



**Polymers and Composites Technology
& Mechanical Engineering Department**

PhD POSITION

Topic:

Identification and classification of damage mechanisms in polymer composite materials under mechanical loadings: Nondestructive characterization by Ultrasonic, Acoustic Emission and InfraRed Thermography techniques

Context and objectives:

Polymer composite materials represent an interesting alternative to metallic materials, namely in the transport industries like aeronautic, aerospace, automobile, etc. They bring numerous functional advantages such as lightness, mechanical strength, chemical resistance, electric insulation and cost-effectively manufacturing of complex geometry structures. However, their heterogeneous and anisotropic aspects could induce, under mechanical loadings, various and complex damage mechanisms (reinforcement breaking, matrix cracking, reinforcement/matrix debonding and delamination) which can prematurely reduce the structures service life. Hence, non-destructive techniques must be developed to evaluate the safety of the materials as well as the in-situ structures.

In this study, the potential of Acoustic Emission (AE), UltraSonic cartography (US) and InfraRed thermography (IR) techniques will be exploited to characterize the damage mechanisms of the polymer composite materials. Optical Microscopy (OM) or Scanning Electronic Microscopy (SEM) will be performed to physically identify the occurred damages under various applied mechanical loadings.

The aim of this study is both the identification and the classification of the various damage mechanisms occurring under different mechanical tests while exploiting the previous techniques data. For this purpose, the thesis subject firstly consists in installing and carrying out the experimental tests. Secondly, suitable techniques of data processing (such as Fourier transform, time-frequency analysis, neural network and K-means classifiers, data fusion, etc.) will be developed and adapted in order to identify and to classify the damage mechanisms signatures.

Required background: A background in mechanics of materials, acoustics and data processing is highly required. A background in non-destructive testing techniques will be appreciated.

Key words: Polymer composite materials, damaging, non-destructive characterization, acoustic emission, ultrasonic testing, infrared thermography, data processing.

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