German Aerospace Center

Press releases 2009

Lower fuel consumption thanks to new turbines - DLR research for Rolls-Royce

13 January 2009

Staff of the DLR Institute of Propulsion Technology at the turbine test bed

Aero engines of the future should be environmentally friendly and cost-efficient. Scientists at the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) in Göttingen are currently testing an innovative single-stage supersonic high-pressure turbine on behalf of Rolls-Royce that fits that description exactly. The turbine is designed be used in business jets.

DLR test bed for high-pressure turbines unique in Germany

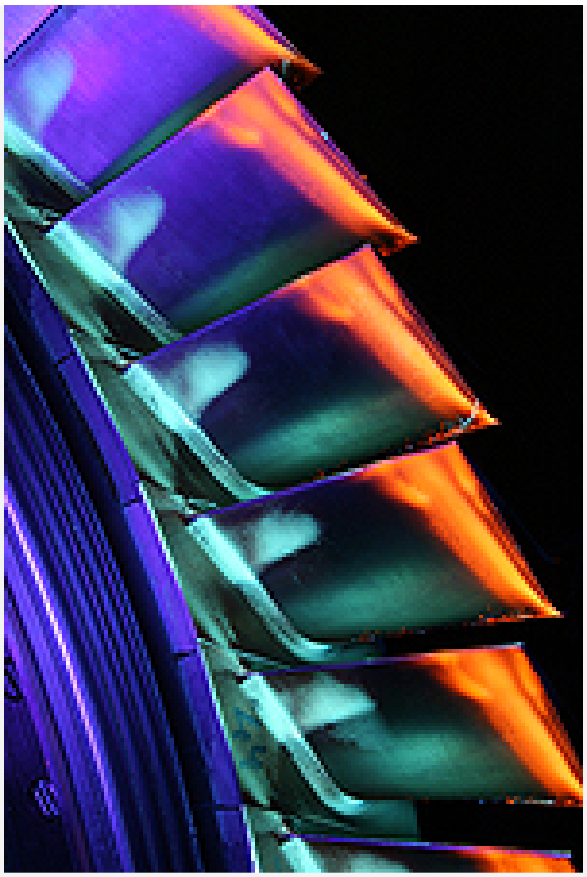
The new high-pressure turbine makes it possible to develop engines with a good balance between costs and performance in the lower thrust range. Before the turbine can be used in an engine, however, its flow characteristics must be closely examined. "The only test bed in Germany suitable for this purpose is the one at DLR in Göttingen", says Dr Erik Janke, who is responsible for turbine aerodynamics at Rolls-Royce Germany. The turbine is one of the most important components of an aero engine. It transforms the energy released by fuel combustion into motion used to drive the compressor. Dr Ingo Röhle, Head of the Turbine Department (Abteilung Turbine) of the DLR Institute of Propulsion Technology (DLR-Institut für Antriebstechnik), explains what makes the test bed in Göttingen so special: "The turbine test bed enables us to operate almost life-size high-pressure turbines using the correct Mach number and air properties. This means that we can accurately simulate the conditions that will occur when the turbine is actually used in the engine."

Rolls-Royce turbine rotor generates data at a rate of 250 000 measurements per second

The new turbine will reduce the engine’s energy consumption and thus its CO2 emissions, in addition to reducing production costs. "In this way, engine research contributes in a very practical way to protecting the environment, while at the same time it helps to secure high-tech employment in Germany in general, and in the Göttingen region in particular", says Dr Röhle. The expertise gained by DLR in this field also benefits other industries, for instance in the energy sector.

The first of two series of measurements for Rolls-Royce Germany was successfully completed in 2007. The results of the second series of tests, which is currently under way, will help to determine the turbine’s final design.

Sensors measuring pressure, temperature and other parameters determine the turbine’s aerodynamic characteristics during the tests. The pressure inside the turbine, for instance, is measured using high-speed pressure transducers that collect data at a rate of 250 000 measurements per second. Over the course of the measurement campaign, this process alone generates a total data volume of 100 gigabytes that then needs to be analysed.



Flow measurements at the rotor

DLR develops a test turbine for Rolls-Royce aero engines

Before the first measurement can be taken, however, the scientists must make sure that the turbine rotor's mechanical strength is high enough to withstand the strong forces exerted on it during operation, and that the rotor is free from vibrations. After all, at maximum speed a rotor blade experiences a force equivalent to 37 000 times the Earth's gravitational pull. By way of comparison, an astronaut on board the Space Shuttle experiences a force of about three times the Earth's gravitational pull during takeoff. Careful assembly of the test turbine in the workshop at DLR Göttingen is also crucial to the successful completion of the measurement campaign.

The project is funded through the aeronautics research programme of the German Federal Ministry of Economics and Technology (Bundesministeriums für Wirtschaft und Technologie; BMWi). About 2.5 million euro is made available for the research conducted in Göttingen. Rolls-Royce has been a leading manufacturer of aero engines for decades. It has two sites in Germany. Thanks to the very promising results obtained so far, Rolls-Royce has already been able to successfully negotiate a contract for an engine based on this new high-pressure turbine technology. DLR is the national aerospace research centre of the Federal Republic of Germany. It employs 380 people in Göttingen, primarily in the field of aeronautics research.

Related Contacts

Jens Wucherpfennig
Corporate Communications, Göttingen
Tel: +49 551 709-2108
Fax: +49 551 709-12108
E-Mail: jens.wucherpfennig@dlr.de
