor is a current hot topic, as it gives new possibilities for positioning and navigation of various instruments. Knowledge of the location-positioning using optical fibers solutions has a wide applications opportunity in the field of civil infrastructures, robotics, flexible instruments positioning and medical instruments.

Aim

The final objectives of the internship are to design and test an innovative device which will enable the user to access the three-dimensional shape of the optical fiber. The measurements should be done using an inexpensive, ordinary standard single-mode fiber. The data transmission and the coupling of the readout signal are exclusively realized via one single fiber core.

The developed solution should be tested to give 3D view inside unknown structure.

Planned outline:

-Bibliographic work on optical fiber sensors functioning.

-Working on distributed optical fiber sensing systems with low/high acquisition frequency, based on Rayleigh scattering in optical fibers.

-Three single mode fibers should be used in a first step to develop the solution for 3D sensing. The three single mode fibers should be installed on a geometrical support which enables the access of the strain/compression data.

-An evaluation of the strain or compression measurement combining with polarization analysis data gives the three-dimensional profile of the optical fiber.

Internship's duration: 6 months

Starting date: March 2019.

PhD possibilities:

A PhD candidate should start working on the subject after the internship test period.