Postdoctoral position at FEMTO-ST Institute

Title : **Modelling fatigue and damping behaviour of plant fibre composites**

Supervision: **Vincent PLACET**, Research Engineer (HDR), University of Franche-Comté
vincent.placet@univ-fcomte.fr
03-81-66-60-55
Morvan OUISSE, Professor, ENSMM
morvan.ouisse@femto-st.fr
Lamine BOUBAKAR, Professor, University of Franche-Comté
morvan.ouisse@femto-st.fr

Duration 18 months (From December 2019 – January 2020)

Salary (gross annual) 35 k€

Location FEMTO-ST Institute
Departments of Applied Mechanics
24 rue de l'Epitaphe – 25000 Besançon, France
https://www.femto-st.fr

Context

SSUCHY: Sustainable Structural and Multifunctional Biocomposites from Hybrid Natural Fibres and bio-based polymers (https://www.ssuchy.eu/)

The project SSUCHY falls within the framework of the development and optimization of innovative and eco-efficient processes and constituents for structural and multifunctional bio-based composites. It is fully integrated into the research program of the Bio-Based Industries (BBI) Joint Technology Initiative operating under Horizon 2020, and particularly focused on BBI Value Chains 1 which is dedicated partly to the transformation of lignocellulosic feedstock to advanced bio-based materials.

Our project is positioned on the development of composite constituents, based on a renewable resource (i.e. biopolymers and plant fibre reinforcements) for the development of multifunctional recyclable and/or biodegradable bio-based composites with advanced functionalities for applications in transportation (ground transportation and aerospace) and a high value market niche (acoustic and electronics). It is dedicated to the development of specific concepts, technologies and materials to achieve a complete value chain and prove the principle at the scale of product demonstrators.

Among the nine scientific Work Packages of the project, two aims at understanding the fatigue and damping behaviour of bio-based composite materials in order to design and manufacture efficient structures with increased damping properties without deterioration of functional properties (static, fatigue, creep, temperature, fire behaviour).

During the first two years of the project, a large amount of experimental data has been collected at different scales using monotonic, cyclic and vibratory solicitations. When compared to classical composites, specific behaviours have been observed. The main objective of this work will be to develop a suitable model for understanding the underlying physics and predicting the damping and fatigue performance of bio-based composites and components, in order to develop tools that render possible the possibility to realize a multifunctional bio-based solution with radically new damping performance compared to classical composite structures while maintaining other functional properties (static, fatigue and creep behaviour).

Objective and tasks

The main objective of this postdoctoral fellowship is the development of a suitable model to predict the fatigue and damping behaviour of plant fibre composites.

The main tasks related to the work will be:

- Develop a model and the associated numerical tools to simulate the time-delayed and fatigue behaviour of plant fibre composites.
  A first 3D anisotropic viscoelastic model basis has been settled during a previous PhD thesis (A. Del Masto – Scale transition between plant fibre and UD composite: propagation of variability and nonlinearities). It was mainly exploited to simulate the instantaneous response of plant fibre composites, better understand the origin of their nonlinear tensile strain-stress response.

- Compare the numerical results to the multiscale experimental analyses.

- Conduct sensitivity analysis.

- Participate to the results dissemination (presentations in conferences, writing of scientific papers).

Profile required

- PhD thesis related to the mechanical modelling of composite materials.
- Softwares: proficient with Matlab and FEM (ABAQUS)
- Curious, self-motivated, hard-worker
- English: fluent reading, writing and speaking with ease.

Application procedure

Applications can be in French or English, and addressed to vincent.placet@**univ-fcomte.fr**
Candidates should send a **CV**, a **covering letter** and **official transcripts**

Recent Team's Publications

- Del Masto A, Trivaudey F, Guicheret-Retel V, Placet V, Boubakar L. Investigation of the possible origins of the differences in mechanical properties of hemp and flax fibres: A numerical study based on sensitivity analysis. Composites Part A: Applied Science and Manufacturing 2019; 124: 105488.
- Jeannin T, Berges M, Gabrion X, et al. Influence of hydrothermal ageing on the fatigue behaviour of a unidirectional flax-epoxy laminate. Composites Part B: Engineering 2019; 174: 107056.
- Jeannin T, Gabrion X, Ramasso E, Placet V. About the fatigue endurance of unidirectional flax-epoxy composite laminates. Composites Part B: Engineering 2019; 165: 690.