

**POSITION FOR POST-DOCTORAL RESEARCHER (MAITRE-ASSISTANT ASSOCIE)
"MULTI-SCALE MODELING OF HETEROGENEOUS COMPOSITE MATERIALS"**

Keywords: textile composites, manufacturing defects, **fatigue life**, multi-scale modelling

General description of the project

Increasing interest in using of textile reinforced composites in lightweight structures for different industrial applications leads to continuing demand on development of high-fidelity design approach. Despite significant progress in the last decade, realistic description of inherent heterogeneity and accurate incorporation of the manufacturing effects into material model are still remaining of high interest. It is known that manufacturing process of the composites structures inevitably introduces some defects into final part. In the case of textile composites, the following defects are generally observed: intra- and inter-yarn voids, fibre misalignment, and modification of the yarn cross-section leading to variation of local fibre volume fraction. As reported numerous in the literature, effect of these defects is seen in quasi-static tests results but has significant influence on the **fatigue performance** as well which should be considered during design. Moreover, material model set-up strongly depends on well-described damage mechanisms and non-linear behavior that are observed at different material scales, i.e. micro-, meso- and macro-.

Objectives

The general objective of the project is to develop a numerical simulation tool for efficient multi-scale modeling of the mechanical behavior of composites under **fatigue loading** with the following key challenges:

- Accurate prediction of non-linear response and failure at different scales.
- Accounting for variability in constituent materials properties and microstructure induced by manufacturing (fiber misalignment, voids, etc.)

All information about defects will be obtained using advanced testing methods, such as X-ray computed tomography in conjunction with image correlation and image post-treatment algorithms allowing effectively observe and quantify manufacturing defects at the different material scales with their subsequent analysis. On the other hand, application of last achievements in multi-scale methods will provide necessary basis for material modelling in this project.

The post-doctoral researcher will be involved in both theoretical and experimental investigations including:

- 1) Manufacturing textile composites by Liquid Composite Moulding (RTM/VARTM) with controlled defects.
- 2) Characterizing and quantifying of the manufacturing defects at the different material scales.
- 3) Advanced multi-scale damage numerical modelling will be based on Continuous Damage Mechanics or Phase Field models with implementation into general FEM or Fast Fourier Transformation solver.

Profile

PhD degree in Mechanical Engineering or Materials Science of Composite Materials. Skills and knowledge in:

- Mechanics of solids, multi-scale analysis, mechanics of composites
- Finite element analysis (ABAQUS/COMSOL/MATLAB) including development of material models
- Fortran or C/C++
- Manufacturing of composites
- Mechanical testing with different *in-situ* and *ex-situ* examinations techniques
- Highly proficient in spoken and written English

Conditions

The intended start date is September 2018 and the duration of the contract is 12 months (contract CDD in French term; net monthly salary is about 2100 euros). Interested applicants should send (preferably via e-mail) a letter of motivation with curriculum vitae, a description of research work, a list of publication and a couple of letters of recommendation to:

Dr. Dmytro VASIUKOV , Tel: +33 (0)3.27.71.24.48, e-mail: dmytro.vasiukov@imt-lille-douai.fr

Professor Chung-Hae PARK , Tel: +33 (0)3.27.71.21.87, e-mail: chung-hae.park@imt-lille-douai.fr

Département Technologie des Polymères et Composites & Ingénierie Mécanique, IMT Lille Douai,

941 rue Charles Bourseul – CS 10838 - 59508 DOUAI (France)

Fax: +33 (0)3.27.71.29.81, <http://www.imt-lille-douai.fr> , <http://tpcim.mines-douai.fr> , <http://tpcim.imt-lille-douai.fr/>