ReSiSTant

Aircraft Turbofan

1 BIONIC SURFACE TECHNOLOGIES

2 Fraunhofer IFAM

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4 IDONIAL

5 Lufthansa Technik

6 MAN Energy Solutions

7 nanto cleantech SINGULARITY MATERIALS

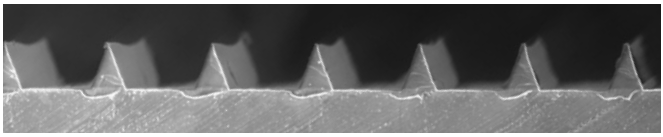
8 RINA

9 IKDG | RWTH AACHEN UNIVERSITY

10 TU Graz Graz University of Technology

Background & Motivation

The overall goal of the project is to achieve an increase of efficiency of 1% in both pilots.



The project is divided in three main parts: First, the investigation and prediction of the aerodynamics as well as feasible riblet geometries, including their benefit on the efficiency. Second, testing and evaluation of possible coating materials in the needed size range and operating conditions as well as tests with and without the riblets in the test rig to confirm the predicted improvements. Third, validation of riblet structures applied on pilot machines to investigate their behavior in real-life applications.

Aerodynamics
. Calculation of Riblet-Geometries
. Numerical simulation of Riblet-Effect
. Determination of number of Riblets and position

Materials & Application
. Feasibility study of different material and application techniques
. Development of Riblet material for industrial compressors
. Nanofunctionalization & -structures for industrial compressors

Testing & Evaluation
. Test rig for industrial compressors
. Tests w / wo Riblets
. Pre-evaluation for materials and nanofunctionalization

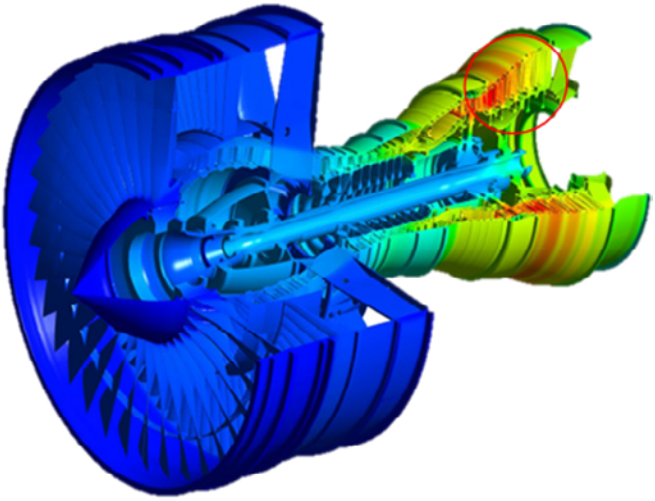
Assessment of Testing and Material-Application
. Selection of material & application technology
. Selection of Riblet-structures
. Selection of type of nanofunctionalization & - structures

Demonstrators and production prototypes
. Production of Riblet-coated parts for demonstrators
. Tests at demonstrators

In-service tests operation of demonstrators and business case evaluation

Concept & Approach

The needed size and pattern of the surface coating will be provided from BST via their patented algorithm within CFD-simulations. The corresponding performance characteristic is experimentally validated with the certified riblet test bench at BST.



GE Aviation is one of the leading aircraft engine suppliers worldwide and will not only provide expertise regarding the possible enhancements, but also introduce a flow-optimized geometry of the turbine center frame for the examined stage. This geometry change as well as the surface optimization will be evaluated in the subsonic test turbine facility of the TTM institute of TU Graz. This test rig only consists of the investigated turbine stage, but allows for measuring different parameters to assess all possible advantages. The real-life performance of the surface optimizations will be investigated at a demonstrator of Lufthansa Technik. Since Lufthansa Technik is the leader of MRO services, it also develops innovative repairs and improvements for aircraft engines. Such improvements are verified and tested with a dedicated test engine which runs in a test facility and is fitted with additional measurement technology, being able to provide real-life conditions as well as the impact of any conducted changes.

Technology & Demonstrators

As the aviation industry is growing annually, fossil fuel consumption and environmental pollution are increasing steadily as well. To achieve the goals of climate friendly aviation in Europe, aircraft have to become more fuel efficient.

One way to obtain this goal is to optimize the engine efficiency via surface improvement and coatings as well as geometry changes. Within this project, so called riblet structures are applied. Those were developed utilizing nanotechnology and the principles of biomimetics with sharkskin texture in mind. Riblet structures reduce the drag of the fluid on the wetted surfaces, resulting in lower wall shear stresses thus higher efficiencies. Applied on modules with high flow velocity and high wall shear stresses like the low pressure turbine, these modified surfaces not only increase the efficiency but can also prevent corrosion and dirt deposits at the same time if they are treated with a suitable nanocoating. As they can be applied during maintenance activities via a coating with imprinted structures, no cost intensive additional ground time is needed.

To validate the benefits of such coatings, two phases of testing are required: Firstly, their performance is thoroughly examined in a test rig, while in the second step the effects in a pilot engine are observed.

Coordination

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