



## Master Transports Aéronautiques et Terrestres

**Lab:** P' PMM, ENSMA - Poitiers

**Internship supervisors:** Yannick Pannier,  
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**Funding:** P' PMM Lab

### ***Thermal cycling of 3D textile composites for aircraft applications***

**Context:** Aircraft applications (warm structures), 3D textile organic matrix composites

**Skills:** Mechanics of materials, X-ray  $\mu$ tomography, FEM methods, ABAQUS

**Type of work:** Experimental and numerical

**PhD:** Funding for a PhD thesis from October 2016 could be available

This internship (training course) is placed within the framework of an academic collaboration with the KU Leuven (Prof. Stepan Lomov) and the Pprime institute around durability and ageing of 3D textile structured composite materials. Prof. Lomov [1] is a world reference in the field of textile composite materials, in particular in what concerns the modelling of their fatigue behaviour. The PPRIME Institute [2, 3] has been carrying out for many years research work on durability of composite materials under severe environmental conditions in close collaboration with aeronautical industrial partners (Airbus, Snecma, Aircelle).

Aircraft manufacturers aim at integrating these materials within warm/hot structural parts of aircrafts (turbo-engines, nacelles), which are exposed to aggressive environments (high temperatures) therefore a thorough characterization of the degradation behaviour of such materials under these conditions is needed. The aim of the internship is to understand degradation mechanisms occurring during thermal cycling of such materials.

Thermal cycling (-50°C/120°C) tests will be carried out by employing conditioning chambers available at the P' DPMM laboratory. The evolution of the damage will be characterised and followed by employing X-ray micro-tomography and image analysis tools recently developed in the laboratory. ABAQUS FEM simulations will be also performed on representative material microstructures to properly interpret tests results.

[1] Karahan, M., Lomov, S. et al., Fatigue tensile behavior of carbon/epoxy composite reinforced with non-crimp 3D orthogonal woven fabric, *Composites Science and Technology*, 71: 1961–1972, 2011.

[2] Lafarie-Frenot, M. C., Rouquie, S., Influence of oxidative environments on damage in c/epoxy laminates subjected to thermal cycling, *Composites Science and Technology*, 64: 1725-1735, 2004.

[3] Guigon, C. et al., Impact of temperature and thermal cycling ageing on performance of 3D woven composites with polymer matrix manufactured by RTM, ECCM18, 18<sup>th</sup> European Conference on Composite Materials, Sevilla, June 22-26, 2014.

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