Internship at ISAE-SUPAERO / ICA for six/eight month

Title : Delamination modelling of 3D woven composites for dynamic loadings applications
Supervisor : Pr. Frédéric LACHAUD / Pr. Eric PAROISSIEN

1) Background

This work concerns the study of delamination initiation and propagation of 3D woven fabric composite for aircraft applications.

ISAE-SUPAERO and Institut Clément Ader work on the design of a specific composite panel with 3D woven fabrics. In order to predict damage and failure during impact loadings, numerical models have to introduce delamination propagation prediction using cohesive behavior or others interface failure numerical methods. For these methods, it's necessary to determine initiation and propagation criteria. It is also important to develop numerical models according to these criteria in order to make the numerical tools robust.

The objective during this work is to determine a methodology to identify and apply a delamination criterion for predicting 3D woven composite failure modelling under impact loadings. So, student will realize tests on tensile machine, on drop tower and also Finite Element Numerical modeling on ABAQUS Explicit / LS DYNA software with User Element and User Material FORTRAN routines.

2) The Internship
In this context the objective of the intern is:
Bibliography
- Damage and failure of composite laminates
- Cohesive zone model
- Delamination of composite materials

Training 10 h(teacher: Frédéric LACHAUD)
- *Specific Damage and failure courses of composites materials*
- *Abaqus UMAT and VUMAT creation*
- *How to realize a good experimental/numerical tests*

Test campaign
- Test for delamination initiation identification (3 pts bending, L-Shape 4 pts bending…etc)
- Test for delamination propagation identification (ENF, ELS…)
- Impact test of 3D woven composite laminate

Numerical approach
- Three point bending numerical tests for damage initiation validation,
- Fracture mechanic test modelling with different numerical methods,
- Impact modeling on Abaqus explicit / LSDYNA of 3D woven composites

- Perform comparison study
Proposal of a method for the validation of the modeling of delamination during impact of 3D woven composite materials

The candidate should have knowledge on composite materials, FE modeling, and design of aircrafts.

This research internship is in collaboration with an aeronautical industry

To apply
Date: from October/November 2022 to April/May 2023 or March 2023 to August/September 2023
Duration: 6/8 months
Remuneration: 650¤ per month
Contacts : send a CV and letter

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References
- Behzad Kazemianfar ∗, Mohammad Rahim Nami
Influence of oblique low velocity impact on damage behavior of 2D and 3D woven composites: Experimental and numerical methods
https://doi.org/10.1016/j.tws.2021.108253

- Jinfeng Peng a, Deng'an Cai a,∗, Yuan Qian b, Chang Liu a
Low-velocity impact and compression after impact behavior of 3D integrated woven spacer composites https://doi.org/10.1016/j.tws.2022.109450

- Behzad Kazemianfar *,1, Mohammad Rahim Nami 2
 Can a 3D woven GFRP composite really provide better impact resistance compared to a 2D woven GFRP composite at all of the thicknesses?
 https://doi.org/10.1016/j.istruc.2021.10.091