

# Research Grants for PhD students from the China Scholarship Council

Information Form (please read the guidelines carefully on the website [www-csc.utt.fr](http://www-csc.utt.fr))

Supervisor's name : Harizi Given names : Walid

Status (prof., assistant prof., ...): Associate professor

Laboratory : Roberval (Mechanics, energy and electricity) Website address : <https://roberval.utt.fr>

Institution : Université de Technologie de Compiègne Website address : [www.utt.fr](http://www.utt.fr)

Scientific competence of the supervisor:

The supervisor of this doctoral thesis, Mr. Harizi, is a specialist in the multiphysical characterization of the damage mechanisms of polymer-matrix composite (PMC) materials using the Non-Destructive Testing & Evaluation (NDT&E) methods. For a few years, Mr. Harizi proposes to instrument the PMC structures with piezoelectric transducers (Lead Zirconate Titanate LZT or PZT and PolyVinylidene Fluoride PVDF) and nanofillers in order to make them smart, functionalized, searchable and carrying information from their manufacturing stage (Process Monitoring) until they will be loaded in service (Structural Health Monitoring).

Two major publications in the field proposed for the PhD :

1. Harizi et al. "On the use of in-situ piezoelectric sensors for the manufacturing and structural health monitoring of polymer-matrix composites: A literature review". Composite Structures, 215, 2019, pp. 127-149.
2. Harizi et al. "Multi-technique approach for non destructive diagnostic of structural composite materials using bulk ultrasonic waves, guided waves, acoustic emission and infrared thermography". Comp. A, 78, 2015,358-61

Website address of the personal page : [https://www.researchgate.net/profile/Walid\\_Harizi](https://www.researchgate.net/profile/Walid_Harizi)

Supervisor's email : [walid.harizi@utt.fr](mailto:walid.harizi@utt.fr)

Description of the research work proposed for a PhD Topic # (see list) : IV.5

Title : Structural health monitoring of polymer-matrix composite (PMC) structures using a network of embedded piezoelectric transducers

Subject :

Inspired by the human nervous system which is a set of interconnected neurons and transmitting information to different organs, this thesis subject focuses on the instrumentation of PMC structures (plates, stiffeners, omegas, etc.) by a network of piezoelectric transducers (PZT and PVDF ) at the heart of the material as soon as they are implemented, in order to make them intelligent. These sensors make it possible to follow the crosslinking phases of the matrix during the manufacturing process by infusion or Resin Transfer Molding (Process Monitoring), and evaluate the integrity of the structure during its operation stage (Structural Health Monitoring). These sensor networks, planar or distributed through-the-thickness of the PMC structure, can be used in passive (as acoustic emission sensors) or active (generators of guided waves, or electric capacitors) modes. Coupled with the conventional NDT&E methods mounted on the structure surface (acoustic emission, infrared thermography, digital images correlation, ultrasound, etc.), these piezoelectric transducers make it possible to establish, in real-time and in-situ, a multi-physical coupling between the external and internal signatures of the resin state transitions during curing and the damage mechanisms during mechanical loadings. The heterogeneous signatures processing requires the use of classification and fusion data methods (k-means, neural networks, etc.).

Keywords :

Polymer-matrix composites (PMCs); Piezoelectric transducers; Smart materials; Process monitoring (PM); Damage; Non-destructive Testing & Evaluation (NDT&E); Data classification & fusion; Structural Health Monitoring (SHM)

Expected collaborations :

No collaborations

Background required from the applicant :

With solid skills in mechanical engineering (engineer level or master 2), he/she has strong scientific competences in mechanics of composite materials, NDT&E methods (acoustic emission, infrared thermography and ultrasound) and processing of heterogeneous data such as classifiers (k-means and neural networks) and data fusion theories. For computer science tools, programming skills in Matlab® are essential. Numerical simulation competences using COMSOL Multiphysics® software are an asset.

Existence of a PDF file detailing the proposal ("yes" or "no") : yes

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