PROPOSAL FOR A RESEARCH PROJECT ERASMUS

Subject Title: Composite delamination of aeronautical structures: numerical prediction using SPH

Speciality:
■ aeronautics/space ❑ transportation ❑ energy
❑ mechanics/metallurgy ❑ engineering ❑ SSI ❑ other :

Kind of Work:
■ R&D theoretical work / numerical modelling
❑ R&D theoretical work and experimental work
❑ R&D experimental work
❑ Other

Length: **5 to 6** months

Person responsible of the project ■ Campus ENSICA ❑ Campus SUPAERO

Family Name and First Name: **Christine ESPINOSA** Function: Associate Professor

Tel : 05 6133 9154 Fax: 05 6133 9095 email: Christine.Espinosa@isae.fr

Lab: Department of Mechanics of Structures and Materials (DMSM)

Person co-responsible of the project ■ Campus ENSICA ❑ Campus SUPAERO

Family Name and First Name: **Frederic LACHAUD** Function: Associate Professor

Tel : 05 6133 9268 Fax: 05 6133 9095 email: Frederic.lachaud@isae.fr

Lab: Department of Mechanics of Structures and Materials (DMSM)

Confidentiality: ❑ no ■ yes ■ kind of confidentiality: industrial

Number of students : ■ 1 students ❑ …… students

Subject

Subject: Delamination is a major issue for the certification of aeronautical composite structures because of this macros scale rupture has a crucial effect on the structure strength. To design and compute real aeronautical structures, engineers must be able to characterize, then understand, then mechanically model, then numerically model the mechanisms that are responsible of delamination extent. Several numerical methods have been developed for that purpose such as different cohesive methods coupled with finite element numerical models. Interfaces between plies are considered to be a specific layer of matter able to dissipate energy during rupture following a restitution path. The path can be modelled linear or progressive up to rupture. Limits exist of course when using cohesive elements and methods such as experimentally determining yield values of stresses and displacements for the loading and unloading path to rupture. This difficulty is related to the well known localization problems and mesh size effects of finite elements that make this method often non predictive.

This project aims to use a novel approach to represent delamination propagation, the Smooth Particle Hydrodynamics (SPH) meshless method that avoids or highly limits the previous numerical penalty. As a starting study, opening mode I will be the considered loading taken into account. Numerical models will be constructed with help of researchers that are already working on this project. A small course will be given on the method theory and the LS-DYNA computation code that will be used.

Pre-requisites or Bibliography:

The applicant must have a previous experience in Finite Element computation and theory, and must have already used a computation code (LS-DYNA, SAMCEF, ANSYS, RADIOSS, NASTRAN, other…).

The applicant will be given a bibliography support, and some references to consult books available at the documentation centre.

Precise objectives fixed to the student:

The first aim of the internship is to evaluate the ability and the limits of the SPH method in modelling delamination propagation. Results of the simulations will be compared with experimental results lead during the internship or already available in the Department.

Implemented ressources:

- Methodology: the applicant will follow a reduced class on SPH usage and will be helped all the internship long, to build up the models, run the simulations and analyse the results.
- Facilities: testing resources, numerical resources: software (LS-DYNA), computers will be lead at the disposal of the applicant with some help.
- Human: engineers, technicians, and the associate professor in charge of this subject will help the applicant if needed.

Special aspects: -

This work is part of a research collaboration between the Department of Mechanics of Structures and Materials of ISAE and EADS IW Toulouse.