"Wave propagation in curved variable-thickness structures: application to structural health monitoring of smart fan blades"

Laboratory and/or research group: PIMM / DYSCO Team

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Funding: EU H2020 MORPHO Project– Embedded Life-Cycle Management for Smart Multimaterials Structures: Application to Engine Components.

Starting date: 2nd semester 2022 Duration: 18-24 months

Context:

This PostDoc position is part of the H2020 project MORPHO where the overall goal is to enable efficient, profitable, and environmental-friendly manufacturing, maintenance, and recycling of next-generation smart engine fan blades. MORPHO consortium is built up with multiple partners across several European universities and companies and close collaboration with them is expected (see https://morpho-h2020.eu/).

The core body of fan blades is composed of bended and non-uniform 3D woven composite material, while the leading edge is made up of titanium (see Figure 1). These geometrically complex components are subject to harsh environmental and operational conditions, such as temperature, fatigue, vibration, and bird strikes. Hence, monitoring their structural health in a robust and automated way is an important challenge towards their development and exploitation.

Figure 1: (a) Engine fan blades – hybrid material composed of 3D woven composite and titanium. (b). Foreign Object Damage (FOD) panel : a substructure extracted from the Fan blade.

Monitoring in real-time and autonomously the health state of aeronautic structures is referred to as Structural Health Monitoring (SHM). A SHM process is classically decomposed into four steps: damage detection, localization, classification, and quantification. In order to achieve this goal, the FOD panels will be equipped with FBG sensors that will be included during the RTM manufacturing process and with printed PZT. These sensors will provide the input data necessary to perform the SHM of the fan blades.
Objectives and research work:

The PostDoc candidate will be in charge of understanding theoretically and experimentally waves propagation and attenuation within a FOD panel and to then propose a dedicated SHM approach for such a structure that will be validated experimentally on a set of several (≈8) FOD panels manufactured by SAFRAN.

Among the main objectives, we can highlight the following:

- To perform a bibliographical review on waves propagation in variable-thickness curved structures.
- To develop specific SHM algorithms from damage detection to RUL prediction based on the previous understanding of the dynamical behavior of bended non-uniform structures.
- To validate the first two points through a series of experimental campaigns carried out on a set of representative FOD panels (≈ 10) manufactured by SAFRAN and equipped with FBG sensors and printed PZT sensors.
- To collaborate closely with another PostDoc working on numerical reduced order models of the dynamical behavior of the FOD panel that will be calibrated using experimental data.

Candidate profile

You are expected to hold a PhD degree in Acoustics, Structural Dynamics or Ultrasounds with an experimental background and a signal processing or machine learning component. We expect a demonstrable interest and experience regarding both experimental and numerical or theoretical activities.

Interested candidates should send to M. Rébillat (marc.rebillat@ensam.eu) and P. Margerit (pierre.margerit@ensam.eu) an application containing:

1) a personal motivation letter (max. 1 A4 page) describing why you apply and how the position fits into your career plans,
2) a full CV showing how your profile fits the requirements (max 4 pages),
3) an electronic copy of your PhD’s thesis
4) recommendation letters
5) a list of referees we can contact.

References:


“The high-resolution wavevector analysis for the characterization of the dynamic response of composite plates” P. Margerit, A. Lebée, J.F. Caron, K. Ege & X. Boutillon. Journal of Sound and Vibration 458, 177-196