The Advanced Flight Simulation Complex at the Defence Research Agency

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SYNOPSIS The Advanced Flight Simulation Complex (AFS) at the Defence Research Agency Bedford, provides a representative, flexible, and high fidelity environment in which to investigate the dynamic interaction between the pilot and his aircraft. This paper describes both the hardware and software systems of this unique facility.

1.0 AFS FACILITIES OVERVIEW

From its inception the design philosophy for the AFS (Fig 1) has been to create a flexible research flight simulator capable of producing high fidelity simulations, which can be run by non-simulation experts with only a minimum of consultancy support. This ease of use is unique amongst research and development simulators and has been achieved by use of flexible hardware and software systems.

1.1 Cockpits

The AFS cockpits (Fig 2) are of modular design, with interchangeable instrument panels, side consoles and pilot inceptors (side sticks, collective, throttle etc.). This flexibility enables them to be readily reconfigured to meet the needs of a given trial. Two single-seat cockpits are currently available, the first based around a fast jet, and the second a helicopter.

1.2 Cockpit Visuals

Outside world visual cues may be provided either by a model-based visual system, or a three-window Computer Generated Image (CGI) system.

A Link Miles Image IV, full day/night, three-channel, three-window CGI system gives the pilot a 120° horizontal by 48° vertical field of view. To increase the flexibility for, say, air-to-air refuelling or helicopter recovery to ships, the three display monitors can be adjusted independently in elevation to put the centre of the screens at positions in the range +36° to -22.5°.

The model-based system consists of miniature landscape models at different scales mounted on flexible belts. A high resolution TV camera views the model through an optical probe and responds to the aircraft manoeuvres.

1.3 Motion Cueing

The AFS offers two motion platforms, including Europe's only large displacement motion system: the Large Motion System or LMS. The LMS (Fig 3) has five independent axes (roll, pitch, yaw heave and surge or sway), and is capable of generating large displacements, velocities, and accelerations, with excellent dynamic response (Table 1). Since all the axes are totally independent, axis performance limits can be simultaneously achieved giving a more consistent motion cue to the pilot than the six leg systems used for many training simulators.

1.4 Computing Systems

The AFS is supported by two computing systems, a non real-time DEC-Vax based network, used for model development, offline non-piloted simulations and data analysis, and a real-time system using Encore (Fig 4) computers for piloted simulations. A micro-Vax gateway node links the two networks. This node allows compilation to take place across both networks, thus easing software configuration control and enabling peripheral devices to be shared. A special feature of the AFS computing system is the application of a real-time relational database to assist the research scientist during the trial.

1.5 Using The AFS

The AFS is a complex interconnection of sub-systems and cueing devices. To ensure the user obtains maximum effectiveness from a trial, software has been extensively employed to make it simple and easy to use, whilst still retaining the required flexibility. The user controls and monitors trials from the primary control desk which can be customised to the user's own requirements through programmable touch screens and 'soft instruments'. A range of standard aircraft models are available wrtten in FORTRAN 77. These may be modified to meet specific trials requirements or users may provide their own models.

2.0 CONCLUDING REMARKS

The AFS offers a readily accessible research and development simulation complex which includes:

- a large displacement motion platform
- option of three-window CGI OR TV based visuals
- a range of reconfigurable modular cockpits
- expert consultant support

These facilities offer a high fidelity simulation capability in a user friendly environment for pilot-in-the-loop investigations.

Table 1

The Large Motion System Performance Limits

	MAX DISPLACEMENT	MAX VELOCITY	MAX ACCELERATIONS
Sway/surge	±4.0 m	2.5 m/s	5.0 m/s/s
Heave	±5.0 m	3.0 m/s	10.0 m/s/s
Roll	±0.5 rad	1.0 rad/s	3.0 rad/s/s
Pitch	±0.5 rad	0.5 rad/s	2.0 rad/s/s
Yaw	±0.5 rad	0.5 rad/s	1.5 rad/s/s

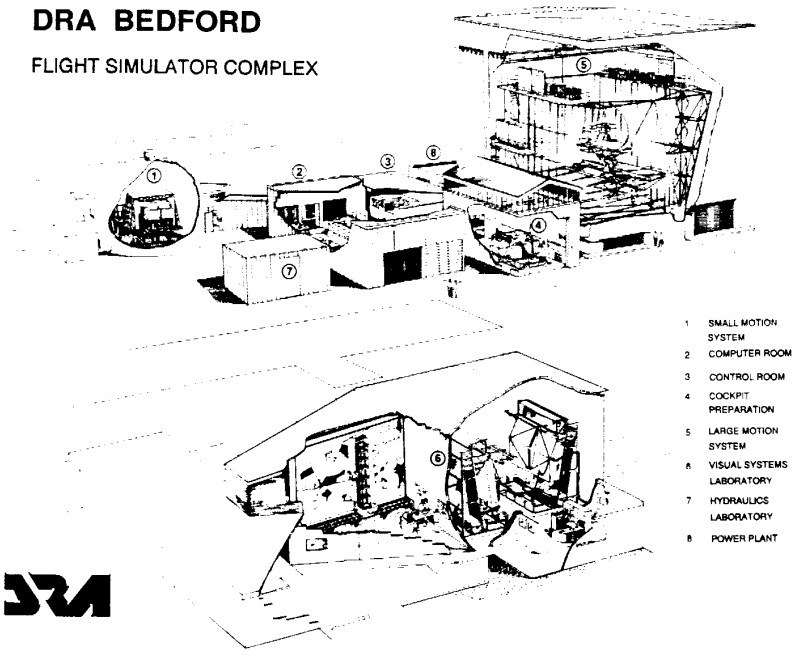
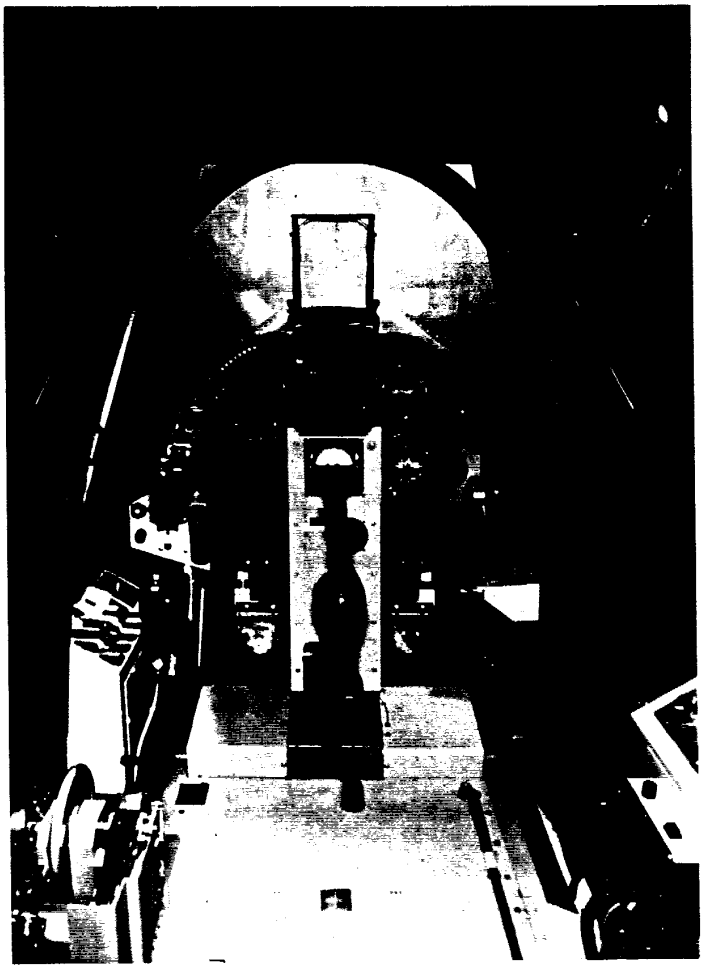


Fig 1 The advanced flight simulation complex



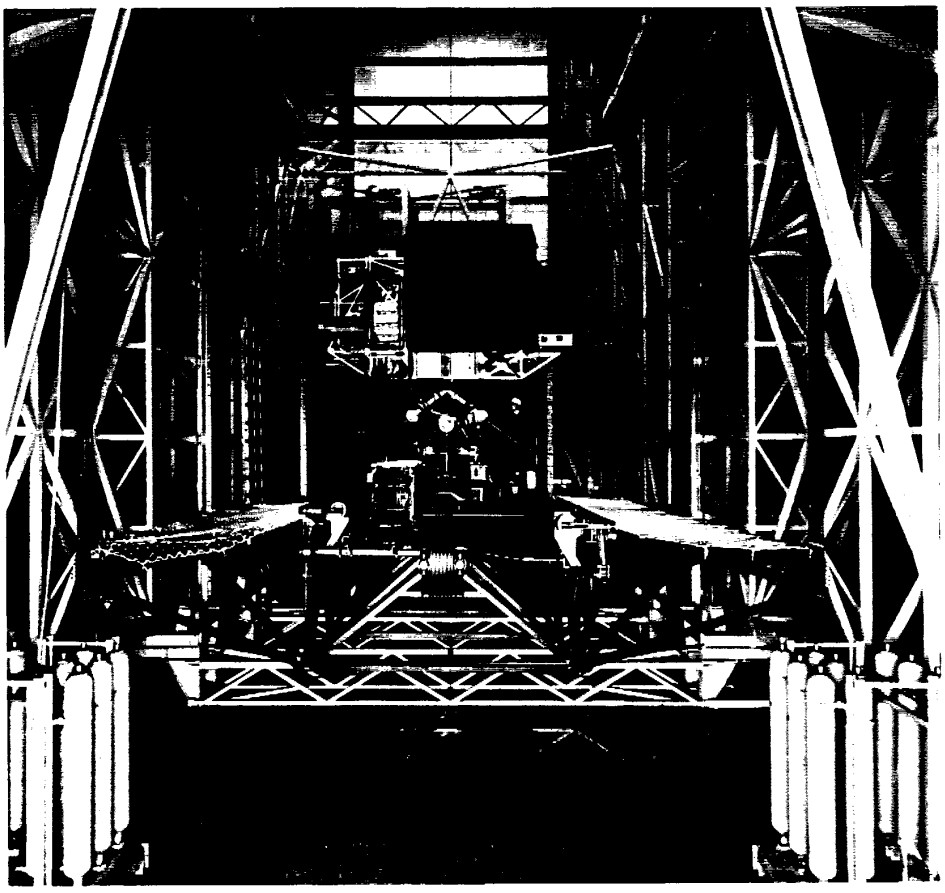


Fig 3 The large motion system