Postdoctoral position

Optimization of fan leading edge manufacturing process

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The European Commission has established a target of reducing greenhouse gas (GHG) emissions of the European Union by over 80% by 2050, in comparison to 1990 levels. Additionally, the Commission aims to achieve carbon neutrality by that same year. In the aeronautics industry, one of the ways to achieve these objectives is to reduce the weight of structures, thereby reducing fuel consumption.

The use of composite materials to manufacture structural parts is a viable approach to attain these objectives. In the case of the LEAP engine developed by Safran Aircraft Engines, 3D woven composites are used in the manufacturing of blades and fan case.

Fan blades for new-generation turbomachines are made of composite material with a structural metal reinforcement, known as the leading edge which can be seen in the Figure. The production of these fan blades for new engines is based on the assembly of metal-composite parts, one of the key points being to respect the geometrical constrains between the different parts. In particular the geometry of the cavity of the leading edge plays a fundamental role on the final properties of the assembly.

These parts present a high geometrical complexity. As a result, the parts are obtained by a sequence of forming passes. Designing the tools and the passes required to obtain the desired part is a very challenging task. Finite element simulations are a key tool in this design process.

This projects aims at improving the predictive capability of existing finite elements models in order to optimize the manufacturing process of these Titanium-made parts.

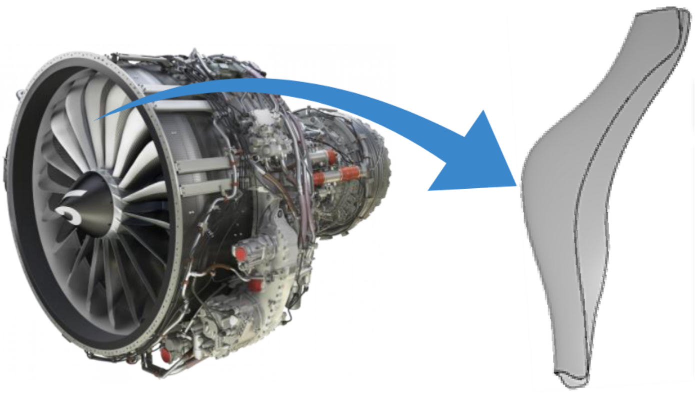
Numerical modeling

Simulation of such forming processes is a challenging task due to the large plastic strain locally undergone by the material. Numerical models must be robust and accurate in order to make realistic mechanical predictions. The non linearity of the process, which involves non-linear mechanical behavior and contact, requires the use of advanced remeshing techniques. The simulations will be carried out using the finite element Software Forge® that is developed at CEMEF.

To reach this end, the following steps are required:

- Accurate representation of the kinematic of the different tools used in the different forming passes.
- Manual mesh refinement strategy.
- Validation of predicted geometries.
- Automation of mesh adaption strategy.
- Optimization of the manufaturing forming stages.

The figure below shows the fan blades along with the leading edge. The geometrical complexity of the leading edge is clearly seen in right part of the Figure.



Fan blade leading edge

Candidate profile

The candidate must hold PhD degree in computational mechanics, high performance computing, material science, or a closely related field. The candidate should demonstrate a strong interest in numerical modeling and programming within a high-performance modeling environment. Knowledge of mesh generation, mechanics and programming in Fortran is required.

Partners

The project is being conducted as part of an ongoing collaboration between Safran and CEMEF with the objective of better understanding and modeling, at different scales, the manufacturing process of fan blades and in particular its Titanium leading edges.