MASTER'S THESIS INTERNSHIP OFFER

DESCRIPTION

> Title : <u>Machine learning approaches for uncertainty quantifications due to numerical simulation process of Electromagnetic Compatibility problems</u>

> Hosting organization: University of Limoges / UCA Clermont Ferrand

> Lab: XLIM Research Institute Limoges / Institut Pascal Clermont Ferrand

> Research Team: CEM et Diffraction (Limoges) – CEM (Clermont Ferrand)

> Scientific pole: RF System (Limoges)- PHOTON axis (Clermont-Ferrand)

> Starting date (month/date): March 2023

> Short description of the internship offer (up to 5 sentences):

Calculation of uncertainties of currents and electromagnetic fields resulting of electromagnetic computation. The sources of error can be due to uncertainty on input parameters (dimensions, permittivity of materials , ..) or to intrinsic parameters sur as discretization, using a specific model…The objective is then to give a confidence interval of the observables.

> Objectives (up to 5 sentences):

The prediction of interference levels induced on electronic systems or equipment is increasingly performed by simulation. Indeed, on the one hand, experimentation is costly and simulation software has reached maturity to represent complex systems. However, the certification phases of systems require the certainty that these coupling levels are below a template set by standards. Therefore, a deterministic simulation is not sufficient to meet this constraint. Indeed, the simulation results are present some errors linked to two main types of factors: The geometric or physical characteristics of the represented objects are not known with infinite precision, the fact of discretizing and representing the objects by models often simplifies reality, which is a source of intrinsic errors in the calculation. Thus the objective is first to become familiar with the methods of uncertainty calculation, uncertainty propagation and sensitivity calculation. These techniques will be applied in the field of Electromagnetic Compatibility showing how the introduction of error bars in the simulations allows answering the problematic

> Description of the internship offer:

The work will be made following different steps:

- Familiarization with mathematical techniques of uncertainty management. This part will be the occasion for the candidate to draw up a state of the art of the potential techniques, to make an assessment of their advantages, disadvantages and field of application.

- know how to build a simulation case and list the uncertain parameters that can be the cause of errors on the observables.

- Apply the uncertainty propagation approach on a case that will be defined during the course and analyze the uncertainties on the currents or electromagnetic fields according to the exogenous and endogenous uncertainties.

> Photo (optional)
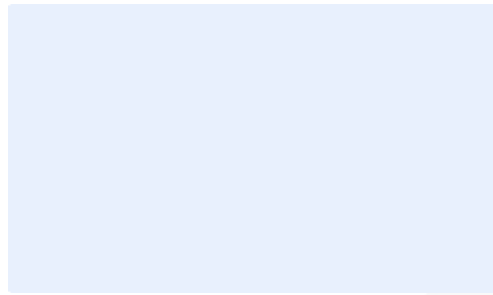
> Description of the research team:

The two research teams (EMC team of PHOTON axis and CEM & Diffraction team) are specialized in Electromagnetic Compatibility (EMC) from theoretical and experimental point of views.

SKILLS

> Expected skills of the applicant:

- Interested in physics, mathematics and computer science
- Have notions of statistical analysis
- Notions of programming (R language, python or matlab)

PHD THESIS OPPORTUNITIES

> **PhD thesis opportunity after the Master course:**

☒ Yes ☐ No

> **If yes, financing already obtained:**

☐ Yes ☒ No

> **If yes, what kind of funds:** Ministerial financing are asked : ½ from University of Limoges , ½ from University of Clermont Auvergne

CONTACT & APPLICATION

> **Surname and first name of the internship supervisor(s):**
REINEIX Alain – GUIFFAUT Christophe (Xlim) – BONNET Pierre (IP)

> **Email of the supervisor(s):** alain.reineix@xlim.fr christophe.guiffaut@xlim.fr, pierre.bonnet@uca.fr

> **Phone number of the supervisor(s): Alain Reineix: 05 55 45 73 54**

> **The application shall be sent to the email:** alain.reineix@xlim.fr

> **Closing date for applications:** 14 décembre 2022