LABORATOIRE D'ANALYSE VIBRATOIRE ET ACOUSTIQUE

LABORATOIRE D'ÉTUDE DES MICROSTRUCTURES ET DE MÉCANIQUE DES MATÉRIAUX

Advanced characterization of abradable coating wear phenomena during blade-tip/casing contacts in aircraft engines

reference :	PhD_09_2024_b
level :	Ph.D.
work place :	Université de Lorraine
contact :	sylvain.philippon@univ-lorraine.fr alain.batailly@polymtl.ca
required skills :	material science, stantard tests on metallic matrials knowledge of dynamic testing would be appreciated, motivation for experimental work
required documents :	transcripts, CV, cover letter and reference letters (or names of potential referees)

1 Job description

In the framework of an international France-Canada project, LEM3 and LAVA plan to develop numerical models that take into account the evolution of the microstructure of coatings (AlSi-PE abradable material) used in low-pressure aircraft engine compressors. The project aim is to understand the influence on the material damage, and in particular the densification microstructure on the severity of the loading on the blade tip. To this end, characterization tests for large ranges of strain rates and temperatures will be carried out at LEM3, Université de Lorraine in France on materials whose porosity will be modified by a controlled compressive load. Based on these results, a constitutive law will be proposed and implemented in numerical models developed at LAVA, Polytechnique Montréal in Canada. The evolution of the blade dynamic response will be investigated to propose optimization criteria for the blade. The experimental work will extend to other types of solicitation (shear and tensile) for the same abradable specimen in order to better represent the real contact conditions between the blade and the turbojet casing.

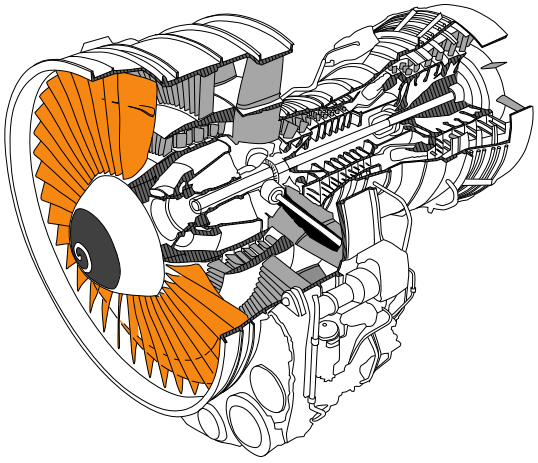

FIGURE. 1 – cut view of a turbomachine

2 Context and objectives

The proposed research has three main objectives :

obj 1 : Accounting for the modified porosity rate (densification) of the material in the existing compression constitutive law.

- Dynamic/static compression tests with abradable specimens which microstructure was modified.
- Proposition of a constitutive law taking into account the porosity rate evolution.
- Implementation of this law into the numerical model developed at LAVA.

obj 2 : shear and tensile tests will be performed in order to improve the static and dynamic response of abradable coating under other solicitations.

- Dynamic/static shear and tensile tests with similar specimens used in the previous study.
- Proposition of other constitutive laws related to damage mechanisms exiting during an interaction blade/coating taking into account the porosity rate evolution.

obj 3 : Implementation of the phenomenological laws for compression, tensile or shear solicitations taking into account the porosity rate evolution in the numerical model developed in LAVA.

3 Work environment

The selected candidate will be part of both LEM3 and LAVA which currently employ several researchers and graduate students working in areas closely related to that of the proposed research. All numerical developments will be made using the Python programming language. The candidate will benefit both from experimental testing facilities at LEM3 and the digital research infrastructure at LAVA (wiki website, gitlab platform, data and computation servers). The candidate will have the opportunity to supervise undergraduate students throughout the duration of the project.