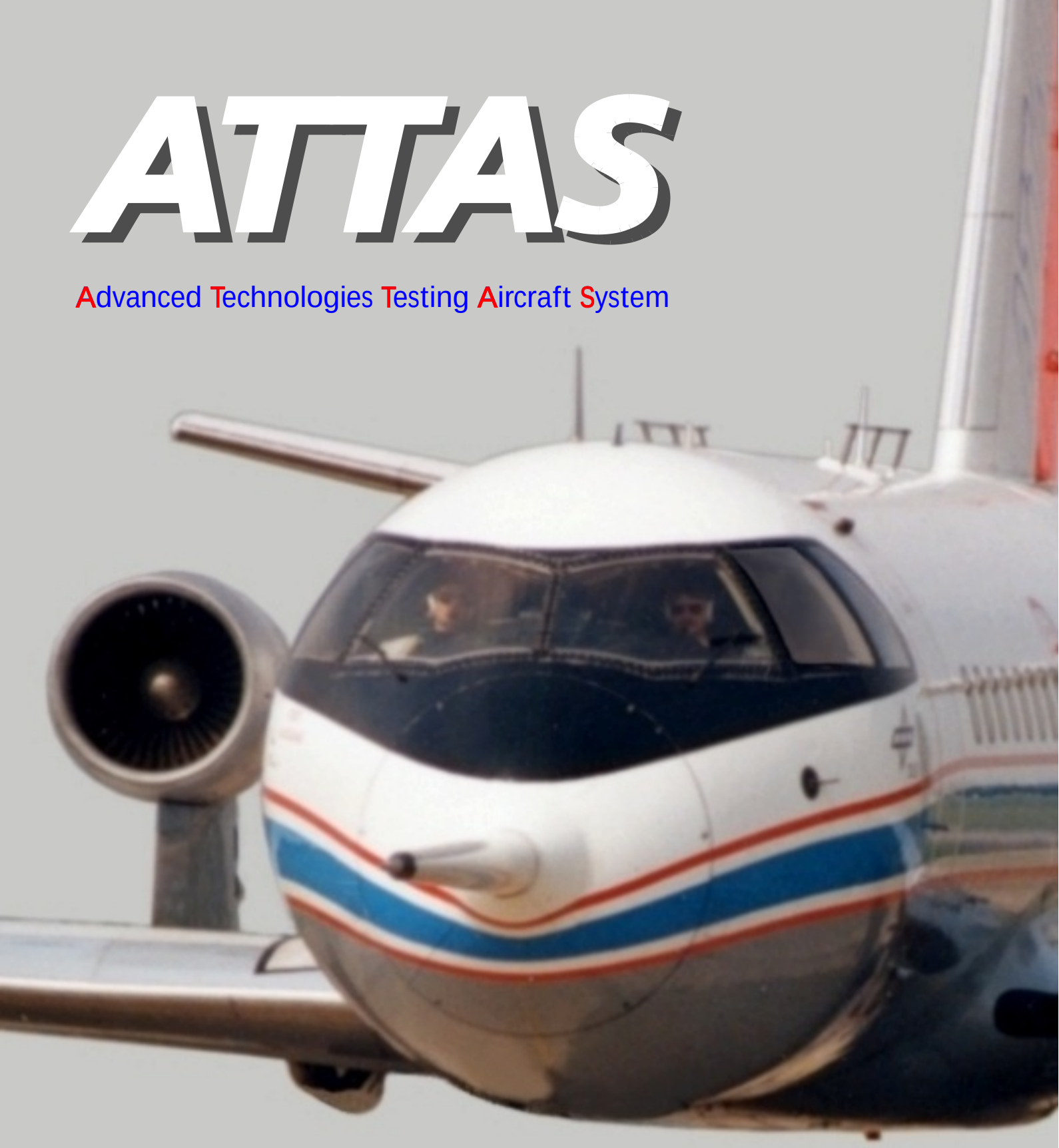
ATTAS

Advanced Technologies Testing Aircraft System



The Flying Testbed for Aeronautical Research

German
Aerospace Center
Braunschweig

DLR

Introduction

DLR, the aerospace research center and space agency with 4700 employees is the largest research organisation in Germany for space and aeronautics applied sciences. At eight locations basic research and experiment activities in the areas of aeronautics, space, ground traffic and environmental sciences are pursued.
The aeronautical research is mainly concentrated in Braunschweig comprising the Institutes of Flight Research, Guidance and Control, Design Aerodynamics, Structure and Materials and the Flight Operations Department.
At Braunschweig DLR operates the advanced flying simulator and technologies demonstrator aircraft ATTAS (Advanced Technologies Testing Aircraft System) as the primary testbed for a broad range of research activities such as flight control, flying qualities, guidance, navigation and man-machine interface.
ATTAS offers unique modifications and capabilities which make it a 'programmable' multipurpose testbed that can be configured to the specific needs of multiple applications.
DLR provides complete scientific and technical know-how in conducting complex scientific flight tests and system evaluation.
Real flight tests in an early stage of a comprehensive research and development process give realistic results to validate the design requirements and to minimize risks in product development

The Aircraft

The research aircraft ATTAS is based on a VFW 614 type aircraft - a short haul passenger jet developed in the early seventies by Vereinigte Flugtechnische Werke (VFW) at Bremen, Germany. The VFW614 turned out to be a very reliable aircraft with exceptionally good flying qualities. The cabin space and payload capabilities are ideally suited for experimental equipment installations and applications.
ATTAS, designed and developed by DLR and MBB from 1981 to 1986, proved as an efficient flying testbed in various research programs since 1986.

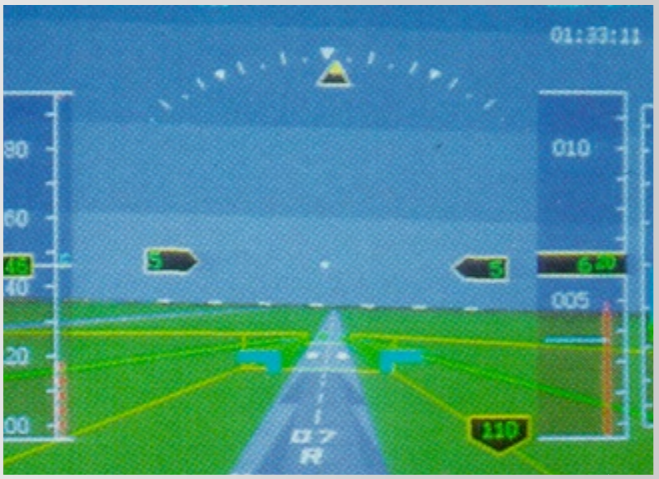
Technical Data

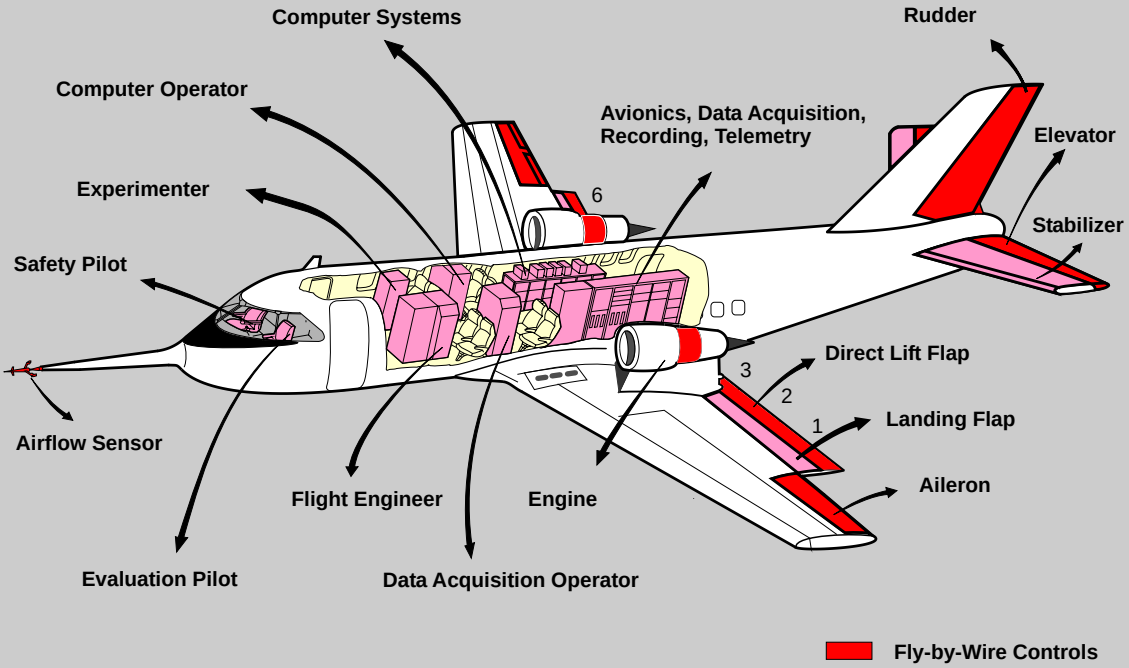
Span:	21,50 m
Length:	20,15 m
Seats:	2+7
Engines:	RR M45H MK 501, 2x 32292 N
Max. Weight	20.965 t

Objectives

Primarily, ATTAS was designed as a flying simulator and technologies demonstrator aircraft with a broad range of demonstration capabilities. To be as flexible as possible ATTAS got a fly-by-wire system in parallel to the mechanical flight control system. This system allows to alter flight control functions very easily by reprogramming the flight control computer. Additionally specific data interfaces allow to implement subsystem hardware on customer's request. Safety is provided by a right hand seated safety pilot who can recover the airplane by disconnecting the fly-by-wire system in any situation.
ATTAS is able to serve as a testbed in order to demonstrate functions and systems under real flight conditions. Flight tests were conducted in the following research areas:

- Digital Flight Control
- Control Law Design and Evaluation
- Flight Envelope Protection
- Automated Flight
- Flight Management
- Flying Qualities
- In-Flight Simulation
- 4-D Navigation
- Pilot Assistance Systems
- Enhanced/ Synthetic Vision
- Air Traffic Management & Control
- Navigation, Communication
- Man/Machine Interfacing
- Pilot/Aircraft Modelling Techniques
- Laminar Flow Experiments
- Engine Exhaust Jet measurements





Modification and Features

The main modifications and installations comprise of:

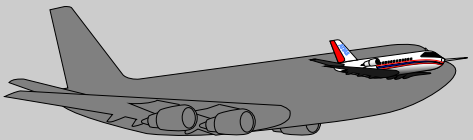
- freely programmable duplex-electro-optical fly-by-wire flight control system
- full fly-by-wire control of all control surfaces including both engines, landing flaps and stabilizer
- six direct lift control flaps
- left hand side evaluation pilot's cockpit for fly-by-wire control, two-axes sidestick or column/wheel and programmable displays
- on-board experimental computer system, model-following control system
- data acquisition, recording and telemetry systems
- free cabin space (5 m^2) for user equipment
- interfaces to link customer's subsystems
- devices for safe flight under experimental conditions
- Electrical power (3x 115V AC 400Hz and 28V DC) for the experimental equipment
- ATTAS can be operated in the fly-by-wire mode in nearly the whole aircraft's flight envelope including approach and landing

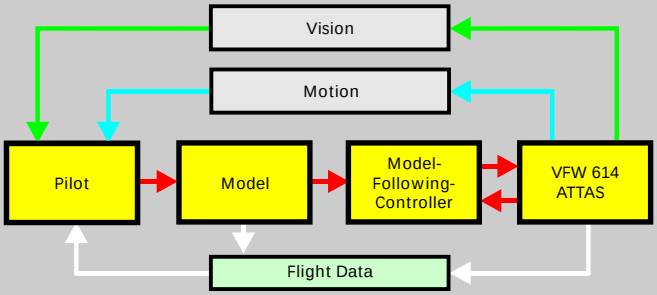
Experiment Computer

VME-bus based Power PC computer free for customer's purpose. Input/ output data interfaces allow easy software and user hardware implementation.

In-Flight Simulation

The IFS technique provides the capability to evaluate the flying qualities of specific aircraft characteristics in-flight under real environmental conditions with realistic visual and motion cues. In-flight simulation programs can simulate aircraft characteristics in a linear or non-linear mode. Complete aircraft six-degrees of freedom models with control system, engine characteristics and artificial gusts are simulated in real time. An advanced model-following control system which has access to all primary and secondary control surfaces drives ATTAS to follow exactly the programmed model response. Left hand side evaluation pilot's cockpit features a complete cockpit environment with sidestick or column/wheel configuration and programmable display formats.
Further, test pilots, flight engineers and students can experience the influence of stability and control parameters modifications directly in-flight.
This technique turned out as extremly valuable during flight control system development of new aircraft. It allows test pilots to fly a new airplane design long time before the first flight, and to minimize the development risk in an early development stage under the most realistic conditions possible.





Principle of In-Flight Simulation

User Interfacing

MATLAB/SIMULINK designed experiments can be directly implemented on the ATTAS Experimental Equipment Computer (EXEC) by using SIMULINK/Realtime Workshop autocoding function. Generalized interfacing to the ATTAS testbed is ensured by standard program procedures. The EXEC can also be used for self coded programs with LAN interfacing to other experimental equipment.

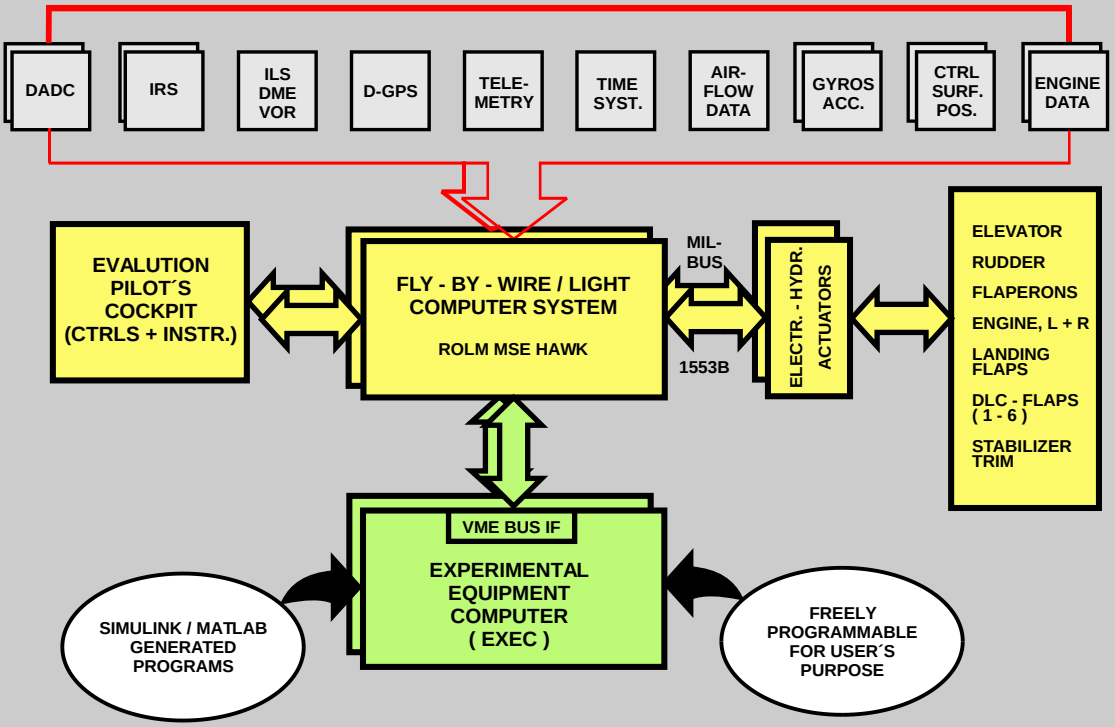
Further, hardware interfaces as ARINC 429 and DMA (VME-Bus) are available in order to connect customer's hardware systems.

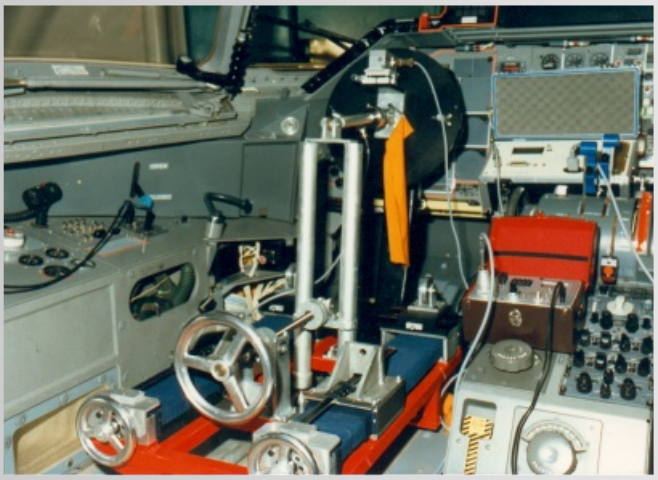
Experimental Rear Cockpit

Additionally, a rear cockpit can be installed in the cabin and plugged into the fly-by-wire system. This generic cockpit with large flat panel displays provides all the flexibility to modify the cockpit layout and to investigate modern cockpit systems in order to conduct man machine interfacing research.

Flight Management

Flight management functions for automated guidance and control are available in order to control the airplane in the longitudinal and vertical plane. Additionally, precise 4-D guidance can be performed. Up and down data links provides for an option to control the aircraft from a ground based control station.





Data Acquisition and Handling

All aircraft and experimental data such as avionics data from Inertial Reference Systems, Air Data Computers, D-GPS and NAV-Systems as well as all control surface positions, hinge moments, pilot's commands, airflow data, engine data, accelerations, body fixed rates and experimental data are recorded on-board on a disk in real time with 50 Hz. An on-board quicklook system based on a real time data base allows to monitor and evaluate the experiment during the flight test.
All measured data can be transfmitted via PCM-telemetry to the ground station where the data are recorded and displayed for flight test monitoring. Telemetry antenna with automatic tracking of the aircraft provides data receiving within a range of more than 200 km (depending on altitude).
Airflow (angle of attack, sideslip, dynamic pressure) is measured by a 5- hole probe mounted on a long noseboom providing undisturbed air flow measurements.
The data acquisition system is modular and flexible, new sensors can be implemented in short time. The operator has quick software access to gains and offsets as well as to built-in test and calibration facilities.
The high accuracy of the acquired data is ensured by regular calibrations performed with specific equipment either on-board or in the calibration lab. After flight all data are archived and can be provided in different standards for further data processing and analysis. Normally CDF standard is used.

Powerful data analysis programs developed at DLR, like XDIVA and ESTIMA, provide all required functions to evaluate data in the time and frequency domain.

ATTAS Simulator

All flight test programs are verified before flight in the ATTAS fixed base simulator which provides full representation of all ATTAS functions and systems (hardware-in-the-loop).The simulator comprises of a complete ATTAS cockpit, on-board computers, data interfaces, visual system and operator stations. Experimenter's software programs or hardware will be tested under the whole ATTAS environment in real time. Flight test procedures are trained and optimized with the test crew. This approach gives full potential in preparing flight tests and provides the basis for efficient flight test conduction.

Service & Infrastructure

ATTAS flight test operation is conducted by a joint team of personnel from the Institute of Flight Research, the Institute of Guidance and Control and the Flight Operation Department. The scientific experimenter is assisted in software implementation, simulation, ground and flight testing, data acquisition and data pre- and postprocessing.

The telemetry station provides flight test monitoring and data recording on the ground.

External electrical power is available in the hangar and on the apron for experiment installation, preparation and ground tests.

DLR is authorized by the German Aviation Certification Authority (LBA) to modify the aircraft and to integrate test equipment.

DLR provides all personnel and infrastructure for aircraft operation, maintenance and repair at the aircraft's home base Braunschweig.

DLR has direct access to the Braunschweig airport.

Address

Map

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