AVIONICS NEWS

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She hovers hands~off!

John Morton, Test Pilot (left) and Peter Wilson-Chalon, Flight Test Engineer (right) flying the Naval Lynx XX510 with "hands off"
Photo: Courtesy Westland Aircraft Ltd

Growing confidence in an outstanding helicopter

As flight development of the Anglo-French Lynx helicopter progresses, and its outstanding qualities are demonstrated, confidence in the aircraft continues to grow.

In addition to quietly showing, during the lengthy programme of tests in Britain and France, that it meets and often exceeds the requirements of its advanced specification, Lynx has dramatically demonstrated its prowess by capturing world-class speed records and, by its startling aerobatics, has thrilled thousands at air displays. It is almost no surprise, therefore, to discover a Lynx hovering close to the ground while the crew leave the entire control problem to the avionics. It would be difficult to demonstrate confidence in the aircraft more clearly.

The aircraft used for the hands-off demonstration, at Westland's Yeovil airfield, has been used for the development of some of the more complex autopilot modes (radio height hold and automatic transition to the hover) for the naval version and for the evaluation of the effects of various weapon fits and asymmetric loads on autostabiliser performance.

Westland and Aerospatiale have recently placed orders with Marconi-Elliott Avionic Systems Limited for 160 aircraft sets of automatic flight control equipment for the utility variant of Lynx, to be used by the Army and the Royal Air Force, and for the Royal Navy and French Aeronavale variants.

Westland report that production orders for 300—350 are expected during the next five years and that the export prospects for Lynx are excellent.

See page 2 for further details of Lynx and its AFCS.

Shackleton AEW radar up~date

New moving target indicator uses digital cancellation techniques

Aircraft flying low over the sea, to avoid detection by surface surveillance radars, will be detected more easily by the RAF's Shackleton AEW aircraft as a result of the installation of a new Airborne Moving Target Indicator (AMTI). The decision to fit this equipment to Shackleton's AN/APS20 radar emphasises the importance which the Ministry of Defence attaches to airborne early warning.

Since its introduction into service nearly 20 years ago the AN/APS20 radar has been progressively improved by a series of modifications introduced by Marconi-Elliott Avionic Systems Limited, the UK's specialist AEW contractor. Performance of the radar has been improved by the introduction of a number of additional units including a parametric amplifier to increase range by 25%, a video accumulator to enhance interference rejection capability and a selective identification facility. Reliability of the radar has also been considerably improved and this, together with the improved performance, has suited the radar to the long patrol duration and frequent operations required in the AEW role.

Now the latest improvement to AN/APS20, the addition of AMTI, will considerably reduce the masking effect of sea-clutter which limits the ability of the radar to detect a low-flying aircraft. This improvement is achieved by using digital cancellation techniques, based on the doppler principle, to process the signals so that the sea-clutter returns, with their small frequency shift, are eliminated while echoes from fast-moving targets stand out on the display.

The order from the Ministry of Defence for the supply of AMTI units for the Shackleton AEW aircraft is an important outcome of the company's work in the field of air defence. Its studies and equipment programmes, directed towards a new generation AEW system to meet the needs of the 1980's and 1990's, have included the production of a prototype FMICW radar in 1970.

Fitters using a special cradle about to remove a Shackleton Radome. (Photo: Courtesy RAF News.)

T.I.H. Prince and Princess Takamatsu at the Marconi-Elliott Avionics stand at the Japan Air Show with Mr D Moore-Searson, Sales Manager, Airborne Display Division.

Britain's aerospace industry on display

400,000 visitors on one day at Japanese show

Britain's capabilities in aerospace have been well demonstrated, in recent months, at several international exhibitions. At the 4th Japanese international air show in early October, Britain's flag was shown in the air by NIMROD, with flying displays and special demonstration flights for Japanese military personnel, and on the ground where Britain was the only country, apart from Japan, to have its own individual hangar. Over 400,000 people attended the show on 10 October, a public holiday.

Mr Heseltine, Minister of Aerospace and Shipping, in the Marconi-Elliott Avionics stand at São Paulo with Mr G U Rands, Sales Manager, Inertial Navigation Division.

The first international air show, held at São Paulo in mid-September, was an expression of Brazil's aspiration to become a figure in the international aerospace industry. She has high hopes for her indigenous aircraft, the Bandeirante turbo-prop transport, Xavante jet trainer and Ipanema agricultural aircraft. Most widely publicised British exhibit was G-VTOL, the joint venture demonstration HARRIER, built from components donated by HSA's Harrier suppliers. G-VTOL took in São Paulo as part of a sales tour of South America, during which 47 sorties were flown.

The Westland/Aerospatiale Lynx

A new advanced technology helicopter

The Westland/Aerospatiale Lynx has been designed to meet modern military and naval demands for multi-role helicopters. It was designed, therefore, with role versatility, ease of handling and ease of maintenance as the prime important factors. It has resulted from the joint Anglo-French programme for helicopter development initiated in 1967.

Based on a Westland design, Lynx is currently scheduled for service with all three British Services and with the French Navy. A civil version is also planned. A contract has been placed by the UK Ministry of Defence, Procurement Executive on behalf of both governments, for over 100 helicopters.

That the design of Lynx embodies much technical advance is clearly illustrated by the following features –

Semi-rigid rotor head
Flexible titanium elements replace two of the three traditional hinges.

Conformal gearing
High power transfer by small, light gears made possible by conformal gear teeth.

Main rotor blade
Stainless steel leading edge and glass fibre trailing edge minimises erosion and corrosion.

Plastics in construction
Extensive use of glass fibre eliminates corrosion, reduces production cost and gives more robust structure.

Hydraulic manifold
Modular system eases fitting of replacements in maintenance.

Power plant
Two 900shp Rolls-Royce "Gem" free turbines to meet Lynx high performance characteristics.

Automatic flight control system
Duplex redundant automatic stabilisers in roll, pitch, yaw and collective axes. The accurate control and failure survivability allows safe extension of the high speed flight envelope. A wide range of automatic operational modes is available to match the multi-role capability. This range includes holds for heading, baro-altitude, radio altitude and airspeed; radio altitude acquire; automatic transition from cruise to hover at a pre-selected altitude down to 30 feet and sonar buoy control.

Agility. In the air the pilot discovers that the response of the Lynx to control demands is exceptional with roll rates in excess of 100° per second, and a roll time constant of 0.11 second.

Ability to change direction, pull 'g' and hug the nap of the earth is outstanding. Can even be flown backwards at up to 70 knots.

Photo: Courtesy Westland Aircraft Ltd.

Navaid checks by TV

Video tape replaces photographic film

The BFS (Bundesanstalt für Flugsicherung), the West German flight safety authority, will use an airborne closed-circuit television equipment for calibrating navigational aids and instrument landing systems. This equipment will be supplied by Marconi-Elliott Avionics to Hawker Siddeley Aviation Limited for five HS748 aircraft they are supplying to BFS.

The television system is used to pick out identifiable objects, of accurately known position on the ground, to provide a reference for the position fixing system against which the various types of navaids are calibrated. Initially two cameras will be installed, one pointing slightly forward and the other pointing vertically downwards. The former gives advance warning of the appearance of identifiable targets which are then located accurately on the picture produced by the second. A video tape recorder is provided.

Compared with similar systems using photographic cameras, the TV system gives a better performance in low visibility conditions and does not, of course, require expensive photographic materials and processing. The results are immediate and can be used in conjunction with a navigation computer to apply corrections in real time.

RAF to evaluate HERMES

Helicopter safe payload computed from actual engine performance

At present helicopter pilots calculate their maximum payload from ambient temperature and pressure and from an estimate of the performance of the aircraft's engine and transmission system. These calculations, which have to take into account conditions at the destination, can be a burden to pilots, and hence be liable to error, especially under demanding operational conditions.

A new system which automatically computes safe payload under all operational conditions has been delivered to the Royal Aircraft Establishment for flight testing in a Sea King helicopter. Known as HERMES (Helicopter Energy and Rotor Management System), the system is unique in that it allows for the *actual* performance of the engines and transmission which the pilot can calibrate accurately. Safe payload can be then assessed without arithmetic in the cockpit. The calibrated performance can also be used to predict when engine maintenance is due.

To operate the system the pilot enters the helicopter weight on a cockpit-mounted Payload Margin Indicator on which he can then read the safe additional weight that can be carried. The Hermes system senses ambient conditions to update the safe payload reading automatically. Should a negative payload reading be shown, the helicopter is overweight. A "predict" mode indicates whether safe landing can be achieved under conditions prevailing at destination.

Hermes components:
Payload margin indicator (left)
Torque Indicator (centre)
Computer (right)

Divisional Profile. 3

Inertial Navigation Division
Europe's airborne inertial navigation pioneers

In 1951, early in the history of inertial navigation itself, Elliott Brothers (London) Limited was engaged in a programme for the design and manufacture of a prototype inertial navigator and so laid the foundations of the Inertial Navigation Division.

The first Elliott inertial platform to fly was the Master Reference Gyro B (MRGB) intended for use as a high accuracy heading reference for the 'V' Bomber navigation systems. To meet the requirements of the Blue Steel stand-off weapon for the V-force, the MRGB programme was redirected. Elliott were called upon to design, develop and manufacture a complete inertial navigation system for the weapon as well as much of the computing and interface equipment for the aircraft's doppler-inertial system. This was to give the V-bomber a very accurate navigational capability to take it to the point of weapon launch.

The Inertial Navigation Division was formally established in 1958 to take over the responsibility for the Blue Steel work and has been dedicated, since then, to what must be one of the most demanding fields of avionics, calling for a unique blend of electronics and precision electro-mechanical engineering. These requirements have shaped the character of the division during its evolution from the Blue Steel days to its present form, employing some 900 people embracing many scientific disciplines, technologies and production techniques.

Today the major pre-occupation of the division is the navigation and weapon-aiming sub-system (NAVWASS) for the RAF Jaguars. This digitally controlled system is the most advanced system, now in service, to have been produced in Europe. At its heart is the E3R case-rotated inertial platform which the division has developed from the well-established E3 platform it supplies for the navigation and attack system of the NIMROD maritime reconnaissance aircraft. Both platforms had their origins in projects started by the division on a private venture basis and the E3 has also been used in numerous other applications in ships, land vehicles and aircraft.

Inertial Navigation Division has worked in close association with Airborne Computing Division on the development of both the Jaguar and Nimrod systems which today are the only digital computer-based navigation/attack systems in production in Europe. Both employ specially developed Elliott computers. In recent years the division has extended its sphere of activity by undertaking the development of a new miniature inertial quality platform and gyro compass for the Royal Navy. Designated the Naval Compass Stabilizer Mk I (NCSI) it incorporates a case-rotated gyro-accelerometer package and a digital navigation computer. The Royal Navy has already placed a substantial production order for NCSI and there has been strong interest from overseas.

As part of the division's total approach to inertial navigation systems it has developed projected map displays. This capability has led to an extension of the division's activity in yet another direction, this time in the general aviation field, with a simple map display called Radiomap. This instrument, which derives its positional data from commonly employed radio navaids such as VOR, displays a map which is automatically moved to show the aircraft position at the centre of the display. It promises to be a powerful new aid which will be admirably suited to the general aviation field because of its low cost.

Group Captain John (Paddy) Finch, CBE, DFC, AFC, RAF (Retd.), MBIM joined the company in 1967 after a successful career in the Royal Air Force in which he became a very experienced and active pilot in the fields of operational flying, flying instruction and test flying. For four years he was Wing Commander Flying and Chief Test Pilot of the Royal Aircraft Establishment at Farnborough and for 2½ years he was Commanding Officer of an RAF 'V' bomber station during which time he was involved in the flight testing of the inertial navigation systems developed by the company.

At first Mr Finch worked with Airborne Display Division but in 1969 he moved to the Inertial Navigation Division as Assistant to the Divisional Manager. He became Divisional Manager in January 1971 during the build-up of the Jaguar NAVWASS production programme and the development programme for the Naval Compass Stabiliser.

A typical COMPACT automatic test equipment.

The picture shows the operator's control and display panel (right) with hinged door open to show the disc store and computer. A Concorde AFCS computer is shown plugged in to its special adaptor which, in turn, is connected to the standard interface panel. The panels above it contain the Function Generator and Sampling Voltmeter.

COMPACT for the big job

This computer-controlled ATE is cheaper, smaller and easier to use

Repair turn-round times have to be cut to the absolute minimum so as to keep today's expensive aircraft flying. The principal bottleneck is the testing needed for fault detection and diagnosis, and for validation of the unit after repair, which may require literally thousands of tests. Since skilled test technicians are at a premium it has been necessary to invest heavily in spare equipments to ensure the availability of replacement units. Automatic test methods are the obvious answer but, although computer-controlled automatic test equipment (ATE) has been available for a decade, it has been large and complex, not very reliable and difficult to operate and maintain. To programme it, a fairly powerful off-line computer has had to be available. Such ATE has involved heavy capital investment and running costs so that the airline may have been no better off, financially, by using it. All this is changed by the introduction of the COMPACT family of new generation automatic test equipments.

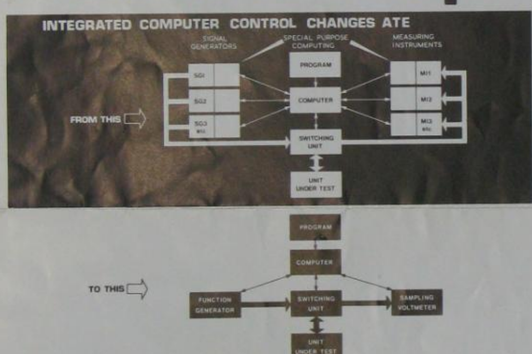
COMPACT ATE has resulted from three major innovations. The first involves the use of the ATE's built-in digital computer to cope with all the programming requirements that previously called for an off-line computer. The second is the use of a new high-level programming language, called IDEAL, which allows test technicians to do all the initial programming and editing in terms they understand. The third is the unique use of the computer for the generation of test signals, and the analysis of measured signals, whereby the multiplicity of specialist instruments in a conventional ATE is avoided.

The result is an ATE of half the size and half the cost yet having the necessary flexibility and range of capability to test all types of electronic and electro-mechanical equipments. Its test programmes can be simply updated when the inevitable modifications to test specification arise during the service life of the unit to be tested. It is easy to operate and is not only very reliable but should it fail, diagnosis and repair of its faults are simple and quick.

COMPACT has been designed for the world market, both military and civil, and its IDEAL language is compatible with ATLAS, the internationally agreed test language. It has been developed by the Automatic Test Equipment Division of Marconi-Elliott Avionic Systems Limited and eleven systems have been supplied for use within the GEC-Marconi Electronics group. It will be used to test systems being made for Concorde and Lynx and the Clansman vehicle radio equipment being made for the British Army.

Automatic Test Equipment Division has specialised in ATE since 1960. It sold its first computer-controlled ATE in 1968. Customers include the Royal Navy, the Royal Air Force, the Royal Swedish Air Force, the US Navy and the US Air Force.

Focus on technique



Function generation and measurement analysis for ATE

Automatic test equipments produced during the last decade have, in effect, constituted a mechanisation of a large collection of signal generators and measuring instruments. A digital computer has been used to sequence the connections of the test instruments to the unit under test and to set up the conditions for each step in the sequence of tests. Although this approach has enabled very powerful automatic test equipments, with diagnostic capability, to be produced they have of necessity been complex equipments with all the attendant difficulties that complexity brings.

The signal generator outputs are all voltages or currents whose magnitudes follow prescribed functions of time. In most cases these functions are quite simple to define. They are rectangular waves, saw tooth waves, sinusoids and so on. However, to generate them, the conventional signal generators incorporate quite complex analogue circuitry to which further special purpose circuitry must be added to meet the requirement for programmable operation in a computer-controlled ATE.

The measuring instruments sample the variable in the unit under test and analyse the meaning of the sample in terms of the commonly employed values such as RMS, mean, peak-to-peak and so on. To do this, the measuring instruments also incorporate analogue type circuitry which is specific to the measurement conditions and, again, to meet the needs of ATE some special circ... be included for programmable operation.

A unique approach has been adopted in the COMPACT range of ATE in which all the computing type operations involved in both signal generation and measurement are carried out in its digital computer. The test signal waveform is produced by generating a time series of numbers in the computer which represent the function which describes the test signal. The time series of numbers is converted, by digital to analogue converter, into an analogue representation, in terms of voltage or current, of the test signal. Using this technique, any numerically describable test signal can be produced, scaled and sequenced purely by software. One digital to analogue converter can be used in sequence, in association with the computer, to replace a multiplicity of conventional signal generators.

A similar approach is used for measurements. The variable to be measured is sampled periodically under the direction of the computer and the magnitude of each sample is converted to digital form by an analogue to digital converter. The resulting series of numbers is analysed by the computer to yield any desired value such as RMS, mean etc.

The basic configuration of an ATE based on this concept is simple compared with the conventional form and the amount of equipment used is very much reduced. This means that the ATE can be smaller and cheaper. It will also be more reliable by virtue of its simplicity. Effective self-test can be more easily achieved which will reduce the mean time to repair and

First airline order for COMPACT

British Airways select new generation ATE for Tristar and One-Eleven avionics

Two COMPACT computer-based automatic test equipments have been ordered by British Airways European Division. They will be used in the maintenance of the avionic systems of the British Airways' Tristar and BAC One-Eleven fleets. British Airways selected Marconi-Elliott Avionics to supply their ATE after thorough consideration of competitive equipments including those ordered in the USA for Tristar maintenance.

In a statement at a recent press conference, arranged by Marconi-Elliott Avionic Systems Limited to unveil the COMPACT range of ATE, Mr R Hatfield, Production Engineering Superintendent, Overhaul, British Airways European Division, said that British Airways were looking for flexibility to cope with changing requirements over many years ahead and he believed they had found it in COMPACT. The small size of COMPACT was a very important factor since every square foot of space at London Airport had to be effectively used. They anticipated that the cost of their COMPACT ATE's would be soon recovered by reduced investment in replacement units.

British avionics for British Airways Tristars

and new VHF communication system for fleet retrofit

As stated in the last issue of Avionics News, the AD380 automatic direction finder has been cleared for installation in Lockheed Tristar aircraft. Now British Airways European Division has ordered this ADF, for its fleet of six Tristars, from Marconi-Elliott Avionic Systems Limited. The airline has also ordered the company's AD170 VHF communications system for its Tristars and for retrofitting its Viscounts, Merchantmen and Trident 1 and 2 aircraft. The AD170 system is already fitted in British Airways Trident 3's.

Already ordered by British Airways Overseas Division for its Concordes, the AD380 was chosen by the European Division after a thorough appraisal of all available ADF's including those of US origin. The AD380 is the outcome of nearly 25 years work by the company in the ADF field during which time over 25,000 equipments have been sold. It conforms with the latest airline requirements and with ARINC 570. The frequency range from 190 to 1800kHz is covered in 0.5kHz steps. The AD380 is crystal-controlled and its special tuning system enables a transmitter bearing to be displayed at the instant the frequency is set up on the digital indicator. This simplicity and speed of operation is of particular importance in congested traffic conditions.

The AD170 VHF communications system is in full conformity with ARINC 566. It provides for a channel spacing of 25kHz which is half that of previous equipments. This spacing will allow ground controllers to communicate with potentially twice as many aircraft in a given piece of airspace. During the next few years airlines will be expected to adopt equipment which meets the requirements of ARINC 566 and British Airways are early in the field by doing so now.

US Army buys LASSIE 3

Measures helicopter speed and direction right down to hovering speeds

The United States Frankford Arsenal is to use a relative wind sensor, known as LASSIE 3 (Low Airspeed Sensing and Indicating Equipment) in the development of advanced systems for helicopters. The sensor will be tested on an AH-1G Huey Cobra.

The sensor, to be supplied by E-A Industrial Corporation, Atlanta, Georgia, measures helicopter speed and direction and angle of attack, right down to hovering conditions. It avoids the downwash effect, that makes conventional sensors unreliable, by using a two-axis swivelling probe which aligns itself with the airflow vector resulting from vehicle motion and downwash. The probe reading is resolved electronically into velocity components.

A series of LASSIE equipments has been developed. LASSIE 1 was evaluated by Edwards AFB and LASSIE 2, the first two-axis system, has been undergoing flight tests by the US Army in a Bell UH-1C helicopter with satisfactory results. LASSIE 3 will be developed by E-A Industrial Corporation from LASSIE 4, a full air data and rotor management system, developed in the UK by Marconi-Elliott Avionic Systems Limited.

HUEY COBRA AH-1G
The world's first Helicopter designed as an aerial weapon platform. (A Bell Aerospace picture.)

E-A Industrial Corporation grows in Atlanta

Dedication of new plant extensions

The vital role of the head-up display in contributing to the operational effectiveness of the A-7 Corsair was emphasised by Rear Admiral Philip Crosby, Commander of the US Aviation Supply Office, when he spoke at the Atlanta plant of E-A Industrial Corporation on the occasion of the dedication of its extended facilities. He was among fifty distinguished guests who heard Mr J D Hanron, President of E-AIC, speak of the growth of the corporation and of its work in the support, repair and module manufacture for Navy and Air Force A-7 head-up displays.

Mr Jack Welsh, Director of International Trade for the Georgian State Department of Community Development, officially dedicated the plant. He told of Atlanta's interest in becoming a truly international trading centre and how the growth of E-AIC is seen as an important development in this connection.

E-AIC is an associated company of Marconi-Elliott Avionic Systems Limited whose products it supports in the USA. Recently the US Navy placed an entirely new form of contract with E-AIC for direct support of aircraft carriers and naval air stations in respect of A-7E head-up displays. The extended facilities will be used for this work which is known as CLAMP (Closed Loop Aeronautical Maintenance Programme).

In addition to support and module production, E-AIC is engaged in development work, of which a recent example is reported in this issue of Avionics News.

Distinguished guests at E-AIC dedication ceremony. At left Mr J D Hanron, President E-AIC with (L to R) Mr Alan Barlow, Deputy Commander, Aviation Supply Office, Philadelphia; Rear Admiral Philip Crosby, Commander, Aviation Supply Office, Philadelphia; Mr John D Welsh, Director International Trade, Georgia State Department; Mr G N Gadsby, Minister Defence Research and Development, British Embassy; Mr J E Pateman, Managing Director, Marconi-Elliott Avionic Systems Limited.

CO_2 Laser development

Anemometry applications envisaged

A CO_2 laser, with a very high frequency stability, is to be developed by Marconi-Elliott Avionic Systems Limited. The laser, ordered by the Ministry of Defence Procurement Executive, will produce 10 watts of radiation at 10 microns wavelength.

Possible applications include its use in a method of anemometry in which air velocity is determined by the doppler shift of radiation reflected from particles entrained in the air stream. The frequency of the new laser will be stable to 1 part in 10^8 which will allow accurate measurements of low air speeds to be made by this method. An anemometer based on this technique could be used, for example, to investigate the turbulence in landing areas due to the effects of buildings and the passage of aircraft. Such information is of value in the study of the performance of aircraft landing systems.

The Directorate of Components, Valves and Devices (DCVD) is responsible in the Ministry for the development of the laser.

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