PhD Position in Structural Materials Group: "Numerical fatigue analysis and failure prediction of fiber-metal laminates (FML)" (VAC-2021-28)

Title of the PhD project: Numerical fatigue analysis and failure prediction of fiber-metal laminates (FML)

INTRODUCTION:

The International Centre for Numerical Methods in Engineering (CIMNE, www.cimne.com) is a research centre, created in 1987 by consortium between the Catalan Government and the Universitat Politècnica de Catalunya (UPC-BarcelonaTech), devoted to the development and application of numerical methods to a wide range of areas in engineering. CIMNE has been selected as a Severo Ochoa Centre of Excellence for the period 2019-2023, the highest level of recognition of excellence and leadership awarded to a research centre in Spain.

POSITION DETAILS

Number of vacancies: 1
Category: PhD (PHD2)
Location: Barcelona
Yearly salary (gross): 17.563,14 EUR
Working hours: Full time
Duration: 3 years
Starting date: No later than Sept 2021

FUNCTIONS TO BE DEVELOPED BY THE APPLICANT

CIMNE is looking for a **PhD Researcher** to be part of the Research and Technical Development (RTD) Group on Fatigue and Structural Materials.

The functions assigned to the candidate will be:

- Complete a PhD on Structural Analysis at Universitat Politècnica de Catalunya – Barcelona Tech. The candidate is expected to complete the PhD thesis in a maximum of three years.
- Collaborate with various research groups within CIMNE and worldwide.
- To publish a minimum of two papers in JCR journals during the PhD period, author and co-author articles in high-impact international journals.
- Carry out quality research, training and management.

- Participate on the dissemination and outreach activities associated with the project.
- Participate in international conferences presenting her/his work.

DESCRIPTION OF THE PHD PROJECT:

FML are a new class of material that exhibit excellent damage tolerance (crack growth performance and residual strength), while preserving similarity with aluminium structures. FML are formed of aluminium sheet (aluminium alloy 2000 series are the most common) and a composite material (usually epoxy polymer as matrix and a glass fiber type S2 as reinforcement) bonded together under pressure and heat, forming a compact laminate. The FML has very low fatigue crack growth rate when compared to the monolithic metal. This rate depends on the laminate lay-up and on the fiber/metal volume.

Several numerical studies about fatigue crack propagation in FML have been published in the last decade, mostly related to simple coupons or subcomponents but no full nonlinear numerical simulation has ever been done on complex FML architecture neither at small scale nor at aeronautical component level.

This thesis envisions developing a complex modelling strategy on the FML fatigue behaviour, specifically GLARE (glass-reinforced aluminium laminate), which is a new class of fiber metal laminate for advanced aerospace structural applications. The approach involves the combination of plasticity and degradation material laws together with fatigue damage and a laminate composition theory to properly capture the experimental behaviour of GLARE. The procedure also requires the inclusion of cycle jump algorithms and differentiated residual stress effects on the material components.

References

Mendonça W.R.P., da Silva D.F.N.R. (2020) Analysis Prediction and Correlation of Fiber Metal Laminate Crack Growth in Semi-Wing Full-Scale Test. In: Niepokolczycki A., Komorowski J. (eds) ICAF 2019 – Structural Integrity in the Age of Additive Manufacturing. ICAF 2019. Lecture Notes in Mechanical Engineering. Springer, Cham. https://doi.org/10.1007/978-3-030-21503-3_55

Barbu, L. G. ,Oller, S., Martinez, X., Barbat, A.H. (2019) High-cycle fatigue constitutive model and a load-advance strategy for the analysis of unidirectional fiber reinforced composites subjected to longitudinal loads. Composite Structures: 220, pp. 622-641. 2019. DOI: 10.1016/j.compstruct.2019.04.015

Alderliesten, R. (2017) Fatigue and Fracture of Fibre Metal Laminates; Springer Science and Business Media LLC: New York, NY, USA, 2017.

REQUIREMENTS

1. Master's degree in Civil, Mechanical, Naval or Aeronautical Engineering
2. The PhD candidate has taken courses during their academic formation on Numerical Analysis of Structures.
3. Programming skills.

EVALUATION OF CANDIDATES

The requirements and merits will be evaluated with a maximum mark of 100 points. Such maximum mark will be obtained by adding up the points obtained in the following items:

- Academic record (60%)
- Previous research and academic experience in the field of the position (20%)
- Programming skills (10%)
- Language skills (10%)

HOW TO APPLY

Candidates must complete the "Application Form" form on our website, indicating the reference of the vacancy and attaching the following documents **in English**:

- Curriculum vitae
- A motivation letter
- Academic transcripts from all Undergraduate and MSc degrees
- Name and institutional contact information of two possible referees

The deadline for registration to the offer ends on 31st May, 2021 at 12 noon.

The shortlisted candidates may be called for an interview. They may also be required to provide further supporting documentation.

CIMNE is an equal opportunity employer committed to diversity and inclusion. We are pleased to consider all qualified applicants for employment without regard to race, colour, religion, sex, sexual orientation, gender identity, national origin, age, disability or any other basis protected by applicable state or local law. CIMNE has been awarded the HRS4R label.