FRAUNHOFER INSTITUTE FOR BUILDING PHYSICS IBP

PRESS RELEASE

Paris Air Show 2017: Test facilities and new simulation models for sustainable aviation

Air travel is still booming, and new developments remain focused on reducing its environmental impact. However, it has become apparent that the enormous gains in engine efficiency over the past few years won't continue at the same pace. Researchers are therefore increasingly turning to disruptive approaches to help mitigate the environmental impact of increasing air traffic. These include new aircraft architectures such as the blended wing body (flying wing) and more electric aircraft (MEA) concepts. Both developments require tools to quickly evaluate cabin conditions and thermal management of high-performance electronics. To meet this need, the Fraunhofer Institute for Building Physics IBP has developed its Indoor Environment Simulation Suite (IESS). The institute's scientists will be presenting their latest test and simulation models to the aviation industry at the International Paris Air Show, which will take place from 19 to 25 June 2017 at the Exhibition Center of Le Bourget (Hall 1, Booth H295).

The Fraunhofer IBP Flight Test Facility (FTF) in Valley near Holzkirchen, Germany, is the only test laboratory of its kind in the world. It houses a low-pressure chamber containing a segment originally from a A310 fuselage measuring some 15 meters in length and with space for up to 80 test subjects. The facility can be used to test both environmental conditions in the cabin, and the aircraft as an integrated system. Tests may include evaluations of the energetics and usage requirements of the cockpit, passenger cabin, avionics and cargo bay. Further innovative equipment and models developed at the FTF help the industry keep pace with the steadily growing requirements placed on aircraft.

To evaluate cabin environmental conditions and thermal management of high-performance electronics in aircraft, the scientists developed the Indoor Environment Simulation Suite (IESS). The suite's models produce meaningful results, which can be viewed in a matter of minutes on a standard notebook. This means that a wide range of tests on cabin environment and thermal management of devices can be evaluated very quickly. As part of the Clean Sky 2 program, the IESS is also being used to determine moisture distribution and air quality. The IESS is the only platform that can validate its results with realistic ground tests. Combining simulations and representative tests in Fraunhofer IBP flight test facilities has proved extremely reliable in several projects, enabling researchers to co-validate the systemic behavior of complete flight missions even while still in the design phase.

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Taking a zonal approach, environmental conditions such as temperature, air humidity, CO_2 concentration and transient boundary conditions can thus be simulated rapidly and inexpensively and then validated using the full-scale test units. This ensures that it is clear what physical elements are at work and that the measurements are then weighted appropriately. A major advantage of this approach is being able to reliably measure parameters indirectly that cannot be directly measured. In contrast to computational fluid dynamics (CFD), this means simulation results have a much greater practical relevance and are available much quicker.

"All electric" is a vision that continually drives the aviation industry and plays a decisive role in the development of new aircraft. Among other things, the concept envisages replacing all functions controlled by mechanical or hydraulic systems with electric systems. At the same time, the industry is investigating how to incorporate more lightweight materials into the design of new aircraft. The goal is to reduce weight and, as a result, fuel consumption. To demonstrate the feasibility of these innovations, and develop and validate the associated energy management in the aircraft, Fraunhofer IBP has supplemented its test laboratories with a further unique facility. The Thermal Test Bench (TTB) extends the thermal testing capabilities of the scientists and their industry partners. It plays an important role in simulating, validating and testing the effect of thermal factors on new systems. It employs an original aircraft fuselage subdivided into three typical aircraft sections (cockpit, cabin and rear), on which a wide range of thermal test can be carries out. The fuselage can be removed and replaced with other test objects, such as a helicopter cabin.

The test bench is equipped with an AirCraft Calorimeter (ACC), allowing it to simulate the most extreme conditions, including rapid decompression of the cabin and thermal shock (extremely rapid temperature changes, for instance if the cabin structure is damaged during flight). The TTB is extremely useful: it reduces the number of test flights needed during aircraft development, saving money as well as protecting the environment.

At the joint Fraunhofer booth in Hall 1, Fraunhofer IBP will be showing detailed animations and presentations covering the setup of its research facilities and testing capabilities.

The Thermal Test Bench with the associated AirCraft calorimeter offers Fraunhofer IBP scientists new research opportunities for the aviation industry. © Fraunhofer IBP

Tests using the DressMAN 2.0 help to evaluate cabin environmental conditions. © Fraunhofer IBP

Die Aufgaben des Fraunhofer-Instituts für Bauphysik IBP konzentrieren sich auf Forschung, Entwicklung, Prüfung, Demonstration und Beratung auf den Gebieten der Bauphysik. Dazu zählen z. B. der Schutz gegen Lärm und Schallschutzmaßnahmen in Gebäuden, die Optimierung der Akustik in Räumen, Maßnahmen zur Steigerung der Energieeffizienz und Optimierung der Lichttechnik, Fragen des Raumklimas, der Hygiene, des Gesundheitsschutzes und der Baustoffemissionen sowie die Aspekte des Wärme-, Feuchte- und Witterungsschutzes, der Bausubstanzerhaltung und der Denkmalpflege. Über eine ganzheitliche Bilanzierung werden Produkte, Prozesse und Dienstleistungen unter ökologischen, sozialen und technischen Gesichtspunkten analysiert, um damit die Nachhaltigkeit, die nachhaltige Optimierung und die Förderung von Innovationsprozessen zu bewerten. Die Forschungsfelder Umwelt, Hygiene und Sensorik sowie Mineralische Werkstoffe und Baustoffrecycling komplettieren das bauphysikalische Leistungsspektrum des Instituts.

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