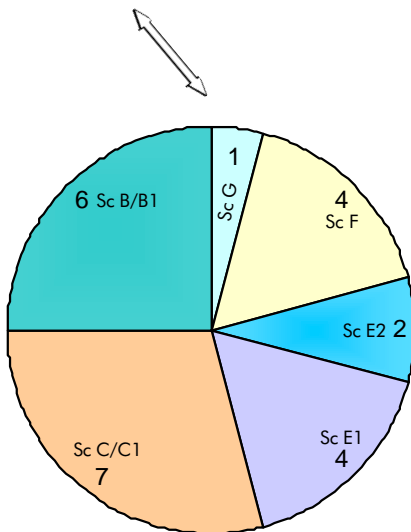
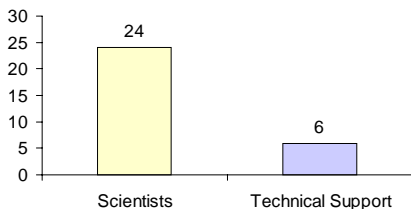


FLIGHT MECHANICS AND CONTROL DIVISION

SUMMARY

Dr J R Raol, Head



The Flight Mechanics and Control Division (FMCD) is engaged both in R&D, and in technology pursuits in the areas of modelling and parameter estimation, flight simulation and flight control.

MAJOR ACHIEVEMENTS AND CURRENT STATUS

With the successful maiden flight of LCA-TD1 conducted by NFTC, ADA in the first week of January 2001, the flight control laws (CLAW) designed

and developed by FMCD (and ADA, CAIR, HAL as other partners of the National Control Law team) for the fixed gain controller of the LCA finally got validated in the real-life environment. The engineer-in-the-loop-simulation (ELS) facility (designed and developed by FMCD) played a very significant role in the analysis and evaluation of these flight control laws before and after the first block of 12 flights. The flight data of LCA-TD1 have been successfully analyzed to estimate the stability and

LCA Flight Control Laws Validated

The maiden flight of LCA TD-1 took place on 4 January 2001 and the aircraft has successfully completed the first block of twelve test flights with fixed gain control laws (designed and developed by the National Control Law team—CLAW—comprising of FMCD, CAIR, ADA and HAL— the FMCD being the work centre). The fixed gain control laws rely only on the quad redundant inertial sensor information and are the ultimate reversionary mode for the normal full up air-data based schedule gain controller. There are two sets of fixed gains which get automatically selected based on the under carriage status and were designed to cater for failures in the air-data system.

The first block of twelve flights was carried out basically to calibrate the air-data system and identify the aerodynamic stability and control characteristics of the airframe. The performance of the control laws was found to be very satisfactory and the pilots rated the aircraft as having level 1 handling qualities in all the tasks performed during these flights. The good match in the responses between flight and simulation has given the designers adequate confidence to expand the flight envelope in the subsequent flight tests. These tests will be carried out shortly using the schedule gain version of the control laws that utilize information from the air-data probes and angle of attack vanes in addition to the information from inertial sensors.

Shyam Chetty, Project Director, CLAW

control derivatives of the open-loop aircraft using the state-of-the-art parameter estimation algorithm.

The focus of the Division's activities continues to be the development of control laws for LCA and the SARAS autopilot. The functional requirements document of scheduled gain CLAW for the second block of flights of the TD2 aircraft has been released to ADE. The integration of slat failure data to the simulation software (ELS/CLASS) has been carried out and validated. A SARAS simulator is operational on the Indigo2 workstation. This setup is being used for autopilot control law testing. Design and development of the stall warning system and autopilot for SARAS are in progress. User-friendly software package for the analytical evaluation of aircraft handling

qualities (HQ) and pilot induced oscillations (PIO) for helicopters is in an advanced stage of development.

The tracking and multi-sensor data fusion algorithms and strategies developed by FMCD have been tested in the playback and evaluation modes at the Interim Test Range (ITR, DRDO) during their recent flight tests of a surface-to-surface missile.

NEW INITIATIVES

Some initial work on application of system identification to rotorcraft has been completed. Development of novel aircraft identification algorithms based on system theory concepts, such as neural networks and genetic algorithms, has been initiated. The R&D work for the on-line flight path

reconstruction and parameter estimation has started. Also, work on the development of the frequency-domain system parameter estimation method has started. The work on the development of algorithms and strategies for multi-sensor multi-target applications has also started.

Studies in the areas of aircraft pilot interactions (API), agility and supermanoeuvrability are under progress. Development of rotorcraft handling qualities assessment software has started.

Development of a low cost flight simulator for educational purposes has been initiated. The work on air traffic management and simulation has begun. Development of a database for visual simulation is under progress.