ILA Berlin Air Show 2016: Fraunhofer IBP presents solutions for improving sustainability in the aviation industry

Aside from the car, the most popular way to get to holiday destinations is by airplane, and flying is the top choice for business travelers, too. According to statistics portal Statista, the world’s airlines generated combined sales of around $556 billion US dollars in global passenger traffic last year. And in addition to economic aspects and rising demands for cabin comfort, ecological considerations are now becoming more important than ever before. Today, fleets operated by German airlines consume 42 percent less fuel per passenger kilometer than they did in 1990. This is mainly due to advances in technology that have, for instance, made aircraft lighter and in turn more energy efficient. Scientists at the Fraunhofer Institute for Building Physics IBP are working on using expertise to drive these trends forward. To this end, they are collaborating closely with numerous other Fraunhofer Institutes and industry partners in ultra-modern, unique test facilities and are applying smart software tools. The scientists will be presenting their latest developments for the aviation sector at the ILA Berlin Air Show (Hall 4, Booth 202) from June 1 to 4.

Ground-based test flights

The Fraunhofer IBP Flight Test Facility (FTF) in Valley, near Munich, is the only test laboratory of its kind in the world. It houses a low-pressure chamber containing a real segment of an A310 fuselage measuring some 15 meters in length and fitted with seats for up to 80 human test subjects. It is used to perform tests on the environmental conditions in the cabin and on the aircraft as an integrated system. These tests involve evaluating the energy performance and functionality of the cockpit, passenger cabin, avionics and cargo bay.

For its part, the aviation industry has a vision that will have a decisive impact on future aircraft developments: all-electric. Among other things, this means using electric – rather than, say, hydraulic or mechanical – systems to control all functions. At the same time, the industry is keen to use lightweight materials when developing new aircraft in an attempt to reduce weight and with it, fuel consumption. In order to design, validate and ultimately demonstrate feasibility and the associated energy management in the aircraft, Fraunhofer IBP made yet another unique addition to its test labs. The Thermal Test Bench (TTB) enables the scientists and their industry partners to expand the scope of their research activities. The thermal test bench plays a key role in the simulation,
validation and testing of new systems from the point of view of thermal behavior. Here, too, a broad range of thermal measurements can be carried out on a genuine aircraft fuselage split into three typical sections – cockpit, cabin, and aft tail. The body of the airplane can be removed and replaced, for instance with a helicopter cabin. The test bench is equipped with the AirCraft Calorimeter (ACC), which allows it to simulate the most extreme conditions, including rapid decompression (a drastic drop in cabin pressure) and thermal shock (extremely quick shifts in temperature, which can be caused by damage to cabin structure during flight). The TTB offers enormous benefits: it helps reduce the number of test flights required, thus not only saving money, but also helping to protect the environment.

To be able to carry out validated thermal simulations in the aircraft when new technologies are still at an early stage, scientists at Fraunhofer IBP have developed the Fraunhofer Thermal Validation Tool Chain. This provides a time- and cost-saving way to simulate and validate thermal details and transient conditions. The main benefits of these scalable methods are a fast comparison and evaluation of various technologies and architectures in the aircraft as well as co-validation using a realistic test environment.

At the joint Fraunhofer booth in Hall 4, Fraunhofer IBP will provide detailed animations and presentations to show how the research facilities are set up and the range of tests they can perform.

**Eco-compatible design with ENDAMI**

In an increasingly global society, air travel is not just a question of luxury, but also rising competition within the aviation industry. All the more important, then, that “ecolonomy” – a combination of ecology and economy – should be a part of developing new technologies. Another facet of ecolonomy is the further development of LifeCycle Assessment (LCA) tool ENDAMI. Although LCAs are a common feature in most sectors, the aviation industry has some catching up to do here. LCA is the term experts use to refer to the systematic, environmental impact assessment of a given product. This analysis comprises the total environmental impact a product will have over its entire life cycle; from its manufacture and use, to what it takes to recycle or dispose of it. Collecting the required data relies on powerful software programs. These are very complicated and at the moment are used mostly by external experts with special training in conducting life-cycle assessments.

In order to give planners and designers simpler and, most importantly, timely access to their airplanes’ Life Cycle Assessments, Fraunhofer IBP developed the ENDAMI eco DESIGN® tool together with its project partners. This was done as part of the European Clean Sky Joint Technology Initiative. Since then, the Fraunhofer IBP scientists have systematically expanded ENDAMI, simplifying its operability so that, while still in the design phase, aircraft manufacturers now have a simple way of working through any number of airplane design variations while never losing sight of the environmental impact of their designs. Work on all technology and demonstrator platforms is continuing as part of the ongoing Clean Sky 2 research initiative. Here the focus is on analyzing and evaluating key technologies and lightweight materials, and on integrating them into the total aircraft system with an eye toward sustainability.
The Thermal Test Bench with its AirCraft Calorimeter is allowing scientists at Fraunhofer IBP to tap new research possibilities for the aviation industry.

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Building physics is one of the keys to a successful building project. The Fraunhofer Institute for Building Physics IBP focuses its work on research, development, testing, demonstration and consulting in the various fields of building physics. These include noise control and sound insulation in buildings, the optimization of auditoria acoustics and solutions for improving energy efficiency and optimizing lighting technology. Fraunhofer IBP’s work also covers issues of climate control and the indoor environment, hygiene and health protection, building material emissions, weatherproofing and protection against heat and moisture, preservation of building structures and the conservation of historic monuments.

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