



SHMII-10

10th International Conference on Structural Health Monitoring of Intelligent Infrastructure  
Advanced Research and Real-world Applications

30 June – 2 July 2021

Porto, Portugal

# Short Course on SHM as a part of SHMII-10

## *Optical Fiber Sensing for Structural & Geotechnical Health Monitoring*

**June 23, 24 and 25, 2021, 14:55-17:00 Portugal Time Zone (GMT+1, Western European Summer Time)**

### **Description**

Structural health monitoring (SHM) is a process aimed at providing accurate and in-time information concerning structural health condition and performance. The information obtained on a structure through monitoring is of great aid to plan and design maintenance activities, verify design hypotheses, reduce uncertainty, increase safety, as well as to lower operating expenses.

Recent developments in fiber optic sensing (FOS) technology have made possible global structural monitoring and integrity monitoring using multiple discrete and long-gauge sensors, as well as truly distributed sensors. These sensors, combined in appropriate topologies and networks, can provide data for assessment of a wide range of parameters relevant to structural and geotechnical behavior.

### **Course Aims**

The aim of this six-hour course is to provide an overview of fiber optic sensing capabilities and the opportunities it can offer. Covered topics include a brief introduction to SHM, an overview of available FOS technologies (both discrete and distributed), and SHM methods based on FOS technologies. The topics are illustrated through numerous case studies from real-life projects.

This short course will review the use and application of fiber Bragg grating (FBG) and distributed fiber sensing based on Brillouin Time Domain Systems (BOTDR/A), along with discussions on sensor placement and installation, data analysis and interpretation.

### **Learning outcomes**

This course will enable the participant to:

- obtain an overall view of optical fiber sensors, the SHM industry and its trends
- learn the required building blocks that make up a Structural Health Monitoring system
- review a wide range of sensor types for the measurement of material properties and structural characteristics
- understand the operating principles, characteristics and advantages of optical fiber sensors (both discrete and distributed).
- illustrate specific sensing solutions and their benefits in diverse civil & geotechnical applications

### **Intended audience**

Technical managers, scientists, engineers, technicians, researchers, and research students who wish to learn about sensing and structural monitoring via optical fiber sensors and review their implementation and applications.

### **Course level**

Introductory to intermediate

### **Cost**

Regular attendees: €190 Euro/person

Students: €95 Euro/student

Registration can be made through the REGISTRATION link at conference webpage

<https://web.fe.up.pt/~shmii10/registration-info/>

If you encounter any difficulty, please contact Ms. Maria Lurdes ([ml@fe.up.pt](mailto:ml@fe.up.pt)) from the SHMII-10 Secretariat

### **Duration**

Three two-hour long sessions spread over three days (two hours per day).



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## Instructors

### Dr. Alexis Mendez MCH Engineering LLC



Alexis Mendez received a PhD. degree in Electrical Engineering from Brown University, USA in 1992. He is president of MCH Engineering LLC—a consulting firm specializing in optical fiber sensing technology. Dr. Mendez was the former Group Leader of the Fiber Optic Sensors Lab within ABB Corporate Research (USA) where he led R&D activities for the development of fiber sensors for use in industrial plant, oil & gas, and high voltage electric power applications. He was also Director of Engineering Sensing solutions at Micron Optics Inc. Dr. Mendez has written 70 technical publications, taught multiple short courses, holds 5 US patents and is recipient of an R&D100 award.

Dr. Mendez is a member of the OFS International Steering Committee, a Fellow of SPIE and was past Chairman of the 2006 International Optical Fiber Sensors Conference (OFS-18), and past Technical Chair of the 2nd Workshop on Specialty Optical Fibers and their Applications (WSOF-2). He is also member of the ISHMII (International Society for Health Monitoring of Intelligent Infrastructure) Committee, as well as VP of the IEEE Fiber Optic Sensors Standards Committee. He is co-editor of the "*Specialty Optical Fibers Handbook*", and co-author of SPIE's "*Fiber Optical Sensors Book—Fundamentals & Applications, 4th Ed.*", and Series Editor of the CRC Fiber Optic Sensors book series.

### Dr Nicky (Nicholas) de Battista University of Cambridge; Epsimon Ltd.



Dr Nicky de Battista is a licensed architect and civil engineer with several years' experience as a structural designer and construction site engineer. He has a Master's degree in structural engineering and a PhD, both from the University of Sheffield, UK. During his doctoral research, Dr de Battista specialised in structural health monitoring of civil infrastructure. Since 2009 he has been involved in several monitoring projects, both in his capacity as a researcher as well as a specialist consultant. He has designed, installed and operated monitoring systems in a number of high profile projects, including deep foundations, tunnel linings, bridges and building structures.

In 2014 Dr de Battista joined the Centre for Smart Infrastructure and Construction (CSIC) at the University of Cambridge as a post-doctoral Research Associate, where he carries out applied research in state of the art monitoring technologies, with particular emphasis on developing applications of fibre optic sensing for civil infrastructure. In 2016 he co-founded Epsimon Ltd, a private company offering specialist instrumentation & monitoring services for civil infrastructure, including design, installation and operation of fibre optic monitoring systems. Dr de Battista co-authored the book "*Distributed Fibre Optic Strain Sensing for Monitoring Civil Infrastructure: A Practical Guide*", published by the Institution of Civil Engineers in 2016.

### Prof. Branko Glisic Princeton University



Prof. Branko Glišić received his degrees in Civil Engineering and Theoretical Mathematics at University of Belgrade, Serbia, and Ph.D. at the EPFL, Switzerland. After eight-year long experience at SMARTEC SA, Switzerland, he moved to Princeton University, where he holds position of Associate Professor at the Department of Civil and Environmental Engineering.

Prof. Glisic is ISHMII's Vice President for Education, has been engaged in R&D of structural health monitoring (SHM) methods and fiber-optic sensors (FOS) since 1996. Since February 2009, he has been employed at the Department of Civil and Environmental Engineering at Princeton University where he founded SHMlab. He was involved at different levels of responsibility in numerous SHM projects, EU, NSF, and USDOT-RITA funded projects, and internal R&D projects. His expertise and current research interests include SHM methods and strategies, structural analysis, FOS and advanced sensory systems, and data management and analysis – system identification, damage detection, and data visualization. His main areas of interest are Structural Health Monitoring (SHM), advanced sensors based on fiber-optics, large-area electronics and conductive polymers, SHM data management and analysis, smart structures, and heritage structures. He is author and co-author of numerous papers, short courses, and the book "*Fibre Optic Methods for Structural Health Monitoring*".



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***Agenda, Times given in Portugal Time Zone (GMT+1, Western European Summer Time)***

**Day 1: Single and multipoint sensing (Wednesday, June 23, Alexis Mendez)**

|               |  |
|---------------|--|
| 14:55 – 15:00 | Welcome to the Course and Course Module  |
| 15:00 – 15:10 | Brief introduction to SHM  |
| 15:10 – 15:35 | Fiber Bragg-Gratings (FBG) Sensors – theoretical background  |
| 15:35 – 15:50 | Applications from Practice, Part 1: Civil Structures (bridge, roadway, building & pile monitoring) |
| 15:50 – 16:00 | Break, Questions and Answers   |
| 16:00 – 16:40 | Applications from Practice, Part 2: Geotechnical Applications                                      |
| 16:40 – 17:00 | Questions and Answers, Discussion, Conclusions   |

**Day 2: Distributed Fibre Optic Sensing (Thursday, June 24, Nicky de Battista)**

|               |  |
|---------------|--|
| 14:55 – 15:00 | Welcome to the Course Module                                       |
| 15:00 – 15:30 | Distributed FOS – theoretical background                           |
| 15:30 – 15:50 | Applications from Practice, Part 1: Sprayed concrete tunnel lining |
| 15:50 – 16:00 | Break, Questions and Answers                                       |
| 16:00 – 16:20 | Applications from Practice, Part 2: Pile foundations               |
| 16:20 – 16:40 | Applications from Practice, Part 3: High-rise building             |
| 16:40 – 17:00 | Questions and Answers, Discussion, Conclusions                     |

**Day 3: SHM methods (Friday, June 25, Branko Glisic)**

|               |   |
|---------------|---|
| 14:55 – 15:00 | Welcome to the Course Module                              |
| 15:00 – 15:20 | SHM process: the main activities and involved parties     |
| 15:20 – 15:50 | Review of various Optical Fiber Sensing techniques        |
| 15:50 – 16:00 | Break, Questions and Answers                              |
| 16:00 – 16:40 | Strain-based SHM; Local, Global, and Integrity Monitoring |
| 16:40 – 17:00 | Questions and Answers, Discussion, Conclusions            |
| 17:00 – 17:10 | Closure of the Course                                     |