

# Research project offer



**Location:** ISAE SUPAERO, Toulouse, France

**Department:** DMSM

**Research group:** ICA “Joining” transversal axis [MSC and MS2M]

**Supervisor:** Laurent MICHEL, Frédéric LACHAUD and Éric PAROISSIEN

**Email :** [laurent.michel@isae-supaeero.fr](mailto:laurent.michel@isae-supaeero.fr) , [frederic.lachaud@isae-supaeero.fr](mailto:frederic.lachaud@isae-supaeero.fr) , [eric.paroissien@isae-supaeero.fr](mailto:eric.paroissien@isae-supaeero.fr)

## OFFER DESCRIPTION

**Title:** Durability of structural bonded repairs

**Proposed duration and period :** 6 months, S1 2021

### Context

A structural repair consists mainly in removing material around the damaged area (fatigue crack, impact, corrosion) then in adding healthy material. The addition of healthy material passes by a joining phase. The classical joining techniques are bolting, adhesive bonding and hybrid bolting / bonding. The adding material can be made in a different material from the parent one leading to the multimaterial interfaces (composite, metal).

Nowadays, the civil aviation does not use adhesive bonding for structural repairs on aircraft, due to the damage tolerance requirements applied to primary structures. One remaining lock is the ability the sizing of adhesive bonding joints taking into account for the progressive degradation of material properties against the environmental conditions [1-2].

This offer is supported by the project entitled DURECO in collaboration IRDL / ENSTA Bretagne.

### Objectives and work

This offer involves 3 main objectives.

The first objective is to perform a literature review about the behavior law of structural adhesives under creep loading including the experimental characterization (tests and models) as well the numerical simulation.

From the synthesis performed, the second objective is to implement on (i) a house-made code for the simplified stress analysis of bonded joints based on the macro-element (ME) technique [3-4] (Figure 1) and (ii) a commercial FE code.

Finally, the third objective is to suggest preliminary design of experimental tests.

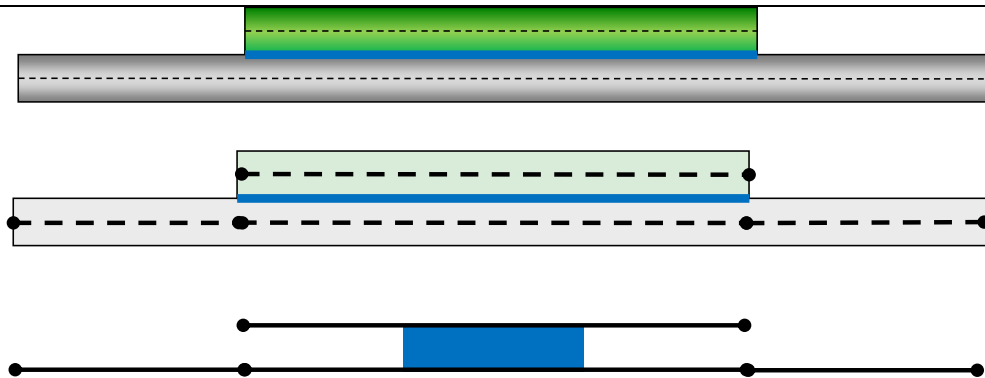
[1] Feuille de route nationale. Vers la maîtrise des Assemblages Collés Structuraux. Aerospace Valley, Astech, Pégase, EMC2 (2014).

[2] CERTBOND, COST Action, CA18120, <https://www.cost.eu/actions/CA18120/#tabs|Name:management-committee>

[3] Paroissien, E., 2006. Contribution aux assemblages hybrides (boulonnés/collés) – Application aux jonctions aéronautiques. PhD Dissertation, University of Toulouse III, November 2006, 286 p., on line <http://thesesups.univ-tlse.fr/3/>

[4] Ordonneau, B., Paroissien, E., Salaün, M., Malrieu, J., Guigue, A., Schwartz, S., 2020. A methodology for the computation of the macro-element stiffness matrix for the stress analysis of a lap joint with functionally graded adhesive properties. *International Journal of Adhesion and Adhesives*, 97, 102505 [DOI: 10.1016/j.ijadhadh.2019.102505]

adhesive properties. *International Journal of Adhesion and Adhesives*, 97, 102505.



**Figure 1.** ME modelling

**Possibility to continue with a PhD (Yes/No) :** TBD

**REQUIRED APPLICANT PROFILE AND SKILLS**

**Study level**  
(tick possible choices)

- Undergraduate students (3<sup>rd</sup> or 4<sup>th</sup> year)
- Master students (1<sup>st</sup> or 2<sup>nd</sup> year)
- PhD students

**Required profile and skills**

This offer is suitable to students in last year of MSc, MEng in Solids Mechanics, Structures Mechanics.

The expected specific skills are :

- Fundamentals of strength of materials
- Basics on the FE method and CAD

**Other useful information**

Feel free to take contact