

*Ph.D. position at A&M ParisTech, Paris, France*

## **“LASER shock induced damages: application to structural health monitoring and non-destructive testing”**

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**Location:** PIMM laboratory, ENSAM, 155 Boulevard de l’Hôpital, 75013 Paris, France.

**Advisors:** N. Mechbal (Associate professor, HDR), M. Rébillat (Associate professor) and E. Monteiro (Associate professor) in the Dynamic, Structure, and Control (DYSCO) group

**Funding:** This 36 months Ph.D. position is funded by the FUI collaborative French project “*MONARQUE – Endommagements maîtrisés par choc laser symétrique pour le CND/SHM et le désassemblage des collages*”.

**Starting date:** between October 2018 and January 2019

### **Research project:**

The growing use of new composite materials in the aeronautic industry is at the origin of new needs associated with the specificities of such materials. These identified needs are: i) defect control during the production process, ii) bonding control during the assembly process, iii) structural health monitoring during commercial exploitation and, iv) debonding of composite structures during the recycling phase.

The MONARQUE project offers an efficient, robust, and ecologically valid solution to the problem of delamination monitoring within composite materials and to the growing need of disassembling in an ecologically friendly manner bonded structures. This solution relies on an optimized use of intense LASER generated shock waves in composite materials. This unique way to create delamination within composite structures will be applied during the MONARQUE project to **validate in situ structural health monitoring algorithms** and non-destructive testing methods.

**PIMM laboratory:** The proposed Ph.D. position will take place within the Dynamic-Structure-Control (DYSCO) group of the Process and Engineering in Mechanics and Materials (PIMM) laboratory. The PIMM laboratory is the largest research laboratory of Arts & Métiers ParisTech with around 150 people. The laboratory provides a world unique environment with many available facilities: scale one A380 nacelle parts equipped with piezoelectric element, high energy LASER shock equipment to generate real-like delamination defects, ...

With respect to the MONARQUE project, PIMM is responsible for the coordination of activities dealing with the **active structural health monitoring (SHM) of structures by means of piezoelectric sensors**. This includes involvement in the optimization of the network sensors (size and position of the elements) and the development and validation of original algorithms for damage detection, localization, and quantification based on **innovative signal processing, machine learning or statistical tools** and upon the idea of **metamodels**. The group has already a renowned experience in these areas.

**Profile:** Candidates are expected to have obtained, or to obtain soon, a master’s degree in **Signal Processing, Statistical Analysis, or Machine Learning** with potential links with the field of Mechanical Engineering. Candidates holding a master’s degree in Mechanical Engineering with a strong Signal processing, Statistical Analysis or Machine learning component will also be considered. A solid background and demonstrable interest for **experimental activities** is mandatory. Additionally, very good research, communication and programming skills, proficiency in English, and a strong motivation towards working in a collaborative environment are required.

**Application:** Interested candidates who meet the qualifications are encouraged to apply by sending their applications to [marc.rebillat@ensam.eu](mailto:marc.rebillat@ensam.eu), [eric.monteiro@ensam.eu](mailto:eric.monteiro@ensam.eu) and [nazih.mechbal@ensam.eu](mailto:nazih.mechbal@ensam.eu) . Applications must include

(1) a **motivation letter** (max. 2 pages) describing why the applicant is applying to this position and how the position fits into his or her career plans,

- (2) a full CV showing how the applicant's profile fits the requirements,
- (3) an electronic copy of the **Master's thesis** (if already available),
- (4) a list of **three referees** that can be contacted.

**Relevant publications of the group:**

- M. Rébillat, R. Hajrya et N. Mechbal, «**Nonlinear structural damage detection based on cascade of Hammerstein models**», *Mechanical Systems and Signal Processing*, vol. 48, pp. 247-259, 2014.
- Mechbal N., Uribe J.S. & Rébillat M., “**A Probabilistic Multi-class Classifier for Structural Health Monitoring**”, *Mechanical Systems and Signal Processing*, Elsevier, 2015, 60-61, pp.106-123.
- Fendzi C., Mechbal N., Rébillat M., Guskov M. & Coffignal G., “**A General Bayesian Framework for Ellipse-based and Hyperbola-based Damage Localisation in Anisotropic Composite Plates**”, *Journal of Intelligent Material Systems and Structures*, 2015, pp.32
- Fendzi C., Rébillat M., Mechbal N., Guskov M. & Coffignal G., “**A data-driven temperature compensation approach for Structural Health Monitoring using Lamb waves**”, *Structural Health Monitoring*, 2016, 15 (5), pp.525-540.
- M. Ghrib, L. Berthe, N. Mechbal, M. Rébillat, M. Guskov, R. Ecault et N. Bedreddine, «**Generation of controlled delaminations in composites using symmetrical laser shock configuration**», *Composite Structures*, vol. 171, pp. 286-297, 2017.
- M. Rebillat, O. Hmad, F. Kadri et N. Mechbal, «**Peaks Over Threshold--based detector design for structural health monitoring: Application to aerospace structures**», *Structural Health Monitoring*, 2018.