# BIFURCATION ANALYSIS IN NONLINEAR PHOTONIC SYSTEMS

**THESIS DIRECTOR:**        **PROF. DR. IR. MARC SCIAMANNA**
**THESIS CO-DIRECTOR:**        **TO BE DEFINED**

## Short description of the thesis work :

Nonlinear photonic systems- including semiconductor lasers, nonlinear light propagation in optical materials and optical fibers, photonic integrated circuits - exhibit a rich variety of nonlinear dynamics among which spatio-temporal turbulence and temporal chaos [1]. These dynamics in time and/or space share similar properties in that they originate from a sequence of bifurcations and can be characterized by similar tools taken from signal theory such as Lyapunov exponent analysis [2], permutation entropy [3], etc. By harnessing these bifurcations and complexty properties, one can develop innovative applications for optical signal processing such as computation, storage and guiding. Our group within the LMOPS laboratory has developed since several years a re-known expertise in the field of nonlinear photonics and complexity analysis, which is received international visibility.

In this thesis, we are looking for a highly motivated researcher to address specific issues related to bifurcation analysis of nonlinear photonic systems. A focus will be made to the analysis of time-delayed photonic systems, i.e. systems in which light experiences feedback. The specific systems to be investigated mathematically and physically will be determined at a later stage, according to priority research projects and to the candidate's profile, skills and knowledge.

[1] M. Sciamanna and K.A. Shore, *Nat. Photonics* **9**, 151-162 (2015)
[2] M. Virte, K. Panajotov, H. Thienpont, M. Sciamanna, *Nat. Photonics* **7**, 60-65 (2013)
[3] D Rontani, E Mercier, D Wolfersberger, M Sciamanna, *Optics Letters* **41** (20), 4637-4640 (2016).

## Developed skills :

Theory, modeling and simulation of complex physical systems including non-linearity, time-delay, noise. Applied mathematics for photonics.

## Keywords :

Nonlinear systems theory, photonics, chaos, bifurcations.

## About the Chair in Photonics:

*The Chair in Photonics is a unique structure in France that has been launched in 2017 at CentraleSupélec on its Metz Campus and within the framework of the LMOPS laboratory. The Chair in Photonics pursues the goal of promotion and developing photonics, as the science and technology using light. This Chair in Photonics is a four-year project supported by CentraleSupélec, Foundation Supélec, AIRBUS group (GDI Simulation), European Union (FEDER), The French Republic, The Grand-Est Region, The Department of Moselle and Metz Métropole. Among its projects, the Chair in Photonics has launched the initiative to create a network of public academic and private partners involved in photonics, so that photonics can be promoted at the highest level in the Grand-Est Region and further in France and abroad.*

Candidates should send their CV and motivation letter before **July 31, 2017** to
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