A LITTLE FLIGHT TEST LABORATORY

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1. Abstract

For many years, at our Department, an activity of ground and flight tests has been in progress. The purpose has been to reproduce, on a smaller scale for teaching aim, all the problems connected with the preparation, the execution and subsequent elaboration of data about flight tests.

At first we carried on a cycle of ground and flight tests to investigate the state of loads in "tube and fabric" cables and wings [1], and some tests were made on propellers and the noise correlated by the same.

Now, we are assembling digital equipment for hazardous flight tests with unmanned planes, with on board data acquisition system, a video/data link to the ground, and a modified proportional radio control to remotely pilot the plane.

This work is intended to describe actual ultralight equipment and the works now in progress.

2. Introduction

It is not possible to teach without a practical verification of qualitative theories presented during university courses. A few years ago, our Department started undertaking the gradual fitting of a Flight Test Center directly connected with a grass airfield and the regarding hangar, to bring the normal operation of adjustment and calibration of the equipment and transducers on board airplanes.

Another reason to have at our disposal a plane fitted with instruments for flight test is to assist the students with all the procedures related with flying maneuvers, and then to allow them to experiment by themselves with the difficulties encountered by the test pilot during the execution of flying tests.

3. Work groups

A first group of students is now finishing the on board devices and the ground devices to remotely control the plane. At the same time a second group of students is continuing the assembly of a new ultralight with a geometrical aspect derived from a prototype, but with some better designed aerodynamic characteristics.

Furthermore, a third group is building an amphibious version of an ultralight. These two last groups will also have the opportunity to attend the scheduling and the execution of the preflight and first flight tests (Figure 1 shows some students around the ultralight).

4. Available equipment

A Flight Test Center disposed of an airborne instrument for the digital recording of thirty two analog channels. Ten of them can be transmitted to the ground station by means of a video link at 3 Ghz. together with the image coming from a video camera. On board, one can mount both the usual transducers for air data to keep flight parameters,

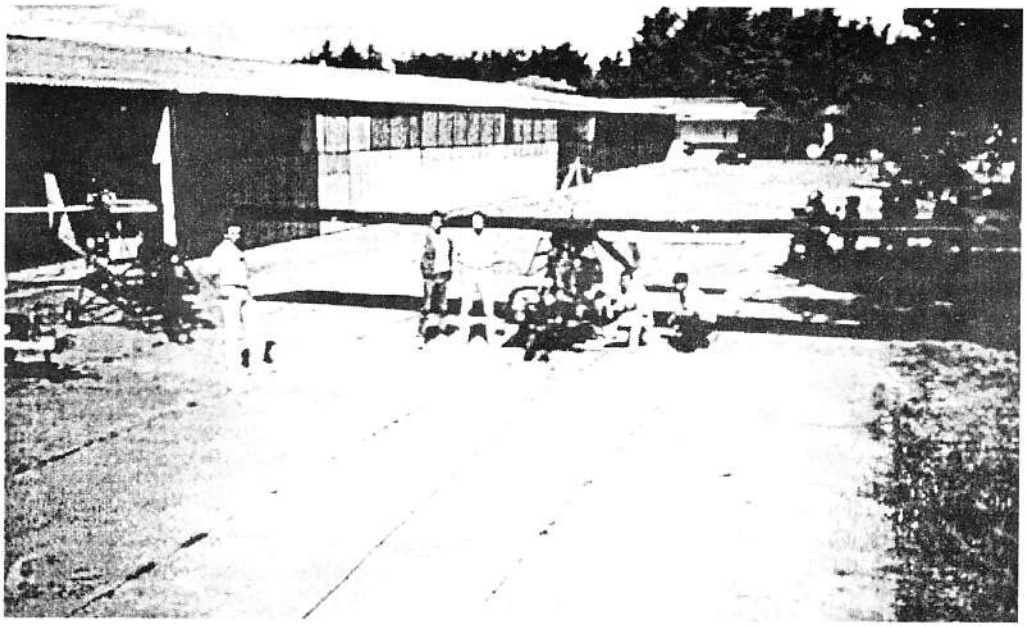

FIGURE 1. Ultralight Flying Laboratory.

both a little inertial platform, both some force and position transducers to measure the stick stress and the correlated deflections of the control surfaces.

We can also mount equipment to a proportional drive, in a close loop, for the four main controls of the plane, pitch - roll - yaw and throttle, and other on-off controls for further flight functions. All this can be mounted in place of the pilot seat with a straight connection to the normal flight controls with no important change to the airplane.

In the laboratory is available the receiving station of the video link for decoding the flight data transmitted from the plane. All the information is visualized on two video monitors, the first one for the image of the external landscape as seen by the pilot, the .second one to represent the flight instruments normally mounted on a cockpit. A full cockpit with rudder bars and cloche is nearing completion for the ground station, as we found from the first tests that it is impossible to control the plane only with the little joystick of the radio equipment.

In another part of the laboratory a modular rig is present to accomplish static tests on wings and little structures by means of hydraulic jacks to apply force and a computer for data acquisition.

5. Test cycles

With this equipment we made some flight tests. The first one gave the loads on the bracing cables of the wing on "tubes and fabric" ultralights during several flight conditions. So we can fix the necessary test conditions to validate in the ground laboratory and the design solutions carried to made such thin structures.

In another program, we acquired the noise prints produced by several types of ultralights and light planes during the take-off and flying over to establish adequate procedures to minimize the noise troubles near inhabited areas [2].

In a further program, trimming and stability tests were made to develop a standard procedure to make such tests on light planes, with small CG excursions [3].

6. Conclusions

The ambitious efforts of our work was to restore a little didactic flight laboratory like those enjoyed by the big aeronautical firms. Obviously the disposable means are remarkably inferior, but these are counter-balanced by the enthusiasm profused by the students, who the first time approach personally the problems related with the flight.

The way we have to do this is still long and hard. It will be some time before we can say we have, in Italy, an outstanding university Flight Test Center. This is certainly one of the last attempts to maintain the pleasure of making and getting new planes to fly.

7. Bibliography

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