UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

DOTTORATO DI RICERCA / PHD PROGRAM IN
INFORMATION TECHNOLOGY AND ELECTRICAL ENGINEERING

Ad hoc course announcement

Fiber optic sensing and optoelectronic circuits: design and application

Lecturer: Vincenzo Romano Marrazzo, PhD

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BIO NOTES: Vincenzo Romano Marrazzo received the B.Sc. and M.Sc. degrees in electronics engineering and the Ph.D. degree in information technology and electrical engineering from the University of Naples Federico II, Naples, Italy, in 2014, 2017, and 2021, respectively. He is currently a Researcher with the Department of Electrical Engineering and Information Technology, University of Naples Federico II. His research focuses on the development of fiber optic sensor-based monitoring systems for various environments, as well as the design and characterization of electronic and optoelectronic systems for sensor reading in both normal and harsh conditions. Dr. Marrazzo is a member of CMS collaboration at European Organization for Nuclear Research (CERN) (CH).

Overview

Fiber optic sensors (FOS) have emerged as a crucial technology for real-time monitoring in different fields, including structural health monitoring, biomedical applications, and industrial automation. Their immunity to electromagnetic interference, high sensitivity, and ability to operate in extreme environments make them superior to traditional electronic sensors. State-of-the-art applications leverage Fiber Bragg Gratings (FBG) for strain and temperature sensing, interferometric techniques for precision measurements, and distributed sensing for large-scale infrastructure monitoring.

The design of an optoelectronic readout circuit is essential for accurately extracting and processing data from FOS. This involves a different kind of optical source (laser or LED) for signal transmission, a photodetector (PIN or APD) for optical-to-electrical conversion, and signal conditioning circuitry, including amplification, filtering, and analog-to-digital conversion. Advanced implementations integrate digital signal processors (DSPs) or microcontrollers to enhance resolution and enable real-time data analysis. Additionally, noise reduction techniques and wavelength-division multiplexing (WDM) are employed for multi-sensor networks.

This course will provide a comprehensive background on FOS technology, highlighting some cutting-edge applications and the sensing approaches that underlie their operation. An additional aspect explored in this

course will be the design of optoelectronic readout circuits. Special attention will be given to the component selection phase, the integration strategies of optical and electronic components, signal processing techniques; all aimed at the design of high-performance sensing systems. Ultimately, through theoretical study and laboratory practice, students will acquire skills in the design and optimization of monitoring solutions based on fiber optic sensors for next-generation engineering applications.

Schedule

Lecture	Date	Time	Room	Topics	Lecturer
1	07/04/2025	14.30-17.30	Sala Ovale Ed 2	Introduction to Fiber Optic Sensors	V.R.Marrazzo
2	09/04/2025	14.30-17.30	Sala Ovale Ed 2	Laboratory activity on FOS	V.R.Marrazzo
3	11/04/2025	14.30-17.30	Sala Ovale Ed 2	Systems for FOS readout.	V.R.Marrazzo
4	15/04/2025	14.30-17.30	Sala Ovale Ed 2	State-of-the-art FOS	V.R.Marrazzo
5	17/04/2025	14.30-17.30	Sala Riunioni Ed 2	Design of an optoelectronic circuit	V.R.Marrazzo
	17/04/2025	14.30-17.30	Sala Riunioni Ed 2	Assessment Test	V.R.Marrazzo

Content details

Lesson 1 – Introduction on Fiber Optic Sensors (FOS) starting from theoretical background to get knowledge to understand the different kind of FOS used for a wide range of applications.

Lesson 2 – Laboratory activity including practical experiences on how to joint two optical fibers with different coatings, how to connect an optical fiber sensors and example of measurement in strain and temperature variation with different kind of FOS.

Lesson 3 – Hybrid lesson on the different way to read a FOS with theoretical and practical example of typical read-out systems and their optical devices composed by.

Lesson 4 – In this lesson, the focus will be on how to design a simple optoelectronic circuit with the purpose of converting an optical signal into an electric. Background on different types of photodiodes will be given, as well as circuital simulation on electronic devices needed for the conversion of the photogenerated current.

Lesson 5 – The last lesson will be on how to pass from the circuital simulation to the printed circuit: dimension rules, components choice, and software explanation will be described for a correct design of a Printed Circuit Board (PCB).

Credits: 4 CFU/ECTS

Participants are requested the following MS Teams group:

FOS-OE-Circuits PhD Course | Generale | Microsoft Teams

Once accepted in the Teams group, students have to fill the following .xlsx file with their information:

participant information.xlsx

The course is conducted on-site. However, students pursuing their PhD period abroad (for research purposes) have the option to request remote attendance for classes via MS Teams

For information:

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