



Test flights in a simulated passenger aircraft of the future

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The German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) has been performing flight tests to simulate and study the flight characteristics of large 'flying wing' configurations to prepare for future aircraft designs. These have been tested and evaluated using DLR's ATTAS (Advanced Technologies Testing Aircraft System) research aircraft.

For 25 years, ATTAS has been a flying 'chameleon' and is a piece of aviation history. At the same time, the test aircraft – with its special capabilities – is also paving the road for the aircraft of tomorrow.

Flying for science

Although the pilot is flying an aircraft resembling a small passenger plane, it feels like he is sitting in an aircraft with the fuselage and wings blended into a single entity. In addition to conventional mechanical flight controls, ATTAS is also equipped with an electrical flight control system. This allows the researchers to intervene in the flight control system using special hardware and software and give ATTAS the flight characteristics and performance of an entirely different aircraft.

"With its special control technology, ATTAS can behave like other aircraft while in the air," explains Dirk Leißling, a researcher at the DLR Institute of Flight Systems. "This gives us the opportunity to simulate aircraft that do not even exist yet, and to see where we still need to make improvements."

First, the aircraft simulation is created using a computer, where a mathematical model defines the dynamic behaviour of the new design. This is transferred to the flight control system of ATTAS. The pilot can then test and evaluate the performance of the new aircraft design first hand under real flight conditions.

Passenger aircraft of the future

ATTAS is capable of simulating not only 'standard' airplanes, but aircraft with an entirely different aerodynamic design as well. The 'flying wing' configuration is a very promising concept for future airplanes. Flying wings are aircraft resembling fish such as rays or skate. While ATTAS, like all previous passenger aircraft, consists of a cylindrical fuselage with wings and a tail unit, the configuration simulated in the flight tests has a somewhat triangular fuselage. At the tail, two vertical stabilisers that are tilted slightly outwards replace the conventional combination of a tail fin/rudder and a tailplane/elevator. There are four engines under the additional wing area. "The peculiar shape of the aircraft improves its lift characteristics, which in turn increases efficiency," explains Leißling regarding the advantages of the flying wing. It is no surprise that flying wings have a great chance of becoming the aircraft of the future and are currently the subject of many studies.

The flying wing model used in the DLR tests is based on a design developed as part of the EU project NACRE (New Aircraft Concepts Research). It is a wide-body aircraft designed for long-haul flights and able to accommodate up to 750 passengers. With a length of 65 metres, a height of 19 metres and a span of nearly 100 metres, the maximum take-off weight of the simulated flying wing is roughly 700 tons. Its four engines provide a maximum total thrust of 1425 kilonewtons.

Results: flight controller required for optimal controllability

During the test flights the scientists explored the flight characteristics by examining individual manoeuvres, such as deliberately varying the aircraft attitude. Using a simulated instrument landing system, the pilots tested landing approaches on a virtual runway. Each manoeuvre was followed by an evaluation of the flying wing's handling characteristics, which showed that the flying wing aircraft is difficult to control due to its unusual shape. Only the introduction of an additional control system developed at DLR brought about the desired results. This type of control system prevents the aircraft from responding adversely to pilot inputs by initiating appropriate counter-manoevres.

"The flight test confirmed our assumptions," said Leißling about the results. "There is a limit to handling a modern, completely uniquely-shaped aircraft without coordinated flight control laws. We can only achieve the flight characteristics we want by using appropriate computer and control technology."

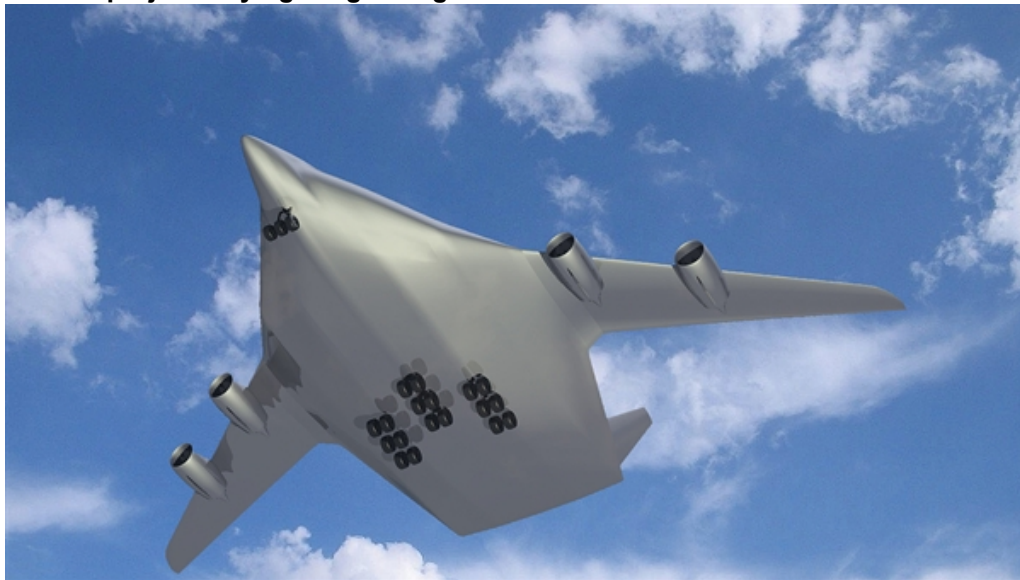
The preliminary results of theoretical investigations could only be confirmed in a 'tangible' way by carrying out simulations during a real flight test; even high-quality simulations on the ground are limited in this respect. Even after 25 years of service, ATTAS is still of great value to aviation research as a flying simulator.

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NACRE project – flying wing configuration



This is what the passenger plane of the future could look like – the flying wing configuration simulated by ATTAS as part of the NACRE project.

Credit: DLR/NACRE.

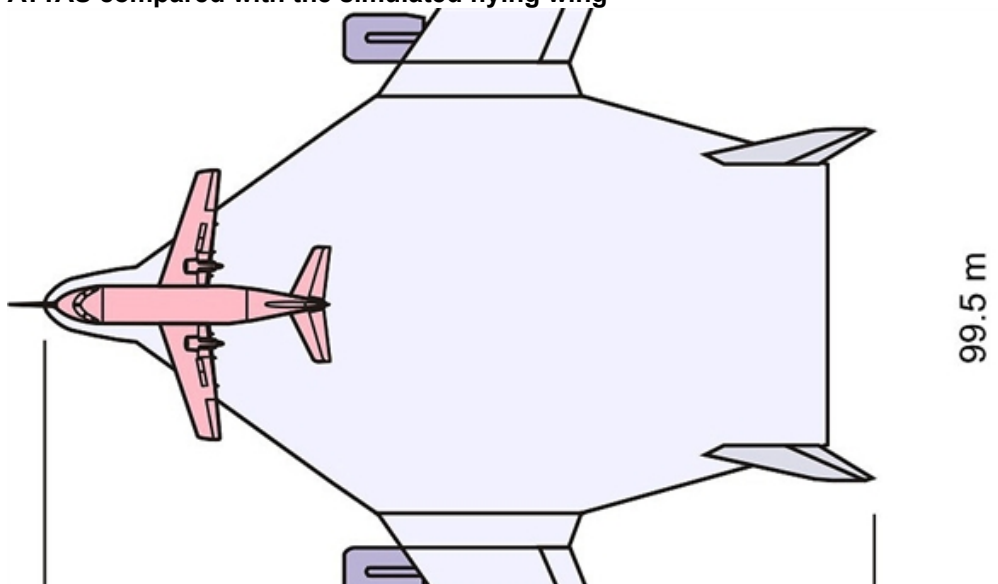
The DLR VFW 614/ATTAS research aircraft



ATTAS (Advanced Technologies Testing Aircraft System) is regarded as one of DLR's most important flying test beds. ATTAS has been in service as a flying simulator since 1986.

Credit: DLR (CC-BY 3.0).

ATTAS compared with the simulated flying wing



The diagram shows a size comparison between ATTAS (shown in light red) and the flying wing it can simulate.

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