

**PHOT 505, 2020 Spring  
(K. Yüksel)**

**Analysis and implementation of a simple refractive index sensor  
based on Fresnel Reflection**

**Context**

Refractive index (RI) measurement is frequently used in a variety of fields, such as chemical industry, food quality and safety analysis, bio-medical applications, environmental imaging systems, petroleum and oil industry and material processing. Being a very critical parameter in all of these areas, there is an increasing interest, in recent years, in determining the exact value of the refractive index of the materials. Several research groups have published different types of fiber-based refractive index sensors which include fiber Bragg gratings (FBG) structures, long period gratings (LPGs) structures, interferometers, photonic crystal fibers (PCF) and sensors using Surface Plasmon Resonance (SPR) effects.

Among these various sensor approaches, Fresnel reflection-based refractometers have emerged as promising tool for refractive index monitoring due to their simplicity and easy accessibility. This shows a great potential of the system in a wide panel of applications requiring the self-calibration and easy implementation features, particularly those in difficult environments.

**Objective**

In this project a Fresnel-reflection-based RI sensor using standard single mode fiber tips as sensing points interrogated by conventional OTDR (Optical time-domain reflectometer) from a distant location will be tested.

**Task list**

1. Reading: single mode fiber structure.
2. State-of-the-art analysis: RI measurement techniques using optical fibers.
3. OTDR principles: theory and lab experiment.
4. Preparation of solutions (e.g, glycerin-water, and alcohol-water) and RI measurement of prepared solutions using commercial refractometer.
5. Sensor design and experimental implementation.
6. Repeatability measurements.
7. Analysis of results.
8. Report and presentation.

**For this project, students are expected:**

- to be motivated for Lab work (Fiber Optic Sensor Lab).
- to have self-motivation for learning fundamental concepts in fiber optics.
- to prepare and calibrate various liquid solutions/chemicals in Chemistry Lab (under the supervision of chemistry department).