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SELECTED BIBLIOGRAPHY
OF
AIR TRAFFIC CONTROL
WITHIN THE FIELD ARMY

25 February 1965

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ABSTRACT

This bibliography resulted from a selective survey of the literature on Air Traffic Control (ATC). The search was limited primarily to the problems of ATC within the Field Army and the related subjects of Communications, Navigation, Radar, Aircraft Identification Systems, Aircraft characteristics, Data and Display Systems, Approach and Landing Systems, Weapons Systems, and the requirements of Army Aviation in a Combat situation.

This bibliography contains 131 references which includes reports, papers, and periodical articles covering the period from 1961 to December 1964.
INTRODUCTION

This selected bibliography contains references pertinent to the literature on Air Traffic Control. The search was limited primarily to the problems of ATC within the Field Army with emphasis of the related areas of Computer Applications, Navigation, Approach and Landing Systems, Communications Equipment, Radar, Combat Applications, Aircraft Identification-Friend or Foe, Military Aircraft, Data and Display Systems and Weapon Systems. References are also included on other branches of Military Aviation as well as Civil Air Traffic Control, however, no attempt was made to specifically cover these fields.

For more comprehensive information on the subject of Air Traffic Control reference may be made to EM 6h28, "Literature Search on Air Traffic Control and the Electronic Equipment Needs of Aviation", dated 2 February 1961, and to Abstract Cards available at the Main Technical Library which up-dates EM 6h28.

Entries in this bibliography are arranged alphabetically by title within the subject categories and their subdivisions as listed in the table of contents.
The following indexes and sources were utilized in this literature search which covers the period from 1961 to December 1964:

- Autonetics Library's report subject file
- Classified Scientific and Aerospace Reports Indexes (CSTAR)
- Computer Abstracts of Cards
- Current issues of Journals, Conference proceedings and Transactions
- International Aerospace Abstract (IAA)
- Pacific Aerospace Library Uniterm Index (PAL)
- Rand Index 1946-1962
- Scientific and Technical Aerospace Reports Indexes (STAR)
- Technical Abstracts Bulletin (DDC)

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A. AIR TRAFFIC CONTROL
1. General

1. ACCEPTANCE TESTS OF AIR TRAFFIC CONTROL CENTRAL AN/OSN-7. R.C. Perle.
   (Bendix Radio Division, Bendix Aviation Corporation, Baltimore, Maryland, Contract AF 19(604)-1881, December 1959, 30 pp., 1 ref., AFCRC-TR-59-372) AD 235 256

   Air Traffic Control Central AN/OSN-7 was found in acceptance tests to meet the engineering requirement in all respects except that the tracker azimuth dead zone is excessive. Time-to-go mean errors observed ranged from 1 percent to 0.1 percent of full scale. The range-mark generator leaves much to be desired. Quality of tracking is comparable to that of the AN/OSN-3. Other features are discussed. Representative data are tabulated.

2. AIR TRAFFIC CONTROL. W.C. Osmun and E. Herbert. (International Science and Technology, September 1963, pp. 20+)

   Air traffic control seems deceptively simple because there are so many ways that parts of the problem can be isolated, defined, and solved. Each technique seems to be the starting point for a solution to the problem of coordinating the flights of many aircraft so they stay safely separated. But engineering them into a balanced man-machine system turns out to be an elusive task. Aircraft fly higher, faster. Users of the airspace make conflicting demands. Automatic communication and information processing is the answer recommended by a host of study groups. But after decades of studies, the pilots and controllers are still linked by a patchwork quilt of navigational systems, communications, radar of various vintages, anxious eyes in the cockpit, and some nervously chewed-on pencil stubs.

The author discusses in detail how it is possible to modernize and improve the air traffic control systems through a series of rather orderly steps.

For purposes of analysis, the author has seen fit to visualize the over-all system of aviation or airspace utilization as consisting of 10 basic component parts. Each of these interacts on the others and none can be omitted in considering any practical system.

These 10 component parts are the aircraft, the airfield, the pilot, navigation, weather information, aeronautical information, rules and procedures, communications, controllers, and air traffic control.


A test and evaluation was made of the Army Aircraft Traffic Control and Navigation System for use in the Field Army employing equipments which are presently available.

Concepts, techniques, and methods for the control of air traffic were evaluated by means of system tests, and the best system to meet Army requirements was determined. Recommendations are made for the implementation of the best system and for determining improvements by means of a supplemental program of tests.


The AN/TSC-1 (XC-1) is an air traffic control tower for the control of air traffic on and around air fields and during landings and takeoffs. It houses both visual and audio communications equipment. Its basic use is similar to that of a permanent airport control tower. The AN/TSC-1 (XC-2) is an air traffic control set consisting of a visual control shelter and a radar control shelter for all weather control of aircraft on and around an air field. Both facilities can be operated independent of or in conjunction with other airport facilities. The development and construction of these facilities is described. The arrangement, mounting and installation of communications and navigational equipment in the shelters is also described.

The constantly growing teleprinter traffic is one of the important factors for the safe and smooth operation of air traffic.

The Dutch company F'M's system at Amsterdam Airport is however the first of these capable of automatically switching teleprinter traffic on all circuits, without any manual control.


Discussion of some basic problems involved in air-traffic control, in terms of recent progress in traffic-improvement plans made in the USA. Particular reference is to a design developed by the FAA for the national airspace-utilization system. This design recognizes that the air-traffic-control system is not an independent system but a subsystem that, to be effective, must interconnect with many others.


Appraisal of principles and technical features which provide a basis for the development of automatic ATC systems aimed at relieving the controller of routine tasks to afford time for decision making and planning of air-traffic flow.


The basic need for air traffic control for aircraft and missiles results from the inability of any pilot or missile control agency to digest and handle information concerning many aircraft, even if presented perfectly, since judgment must be centrally controlled. Only in wholly controlled space is separation safely handled, a system necessity.

The perplexing problem of today's air traffic control is one of flying faster and faster to a longer and longer waiting line. This paper discusses the control capabilities of an advanced air traffic system in being. An Air Force development first initiated to handle the fast interceptor recovery so vital to maximizing scramble range, the AN/GSN-11 Air Traffic Control Central is near the end of exhaustive simulator tests and scheduled to begin live flight evaluations in July, 1961.

Contending that air safety ultimately depends on achieving higher safe acceptance rates, GSN-11 adaptability to latest theories on queuing, separation, dual runways and others is discussed. Electronic design and hardware make-up of the GSN-11, described in the literature, is first reviewed briefly.

11. DOPPLER VOR EXTENDS USE OF OMNIRANGES. J. Holohan. (Space/Aeronautics, Volume 31, June 1959, pp. 118-121)

The most widely used navaid the world over is the visual VHF omnirange. Its Achilles heel has always been its vulnerability to site errors, for which many cures have been attempted. Doppler VOR is one of them—and there's strong evidence, including flight test data, that it works.

The Federal Aviation Agency (FAA) reports that in extensive lab field, and flight tests made over a two-year period by its technical Development Center, a "new" Doppler-type of VOR station has cut site errors to negligible proportions.


The first integrated military/civil air traffic control centre in the United States came into service on December 1. This new Great Falls air route traffic control centre makes full use of the Air Defense Command's SAGE facilities at Malmstrom. In doing so, it also provides radar coverage over certain areas of North Dakota which previously lacked such services for civil aircraft.
A requirement exists for an accurate and simple system to indicate the distance and azimuth between aircraft engaged in station keeping. This test was conducted to determine the potential of the air-to-air TACAN Set AN/ARN-72 used in conjunction with the UHF Direction Finder AN/ARA-25 to provide this information. It was determined that this equipment could satisfy this requirement to a limited degree but it does not provide the precision positioning information required for present station keeping tactics in an all-weather environment.

Description of an air traffic control system in which position, identity, and altitude information are provided automatically and continuously. Each aircraft in the system carries a small pulse-coded transmitter that operates in conjunction with a ground network of receivers. Four ground stations define a sector of coverage, and the signals received at the sector's four sites are relayed by microwave links or telephone lines to a surveillance center, where information processing takes place.
15. INVESTIGATION OF DEPLOYMENT PROBLEMS AND ALIGNMENT OF THE
AN/TSQ-17 EMS SYSTEM. J.J. Laugniger, et al. United
(Radio Corporation of America, Burlington, Massachusetts,
Technical Documentary Report Number ESD-TDR-63-601, Contract
No. AF 19(604)-8020, June 1963, 281 pp., UNCLASSIFIED) AD 425 113

This report concerns the analysis, evaluation and recommendations
of specific solutions to problems concerned with the design of
equipment for an air-transportable traffic control system (EMS).
Technical characteristics, design criteria, and electrical and
mechanical drawings in the following problem areas are discussed.
(1) Application of the principles of modular packaging to data
collection and remoting equipment for surveillance, IFF, and
precision approach functions. Design of monitoring and self-
checking circuits to rapidly isolate trouble to specific modules.
(2) Application of redundancy to more critical circuits to
insure continuation of operations in event of partial failure. (3)
Simplification of critical circuits to reduce skill level and
training of maintenance personnel, and (4) The delineation of
"by the numbers" procedures for initial alignment of equipment
at a deployed site, and for maintaining operational continuity
of essential functions in event of partial failure.

16. INFORMATION SYSTEMS INTEGRATION. R.L. Kirby. (Mitre Corporation,
Bedford, Massachusetts, Report number SR 93, Contract AF19
528 2390, ESD TDR-63-500, April 1964, 44 pp., UNCLASSIFIED)
AD 438 429

A series of diagrams depict the way automation has,
historically, been introduced into existing organizations,
emphasizing that automatic interchanges are the last to develop.
The automation of air traffic control in the case of a flight
path traversing adjacent control sectors is used as an example.
The meaning of the total integration job is then developed in
terms of levels of integration, hierarchical networks of systems,
and organizational and functional interfaces by following
round a systematic path through a series of diagrams through
various levels to the 425L system. The applicability of the
discussion to both business systems and command and control
systems is pointed out.

17. OPERATIONAL TEST AND EVALUATION OF AIR TRAFFIC CONTROL CENTRAL
AN/GSN-11. (Electronics and Ordnance Division, Avco Corpora-
tion, Cincinnati, Ohio, Contract AF 19(604)7379, ESD TDR
63-187, Report Number AE-219-63-1, 1 Volume, January 1963,
UNCLASSIFIED) AD 299 074

DESCRIPTORS: *Air traffic control systems, *Ground controlled
approach radar, *Airport radar systems, *Analysis, Moving target
indicators, Radar beacons, Radar range calibrators, Wind,
Radar tracking, Position finding, All-weather aviation,
Operation, Aviation safety, Flight testing, Tests, Flight speeds,
Statistical data, Ground speed, Radar landing control, Airplane
landings, Radar scanning.


20. REPORT OF TEST RESULTS AND CAPABILITIES OF AN/MPN-17A SYSTEM NO. 3 (U). (Gilfillan Brothers, Incorporated, Los Angeles, California, Contract AF30 635 25279, RADC TDR63 254, July 1963, 359 pp., SECRET) AD 340 313L


21. SMALL, LIGHTWEIGHT ALTITUDE TRANSMISSION EQUIPMENT. (Hazeltine Technical Development Center, Incorporated, Indianapolis, Indiana, Final Report, Contract ARDS177, April 1963, 1 Volume, UNCLASSIFIED) AD 400 560

Both SLATE I and SLATE II operate at a transmitter frequency of 1090mc and receiver frequency of 1030mc. SLATE I reply codes include any of 33 altitude codes plus an IDENT pulse. SLATE II reply codes include any of 33 altitude codes in mode C or codes 00 through 77 (64 codes), plus the IDENT pulse in mode 3A. Both SLATE modes incorporate additional circuits to provide echo suppression and side lobe suppression.


This report describes the design and development of Small, Lightweight, Altitude Transmission Equipment (SLATE III and SLATE III Mark I). The development was performed by the Hazeltine Corporation, Hazeltine Electronics Division for the Federal Aviation Agency, Systems Research and Development Service under Contract ARDS-558. SLATE III operates in the Air Traffic Control Radar Beacon System to furnish the air traffic controller with aircraft identification and altitude information. Two SLATE III and one SLATE III Mark I equipments were delivered.
At its Washington Headquarters and at its Atlantic City experimental facility FAA has been pursuing its program to ease the air traffic jam. Implementation of Phase II of its program—application of existing technology to air traffic control—has now been divided into nine functions: (1) Flight plan acceptance, processing, and distribution; (2) Automatic updating of flight strips; (3) Time and altitude conflict prediction, resolution, and display; (4) Bright radar display; (5) Flow control; (6) Radar track-while-scan with tracker-driven alphanumeric data; (7) Profiles and sequencing for transition and terminal control; (8) Radar beacon interrogation; and (9) Scramble corridor and conflict prediction, resolution, and display.

Most important piece of equipment in this program is a special purpose digital computer developed by Librascope Div. of General Precision to end manual air traffic paperwork.

This report presents a workable station keeping concept, and describes a number of techniques through which this concept can be mechanized as an integral interrogator-transponder system. Since this is a preliminary report, only the more salient problems of mechanization and expected system characteristics are discussed. Since an experimental model of the complete system described has not been tested, the validity of the operation characteristics which are discussed, is left to the reader to surmise.
25. A STUDY OF ECCM TECHNIQUES FOR FUTURE EMERGENCY MISSION SUPPORT SYSTEMS (U). N.J. Cafarella, Jr. (Radio Corporation of America, Burlington, Massachusetts, Contract AF9 60(6) 8859, ESD TR63 183, January 1963, 76 pp., SECRET) AD 346 795

DESCRIPTORS: (*Electronic counter counter-measures, Research program administration), (*Air traffic control systems, Electronic countermeasures), (*Radar jamming, Air traffic control systems), Communication systems, Navigation, Search radar, Redundant components, Surface to air, Landing aids, Command and control systems, Radar anti-jamming, Radar navigation, Airport radar systems, Navigation aids (U).

2. Computer Applications


This report presents a detailed description of a digital computer system which is designed to perform the functions of the present analog computer system of the Air Traffic Control Central AN/GSN-3 (XD-1) (VOLSCAN). The logical design of the terminal equipment necessary for incorporation of a digital computer into the present analog system is specified. Detailed flow diagrams of the digital computer program to perform all of the functions of the present analog system are included.


The electronic industry and air traffic control authorities (ATC) in many countries are at present endeavouring persistently to increase the efficiency of ATC by the use of automatic aids. The results of the studies and development work so far undertaken, which have in some cases involved the expenditure of vast sums of money, can already be seen in basic agreement on some points as to the measures to be adopted. One of the most important of these is the planned use of programme-controlled high performance digital computers at control centres.

Some of the most important problems which can be handled in an almost ideal manner by a suitable digital computer system and the necessary preparations and tests already in progress in various quarters are discussed.

This report details the accomplishments resulting from Task 25B, Tactical Field Computer Micromodules, and Task 27B, Tactical Field Computer Equipment, of Extension II of the Micromodule Program.

The task at hand—demonstration of the feasibility of micromodular equipment in tactical computer applications—was predicted upon the success achieved in developing a wide range of reliable micromodules and microelements during the Initial Program and Extension I thereof.

The objectives have been achieved. The Acceptance Test of Micropac Computer demonstrated complete fulfillment of all performance requirements.

29. GENERAL DESCRIPTION AND BASIC LOGIC OF THE UNIVAC FILE COMPUTER I AIR TRAFFIC CONTROL/AUTOMATIC DATA PROCESSING SYSTEM.
K.W. House, et al. (Federal Aviation Agency, Atlantic City, New Jersey, Final Report, April 1962, 112 pp., 6 refs.) N63-71472

This report provides a general description and the basic logic for an air-traffic-control automatic data-processing program. This document was written without reference to a specific computer and in sufficient detail to permit a person of limited background in air-traffic control and computer programming to understand the processing methods and logic employed.

30. AN INVESTIGATION OF ANALOGUE AIDS FOR MOBILE RAPCON CONTROLLERS.

A design study was directed toward the introduction of simple, lightweight analogue devices to improve the operational performance of Mobile USAF Radar Approach Control (RAPCON) facilities. Special emphasis was placed upon the need for scheduling spacing, and guiding high performance aircraft returning from high priority missions. Operational requirements are outlined and designs are presented for an Approach Scheduling Control (ASCON) Computer, an Approach Spacing Computer, and a Tangential Approach Computer.
3. Data and Display Systems

31. AUTOMATION IN AIR TRAFFIC CONTROL AN EVOLUTIONARY CONCEPT.

For air traffic control, an Elliott 502 "on-line" Data Processor and Display System has been ordered by the Ministry of Aviation for the experimental investigation of the use of automation techniques. The joint planning of facilities to be provided by this tool is being undertaken in close collaboration with the Air Traffic Control Experimental Unit and the Royal Radar Establishment. Much of the FREDA concept has been stimulated by this association.

Planning for the future of automation in air traffic control has given some appreciation of the problems presently being faced, and overcome, by controllers. Discussions have taken place with air traffic control authorities in many different countries. These have confirmed the view that the need for assistance exists now, in many areas, to enable controllers to maintain their present effectiveness in handling an increasing volume of traffic.

32. CENTRAL DATA PROCESSOR OF THE AIR TRAFFIC CONTROL SYSTEM.
L.L. Wolman. General Precision, Incorporated. (IRE Wesccon Convention Record, Part 6, at the Western Electronic Show and Convention, Los Angeles, California, August 23-26, 1960, pp. 85-94)

The Air Traffic Control Central Data Processor is a transistorized, distributed, digital electronic data-processing and computing complex which provides high reliability, unusually thorough error detection and correction, an exceptionally efficient method of data retrieval, large volume input/output capability, and the flexibility to fit varied system applications. Real-time, on-line operation is achieved through the simultaneous use of the four subsystems.


For some years all those concerned with air traffic control have devoted considerable effort to increasing the efficiency of the system by improving equipment, techniques and operating procedures. In the main, recent effort has been directed towards improving the techniques of acquiring data, and then applying and processing it, in order to perform automatically some of the functions of the air traffic controller. Rather less emphasis has been placed on the development of a suitable communication system, although this is nevertheless a vital part of traffic control. The communication system must be much more sophisticated and speedy if it is to meet the requirements of the automatic system into which it fits.
DATA PROCESSING REQUIREMENTS OF THE FAA AIR TRAFFIC CONTROL
DATA PROCESSING CENTRAL. N. Pomerance. General Precision,
Incorporated, Pleasantville, New York. (IRE Wesccon Convention
Record, Part 6, 1960, at the Western Electronic Show and
Convention, Los Angeles, California, August 23-26, 1960,
pp. 95-101)

Today's air traffic control system is operated primarily
on a manual basis. The Air Traffic Control Data Processing
Central is designed to perform the correlation, computation
and display of data on which air traffic control is based.
Its fundamental goals are to reduce routine controller work
load, to free the controller for decision making, to provide
an evolutionary system to meet the growing needs of the system,
and to provide a flexible system to meet the changing
requirements of air traffic control. The operational
environment of the system may be divided into two regions:
One environment is primarily radar and exists in the vicinity
of busy terminal areas, and the other is primarily non-
radar and exists over the major portion of the nation.

THE DECCA DATA LINK. (Decca Navigator News, November 1962,
pp. 4-5)

Brief review of the function of the Decca automatic digital
data link as a component of an air-traffic-control system. The
air-ground data link permits the accurate display, at an air-traffic-
control center, of the instantaneous position, flight level, and
identity of all cooperating aircraft in any control sector.
The system is designed to provide data renewal of 50 aircraft
every ten seconds.

DIGITRAC Censor DATA PROCESS R. K. Mellberg. Standard Radio
and Telefon AB, Bromma, Sweden. (Electrical Communication,
Volume 39, Number 4, 1964, pp. 488-494)

The digital data processor Censor (Central processor) is
a parallel purely binary machine with a random-access magnetic
core memory as an internal store. It can be characterized
as a multipurpose computer primarily intended for real-time
data processing in control systems. Thus the machine has
features that make it very fast in such applications.
In the control of air traffic, data transmission meets the frequency exacting requirements for speed and accuracy. Data transmission equipment must work compatibly with all kinds of data sources and data consumers. Thus flexibility and adaptability are essential requirements. For this reason it is better to consider the data link as a function rather than as a specific equipment.

The most frequently used way to send azimuth information from the antenna to the plan-position indicator is to use a synchro transmission system. At the receiver end a sine-cosine generator or resolver transforms data to Cartesian coordinates. Analog data processing is used. By careful synchronization of the rotary components of the system, a relatively high degree of accuracy is obtained.

Symbols in the Digitrac system are produced by character generators. The total number of symbols required depends on the size of the system. A typical system, able to track about 100 targets simultaneously, needs three generators to produce all required symbols for the plan-position indicators and all data on the tabular displays. The workload is shared by using one generator for the raw-video indicators, one for the synthetic indicators, and the third for the tabular displays.

The digital plan-position indicator is housed in an octagonal casing that mounts into the operator's desk.

The indicator is assembled from chassis and printed-card subunits. These all swing out on hinges and are therefore easily accessible. Each indicator can accommodate a 12-inch or 16-inch (305- or 406-millimeter) cathode-ray tube. The inputs to the indicator consist of radar range sweeps, symbols, and vector lines, all converted from digital to analog form, and video signals, supplied in standard analog form. It is also possible to display information received from several radar stations as an integrated picture.


Outline of the operation and capabilities of an experimental video tracking system designed as part of a system to determine the feasibility of implementing semiautomatic control of aircraft. This system communicates directly with a general-purpose digital computer, and is capable of generating and controlling 50 analog video trackers which can operate in either a track-while-scan or rate-aided mode. The system also provides aircraft position information to the computer for mathematical calculations of aircraft position errors, and processes computer-derived information for presentation on plan position data displays for controller use.

42. GENERATION OF ARTIFICIAL ELECTRONIC DISPLAYS, WITH APPLICATION TO INTEGRATED FLIGHT INSTRUMENTATION. C.H. Balding, Kaiser Aircraft & Electronics Division, Kaiser Industries Corporation, Palo Alto, California. C. Susskind, University of California, Berkeley, California. (IRE Transactions on Aeronautical and Navigational Electronics, Volume ANE-7, Number 3, September, 1960; pp. 92-98)

Interest in complex, dynamic, artificial displays has been stimulated in recent years by the need for a single integrated display of flight information, for pilots of high-speed aircraft, that would replace the multitude of flight instruments in current use. The method described in the present paper is capable of meeting the need for such a system. In this embodiment, the display that results presents to the pilot a stylized picture of the real world that not only integrates all of the information necessary to establish the aircraft's attitude, altitude, and speed in a single display, but does so in a manner that is closely related to the pilot's picture of the real world.
Tests were conducted to check the feasibility of an air-ground-air narrowband frequency-shift-keying data system utilizing frequency diversity and Doppler correcting techniques. Results of air-ground-air data-transmission tests were described. It can be concluded from the test results that Doppler-correcting narrowband techniques applied to frequency diversity operation in ground-air-ground data transmission is feasible, resulting in reliability and error rates equivalent to ground point-to-point systems operating within similar effective power ranges and antenna gains.

The important features of a variety of dynamic display equipments and techniques pertaining to air traffic control centers are described, broken down into (1) cathode-ray tube techniques, (2) optical techniques, and (3) special techniques. These equipments and devices are briefly analyzed from the standpoint of one or more of the following possible display applications: (1) large, bright, PPI-type displays, (2) color coded displays, (3) displays imparting altitude information, (4) tabular displays, and (5) miscellaneous displays. Significant advantages and disadvantages of these equipments and techniques are discussed. The equipments which most nearly fulfill, within the present state of the art, the requirements of these air traffic control display applications are indicated. Promising display techniques, some requiring further development effort, are pointed out. Certain topics for human engineering study are suggested.

The AN/TSQ-13 system is designed to transmit digital data along a network of operating sites. A brief analysis is presented of the problems met when any site becomes inoperative and the network sequencing system is interrupted.
16. TRANSISTORISED AND TEMPERATURE-CONTROLLED: DECCA RADAR (TDS MARK V) OFFERS NEW METHODS OF INCREASING RELIABILITY. (Interavia, Volume 17, January 1962, pp. 105-107)

The tendency in recent years for the display and data handling element of a radar system to increase in size and complexity to meet current operational requirements, both military and civil, has been marked. The amount of electronic equipment required to create an effective display and data handling system with conventional engineering techniques is very large indeed, entailing high power consumption, with severe problems of heat dissipation.

The Decca system, known as the TDS Mark V, was developed to make possible the much wider use of really efficient display systems.

47. TRENDS IN DATA PROCESSING FOR AIR TRAFFIC CONTROL. L.B. Hallman, Jr. (Directorate of Operational Support Engineering, Aeronautical Systems Division, Wright-Patterson Air Force Base, Ohio, ASD TN 61-103, Report for April-July 1961, October 1961, 8 pp., UNCLASSIFIED) AD 266 732

Information is presented on the generation, storage, and acquisition of a certain class of data that may be best obtained directly from the air or aerospace vehicle and used in the control of air traffic. Suggested means of processing such data within the aerospace vehicle are described and pertinent design parameters discussed.
B. AIRCRAFT IDENTIFICATION SYSTEMS
48. AGREE RELIABILITY TESTING OF AIR TO AIR IDENTIFICATION EQUIPMENTS.

A request for quotation for approximately 100 Air to Air Identification Systems with an AGREE reliability requirement was received at Hughes Aircraft Company during the latter part of 1958. The AAI system consists of an interrogator set AN/APX-26 and a Transponder Set AN/APX-27 manufactured by Hughes Aircraft Company, El Segundo, California.

The interrogator set, with the radar subsystem, generates and transmits code paired-pulse r-f energy into space to challenge unidentified airborne targets and process the Transponder return to mark or erase the radar target video as displayed on the flight command indicator.

49. AIRBORNE VEHICLE IDENTIFICATION BY ELECTRONIC FLIGHT DATA CORRELATION.

A primary requirement for an effective air defense complex is the positive identification of all airborne vehicles. Such identification prevents dilution of defense capability and ensures protection of friendly aircraft. The system described in this paper, the Airborne Vehicle Identification (AVID) system, can supplement existing methods and automatize some of them to provide an increased capability for positive identification.

50. DEVELOPMENT AND TESTING OF TRANSPONDER SET AN/APX-45 (XN-1,2,3,4) AND CODER-RECEIVER TRANSMITTER KY-311A (XN-1)ASQ-19. (Stewart Warner Corporation, Chicago, Illinois, Contract NOas59 4185 and NOw63 0144, Final engineering report, 15 June 1963, 1 Volume, UNCLASSIFIED) AD 115 145L

51. **EMS MINIATURIZATION STUDY.** E.P. Farnsworth and F. Marsden.
   (Laboratory for Electronics, Incorporated, Boston, Massachusetts,
   Contract AF 19(6014)861, AFCRL 62-54, Final report, 5 July 1961-
   UNCLASSIFIED) AD 273 133

   A study was made to determine which items of equipment specified
   for the Augmented 4-Wheels System and required in the 1965-1975
   EMS System can be reduced in size by miniaturization or development
   effort, to provide a more compact, mobile, air transportable system
   in the future. Included are considerations of the economics of
   micro-miniaturization, over-all equipment size reduction achievable,
   maintenance and reliability problems, and effect on performance
   characteristics.

52. **FINAL REPORT STUDY OF EXISTING IFF-SIF SYSTEM.** T.I. Humphreys,
    et al. Packard-Bell Electronics Corporation, Los Angeles,
    California. (Packard-Bell Report number 10153, RADC-TR-57-66,
    Serial Number 57-1007, Contract number AF 30(602)-1538,
    28 February, 1957, 43 pp., SECRET) AD 114 392

53. **HAWK - IFF. A TACTICAL AIRCRAFT IDENTIFICATION SYSTEM FOR LAW K (U).**
    (Raytheon Company, Bedford, Massachusetts, Report number R-1376,
    9 October 1961, 1 Volume, SECRET) AD 334 661

    missiles (Surface-to-air), Signal-to-noise ration, Antennas,
    Power supplies, Control panels, Traveling wave tubes, Circuits,
    Identification, Maintenance, Radar homing, Fire control
    systems, Continuous wave radar, Identification systems,
    Aircraft, Antiaircraft defense systems.

54. **AN IDENTIFICATION SYSTEM FOR USE AS AN AID TO RAID DETECTION AND
    AIR TRAFFIC CONTROL (U).** W.K. Squires. (Rand Corporation,
    Santa Monica, California, Report number RM-2169, May 13, 1958,
    42 pp., SECRET) AD 305 561
55. INVESTIGATION OF TRANSPORTABLE SEARCH RADAR AND SIF EQUIPMENT.

The purpose of the project was to investigate transportable second radar and SIF equipments for application to the purposes of the Mobile ATC/Communication Facility—more commonly known as Augmented Four Wheels. Available equipments were evaluated against a specific performance criterion, and five equipment systems were recommended as applicable to the Augmented Four Wheels program. Each of the five search-radar systems was critically evaluated against Air Traffic Control criteria for the Quick Reaction Posture requirement of the Air Force. Remote-control requirements for the search radar and other subsystems, within the Augmented Four Wheels System complex, were thoroughly investigated. Microwave link equipments were evaluated, and specific performance characteristics were defined for use in the Augmented Four Wheels System. Space and housing requirements for the search-radar subsystem were critically studied, and definitive shelter specifications were prescribed.

56. RADAR RECONNAISSANCE SYSTEM AN/APS-85 SIDE LOOKING AIRBORNE RADAR.

The AN/APS-85 is a side-looking X-band airborne MTI radar capable of providing data on both fixed and moving ground targets for Army area reconnaissance purpose. The radar system consists of the side-looking radar (Radar Set AN/APS-85) and a forward looking radar (Radar Set AN/APN-109).

57. RECOGNITION, IDENTIFICATION AND DATA PROCESSING.
M.J. Anderson.
(Hughes Aircraft, Contract AF 19(604)-8437, Report number TN-794, AFCRL 62-170, March 1962) AD 276566

Problems associated with the application of new sensor and data processing techniques applicable to the recognition of non-cooperative aerospace vehicles are investigated. An aerospace vehicle recognition system concept is formulated. An evaluation methodology applicable to target recognition systems is developed. The methodology takes into account the principal functions performed by recognition systems, the quality of performance, the time required to perform the functions and the cost of the system.
58. STUDY OF ANTI-JAM TECHNIQUES FOR THE MARK XII IFF SYSTEM (U).


Discussion of the TIE (Target Identification Equipment) system proposed by Cubic Corporation, in order to provide the radar controller with a method for the positive identification of all targets which appear on his radarscope and which are in communication with him on any ATC frequency. The system is omnidirectional, and utilizes angle-measuring equipment which requires no moving antennas and which provides accurate threedimensional position data. The operation of the system, which is based upon a phase-difference measurement, is discussed at some length.


The AF need for an Identification (IFF) transponder set capable of being installed in all combatant-type aircraft led to the development of the AN/APX-19. Prototype models fulfilled all applicable spec. requirements; the set can be used in the Mark X (SIF) Identification system presently used. The history, tests, and conclusions of the AN/APX-19 R & D program are summarized.


Many possible methods of identification are analyzed and compared on the basis of their effectiveness in preventing the destruction of friendly aircraft in the airspace over NATO Europe. Repeated runs on the IBM 704 computer provided results in the form of totals of friendly and hostile aircraft shot down when the different methods are in use. Conclusions are reached regarding the most effective combination of methods for an Identification System for NATO Europe.
C. ANTI-COLLISION AND PROXIMITY WARNING
63. FEASIBILITY STUDY OF PHOTOELECTRIC ANTICOLLISION SYSTEMS.
J.L. Harris. (University of California, Visibility Laboratory, San Diego, California, Contract NASA-72092, Report Number SIO 60-449, June 1960, 31 pp.) AD 214736

Information is presented as to the upper limits on performance capability of various visible spectrum anticollision systems. It is hoped that this information can be a valuable aid in evaluating proposals for anticollision equipments which specify operation in the visible spectrum. It is believed, that a 24 hour a day pilot warning equipment could be designed and constructed. The system would use passive contrast detection with color discrimination during day light hours and a modulated light source on board each plane at night (this might possibly utilize present anticollision lamps). Information other than detection and angular location could be obtained only during night-time operation.


The results of an experimental evaluation of interrogation-transponder techniques are presented as applied to the airborne Pilot Warning Indicator (PWI) and Collision Avoidance System (CAS) problem. Both PWI and CAS are referenced because the system is designed to provide both levels of collision prevention capability on a mutually compatible basis in terms of transmitted signals.
D. APPROACH AND LANDING SYSTEMS

Discussion of the AN/GSN-5 closed loop system which makes possible the routine accomplishment of fully automatic precise lateral and vertical navigation of airplanes through final approach and touchdown with a minimum of new airborne electronic equipment. This system has performed successfully in a wide variety of environmental conditions. Over 3,000 automatic landings have been achieved in aircraft varying from small business airplanes and military fighters to the most modern jet transports. A variety of operational modes provide flexibility for all types of requirements, while the inherent simplicity of the system assures safety, and its adjustment capabilities minimize problems of siting. Considerations in the design of the system, system configuration and operation, special features, and flight test experience are presented.

66. ACTIVITY REPORT. (Electronic Systems Division, Air Force Systems Command, Bedford, Massachusetts, EDS TDR 62-26, August 1962, 28 pp., UNCLASSIFIED) AD 285 276

Contents:
Approach and landing systems
Airport lighting systems
Communications
Data acquisition, processing and display
Navigation
Research
Aircraft safety
Weather
Support activities


Contents:
Approach and landing systems
Airport lighting systems
Communications
Data acquisition, processing and display
Navigation
Helicopter operations
Research
Aircraft safety
Weather
An eventual goal in the operation of piloted aircraft is to provide the capability of instrument flight under zero visibility conditions without the aid of any ground based equipment for all phases of flight. Ideally, this should encompass takeoff from one field to landing rollout to another. This task is not feasible with currently available equipment. As one step toward the solution of the problem and to provide a means for further development, this study was undertaken under the auspices of the Ames Research Center of the National Aeronautics and Space Administration.

The immediate objective is to determine what portions of the task can be accomplished in a practical manner with presently available equipment and to determine the equipment required in the immediate future to implement a system which can be used to investigate and demonstrate various means of accomplishing the desired task.

Present investment in ILS equipment throughout the North American and European continents makes it unlikely that a major new system will be substituted in the next decade. Thus, the All-Weather Landing System described here is meant to meet the needs of current military and impending commercial requirements.

The All-Weather Landing Set is a complete ILS-type landing system, including initial and final approach, touchdown, and runway rollout. It provides the touchdown capability required for a manual landing or, when coupled to an automatic flight control system (AFCS), provides fully automatic approach and landing under zero ceiling and visibility conditions.
70. APPROACH AND LANDING SYSTEMS. R. Bailey, et al. (Army Signal Research and Development Agency and Lab., Fort Monmouth, New Jersey, Technical Development Plan, 1 January 1964, 66 pp., refs., N64-32585) AD 442 741

A detailed development plan, a reliability program and maintainability program, and a detailed development funding plan are presented for experimental investigation leading to the design of a landing system to be used for formation flights of all Army aircraft under tactical conditions. The system is to consist of a ground transmitter, antenna system, and power supply, and an airborne receiver and display. The ground components will be capable of being paradropped in their own transit cases. One man will be able to quickly set up and operate the equipment. The system will provide azimuth (localizer) and elevation (glide slope) guidance to at least five miles from the landing strip under all flyable conditions.


The Landing Control, Central, AN/GSN-5A is a ground-based, final approach navigation system providing three basic approach and landing techniques. These include completely automatic control, cross-pointer guided approach, and talkdown. These techniques used singularly or in combination maintain aircraft surveillance and guidance information to touchdown.

72. CURRENT DEVELOPMENTS IN ALL WEATHER LANDING. PART II—THE AMERICAN SCENE. G.W. Webber. (Aircraft Engineering, March 1963, pp. 74-76)

The task of reviewing the American all weather landing scene is considerably more difficult than the corresponding task of reviewing the European scene. The most obvious reason for this is the difficulty of keeping fully up-to-date with all developments and proposals emanating from an industry which is several times as large as the corresponding British industry and 3,000-5,000 miles away. Hence the author cannot claim to have comprehensive knowledge of every development in progress and can only hope to give what he sincerely hopes is a reasonably full and balanced account of the major developments.

The engineering results of the REGAL test evaluation program conducted by the FAA are presented. The basic objective of the program was to determine the feasibility of the REGAL system using an interferometer antenna, and to provide airborne derived elevation angle and range data capable of providing accurate guidance for landing aircraft. The latter part of the program was used to determine how well REGAL actually performed in a landing system. Over 200 completely automatic landings were achieved using four different type aircraft, all equipped with different type landing computers and autopilots.


This report presents the work effort for the period between 1 November 1963 and 31 January 1964 on the Tactical Army Aircraft Landing System (TAALS) study program. This is directed toward the establishment of all-weather landing system design requirements for future tactical Army aircraft. The program is divided into four study task areas: (1) Atmospherics; (2) Radiation and Detectability Propagation Studies; (3) Radiator and Detector Equipment Investigations; and (4) System Design Studies.


The need for an all-weather landing system has been steadily growing during the past few years—a need which is dictated by the increasing complexities of controlling high-performance aircraft and by a new emphasis on air safety. Government agencies and private industry here and abroad have been vigorously investigating control theory, equipment requirements, and the safety problems associated with development of a system that can make a routine procedure of all-weather landing.

This paper investigates the theory, operation, and flight-testing of the APN-111 All-Weather Automatic Landing System.
E. COMBAT APPLICATIONS
It may be that history repeats itself because some things are worth repeating.

Early in 1960, a test platoon was organized at Fort Benning to find out and demonstrate how the Army could use the parachute most effectively as a combat instrument. The efforts of this group of volunteers led to the first mass jump, the first parachute battalion, and, eventually, to the birth of our airborne concept and a high-spirited soldier to make it work.

Now, a test division of men picked from throughout the Army is being organized on the same red clay hills to try out a more sophisticated concept—the air assault division. If expectations are met, our Army will have a way to get at the enemy with a soldier who is not only rugged and ready—but relatively rested.

"Although aviation offers the only feasible solution to the Army's problems of mobility in the battle area, the Army is reluctant to adopt it wholeheartedly as a substitute for conventional transportation methods." This sentence was one of the many similar ones in a stinging memorandum prepared in the Office of the Comptroller, and sent to then-Secretary of the Army Elvis Stahr, Jr., on January 24, 1962.

The memorandum set off a series of events that is still in motion, most noticeably at this time at Elgin AFB, Fla., where Tactical Air Command is conducting a series of tests with an Army infantry division, and in Georgia and South Carolina, where the Army is experimenting with a radically new type of fighting unit built around helicopters used for transportation and close-in fire support.

The way the tests come out and the decisions made on them may well have a lasting influence on the Army and Air Force and the progress of unification.
The greater area of firepower influence today requires that Army surveillance penetrate to a greater depth and have greater mobility. Evaluation of the vast amounts of data collected in many forms must be done quickly at a single location and interpreted effectively.

All of the various sensor inputs—such as radar, camera, ir, prisoner-of-war interrogations, front-line observers—must speak to evaluators in a common final language. This means the man-machine interface must be designed for quick information transferrence.

The new emphasis on an airborne army to provide increased mobility and quick reaction time leads to extended airborne equipment requirements for the Army. Self-contained beacon systems are needed. Communications breakthroughs and system developments are called for. Identification equipment (iff) with instant readout is badly needed to keep pace with improved ability to down an aircraft rapidly.

To obtain high information-carrying capacity in radio communications, wide bandwidth is needed. This demands high carrier frequencies, resulting in line-of-sight limitations on propagation characteristics. Among possible solutions are elevated repeaters such as satellites, mountain-top installations, or the use of chaff.

BATTIEFIELD IDENTIFICATION SYSTEM STUDY (U). C.H. Vaughn.

BENDING UNIT TO CONTROL ARMY PLANES. (Army Times, Volume 19, April 25, 1959, p. 50)

DEPUTY DIRECTOR OF ARMY AVIATION ANSWERS HARDWARE QUESTIONS. R.H. Schulz. (Data, Volume 8, August 1963, pp. 15-20)

An interview with Colonel Robert H. Schulz, who discusses the role of Army Aviation and some of the problems involved in combat support and readiness.
The SARAH System was evaluated to establish: (1) if it could be used to improve the Special Air Warfare capability during operations involving the location and identification of drop zones, landing zones, and personnel under adverse visibility conditions; (2) accuracy as a drop point indicator for paratroops; and (3) potential use in other Special Air Warfare applications. The evaluation included 44 actual cargo drops as well as quantitative and qualitative tests of accuracy and performance. Techniques were developed to provide an acceptable accuracy when the system is used as a drop point indicator and the beacon is located in wooded areas. In addition, a number of simulated visual releases were accomplished on an instrumented range to develop some accuracy standards against which such equipment can be judged. Employment of the SARAH System in the Republic of Vietnam is strongly recommended.

LACAS targets are enemy personnel, equipment and installations close to friendly forces and frequently known to them. In order to achieve maximum destructive effect on the enemy without erroneously hurting friendly forces, air/ground coordination must be punctual and precise, and mandatory.

In an interview with Data Magazine, Major General Clifton Ferdinand von Kann, Commander of the U.S. Army Aviation Center and Commandant of the Aviation School at Fort Rucker, discusses the role of the school in training pilots to meet the needs of air mobility of the U.S. Army. General von Kann states that much of the future tactics of Army Aviation hinges on the lessons learned in South Vietnam, and that Army Aviation must provide significant advances in deployment and mobility to fulfill this requirement in military tactics.
85. R&D FOR ARMY AVIATION MEANS RUGGED AND DEPENDABLE. W.W. Dick, Jr.
(Data, Volume 9, August 1964, pp. 19-21)

General Dick believes mobility is a key to Army superiority in any conflict and this explains his high interest in Army aviation. "I feel that if we want to take full advantage of the increase we now have in firepower, we must turn our attention to increasing mobility," Bill Dick declares. "The Army must move by air, and reconnoiter by air if it is to increase its mobility. The aircraft, both rotary and fixed wing, must become a routine transportation platform to serve in this mobility mission."

86. SKY TRAILS TO TARGETS BLAZED BY FORWARD AIR CONTROLLERS (IN VIETNAM). (Air Force Times, Volume 25, PACAF20, September 30, 1964)

(Army, Volume 11, September 1963, pp. 35-53)

In this important article, the President of the 1962 Army Mobility Requirements Board, which produced the now famous "Howze Board" report, puts the air assault division, proposed by it, under scrutiny by employing it on a tactical problem in the region of South Carolina's Great Pee Dee River.

As the 11th Air Assault Division at Fort Benning attains structure and competence it will proceed on the basis of its assigned mission, expanded presumably by its study of the Mobility Board report and undoubtedly by its own initiative, to develop the details of doctrine, tactics and technique for its employment. It will also have the chore of proving or disproving or modifying the organization prescribed by the Board.
F. COMMUNICATION EQUIPMENT AND SYSTEMS

Voice radio channels forming the vital links for the control of civil and military air traffic are becoming seriously congested. Studies have shown that by 1970 air traffic control communications will quadruple the 1958 volume. Automation through the use of a data link offers a practical means to relieve congestion and provides growth potential to keep pace with the rapid acceleration in communication requirements.

The Federal Aviation Agency has developed the Automatic Ground/Air/Ground Communication System (AGACS) as an initial step in mechanizing routine communications. This experimental equipment is currently under evaluation at the National Aviation Facilities Experimental Center.

89. DOMESTIC AIR TRAFFIC CONTROL RADIO COMMUNICATION EQUIPMENTS, DISTRIBUTION AIRBORNE AND GROUND EQUIPMENTS, VOLUME I. (U.S. Government Research Reports, August 1959, 731 pp., $8.00) (Order from OTS), PB-171 131

90. DOMESTIC AIR TRAFFIC CONTROL RADIO COMMUNICATION EQUIPMENTS, TECHNICAL CHARACTERISTICS AIRBORNE AND GROUND EQUIPMENTS, VOLUME I. (U.S. Government Research Reports, August 1959, 411 pp.) PB-171 132


This report is intended to provide a human factors review of the AN/TSQ-47 Air Traffic Control/Communications System. A thorough review could be done only after Category II and III testing. At the writing of this report, only Category I testing is nearing completion; therefore, much of what is reported herein is a result of data gathered during the fabrication and initial testing of the system.
92. PANEL ON MEETING PRESENT AND FUTURE DEMANDS OF GROUND-AIR-SPACE COMMUNICATION SYSTEMS PLANNING. ITT Communication Systems, Incorporated. (Signal, October 1963, pp. 46-56)

A panel discussion prepared to present a few thoughts from industry which would be of interest to the Military Communicators. The discussion was directed toward analysis of requirements and standards and the application of new communication techniques in media, equipment and system design to support the rapidly increasing demands of civilian and military subscribers.


Tests were conducted at the National Aviation Facilities Experimental Center (NAFEC) to evaluate the No. 300 Switching System, Type I, developed for FAA use by the Bell Telephone Laboratories. The purpose of the development was to provide an integrated communication (interphone and radio) switching system which could be introduced into the present Air Traffic Control environment and added to as additional switching requirements are imposed upon the system.


The air traffic system consists of a myriad of closely interlaced sub-systems, any one of which is inadequate in itself. The sub-system under discussion here is the communications network which supports the entire Air Traffic Systems structure. It is not intent of this article to revolutionize Air Traffic concepts, but to point out the urgent need for keeping pace with the state of the art involving communications.
G. MILITARY AIRCRAFT
95. AIR MOBILITY NEEDS TRANSLATED INTO R&D REQUIREMENTS. J. Dibble, Jr.  
(Data, Volume 9, August 1964, pp. 23-25)  

Chief of Air Mobility Division of OORD answers questions on Lockheed rigid rotor, Piasecki compound, Hughes hot cycle, Hiller tip turbine and other V/STOL innovations.


97. KNOW YOUR ARMY FIXED-WING AIRCRAFT. (Army Information Digest, Volume 18, (Pictorial), June 1963, pp. 34-38)


There are 3 commercial scheduled helicopter airlines: New York Airways, Chicago Airways and Los Angeles Airways operations of which are conducted in accordance with Visual Flight Rules (VFR) in Visual Meteorological Conditions (VMC) and those with Instrument Flight Rules (IFR) in Instrument Meteorological Conditions (IMC); establishment of helicopter routes and other measurements taken; examples of experience gained.

99. MILITARY USES OF THE HELICOPTER. (Helicopter and Hovercraft World, Volume 6, April 1963, pp. 95+)

Survey of the use of helicopters by the armed forces of the U.S., France, the U.K., the Soviet Union, and other European countries. A theoretical discussion of helicopter applications in combat and transportation is backed up by data of practical experience obtained in Korea, Viet Nam, and Algeria, with emphasis on guerilla warfare. The specific uses of a variety of light and heavy helicopter types are discussed, as well as the helicopter production facilities of some of the countries.
100. NEW HORIZONS FOR ARMY AVIATION. J.J. Tolson. (Data, Volume 9, August 1964, pp. 9+)

An interview with Brig. General John J. Tolson, who discusses the present status of and offers his personal predictions on Army Aviation of the future.


Discussion of two types of environment in which the Army helicopter operates. These are (1) the operational environment, which includes the elements and factors that influence, or have a bearing on, the overall efficiency and capability of Army aviation; and (2) the induced environment, which is considered a man-machine relationship and covers some of the human-engineering aspects apparent in this relationship. In considering these areas and the problems associated with them, possible solutions being investigated are described briefly.


The title of this paper is "V.T.O.L. and S.T.O.L. Aircraft and Helicopters and the System of Air Traffic Control they will require," but it does not set out to give an audience of Air Traffic Control experts a lecture on how they will have to run their business in the future. What it does do is to make a few remarks on how the operators will wish to run these types of aircraft, when they have them, and to draw some inferences about the new problems in Air Traffic Control which will have to be solved as a result.

One point which may vitally affect the operation of all these types of aircraft is noise, but this is not discussed. Instead it will be tacitly assumed throughout the noise problems will have been overcome before the aircraft go into service.
H. NAVIGATION
103. ARMY TACTICAL AIR NAVIGATION AND TRAFFIC CONTROL. W.M. Young.  
(Army Aviation Digest, Volume 2, March 1956, pp. 5-8)

In any combat operation, it is the desire of the field army commander to be able to move his units rapidly in any direction, at any time, within the theater of operations and to know in advance what opposition awaits his units at a new location. Collection and evaluation of information which will reveal this opposition is the mission of battlefield surveillance, a mission in which the Army aviator plays an important role. However, the phase in which tactical air navigation and traffic control systems are most essential is the actual movement of men and materiel.

104. AUTOMATION IN AIRCRAFT NAVIGATION AND AIR TRAFFIC CONTROL. 
(British Communications and Electronics, Volume 10, June 1963, p. 459)

Brief description of the HARCO (Hyperbolic Area Coverage) navigation system. It consists of a small general-purpose digital computer (Omitrac Mark II) whose basic task is to convert the normal Decca hyperbolic positional information into rectilinear coordinates to enable the Mark III Flight Log pictorial display to employ distortion free charts. In this manner the full benefits of pictorial presentation can be realized at all points of coverage. The Decca receiver is also discussed. Noted is the air-to-ground data-transmission system, known as the Decca Data Link, which is compatible with HARCO.

105. THE DECCA INTEGRATED AIRBORNE NAVIGATION SYSTEM. (Intersavia, Volume 13, May 1958, p. 421)

After three years development work Decca Radar Limited has produced a Doppler radar which, combined with Decca/Dectra, provides aircraft with a complete universal navigation system, known as DIAN (Decca Integrated Airborne Navigation).

Doppler radar alone does not fully meet the requirements of air traffic control in high density traffic areas. It is for this reason that the integration of Doppler with Decca/Dectra is of special interest.

The purpose of this study was to investigate existing and proposed navigation systems to determine their potential usefulness in the common system of air-traffic control (ATC). An important part of the project was to obtain information about navigation systems that would be available to the Air Navigation Development Board (ANDB).


The hyperbolic type of navigation system, in which the position-lines are the loci of points at which there is a constant difference in the arrival-time or the phase of signals received from a pair of spaced transmitting stations, can furnish a level of position-fixing accuracy sufficient for the requirements of air navigation and air traffic control (ATC) in areas of high traffic density.


Discussion of various improved navigation aids and analysis to two types of all-weather landing systems. The first type uses the ground-radar-acquisition techniques, and the second utilizes pilot-derived methods. The Bell Aircraft G3N-5 is described as an example for the former. The British BLEU (Blind Landing Experimental Unit) and the American AN/ APN-114 systems are presented as examples of pilot-derived systems, using airborne radio altimeters for height finding.
109. NAVIGATION AIDS IN PROTECTION OF GROUND FORCES BY FIGHTER AVIATION.
Z. Guminski. Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Division. (4 February 1963, 7 pp.; Translated into English from Wojskowy Przeglad Lotniczy (Warsaw), Number 1, 1962, pp. 13-16) AD 298 222

Fighter aircraft that are protecting forces engaged with the enemy must act beyond the front lines; fighters assigned over enemy territory must remain there only a short time. Boundaries of transmitting the vectoring of fighters in the air from one point to another must be ascertained in advance. This paper discusses these navigation aids for fighters.

110. PICTORIAL NAVIGATION DISPLAYS AND LOW ALTITUDE NAVIGATION.

Described are what a pictorial navigation-display system for use in Army aviation should do, how it should look, and what tactical and training implications such a device might have. Evaluated in these terms are the ACF RT-1B, Bendix's Position Fixing Navigation System (PFNS), and Bendix Air Navigation Display System (BANDS). None of the three met all the major requirements. Potential modifications of the ACF RT-1B for Army tactical use at very low altitudes are suggested.
I. RADAR
1. General


In an effort to improve the traffic handling capabilities and safety of the U.S. air traffic control system, automation of certain functions of the air traffic controller is being undertaken. In the transfer of certain responsibilities from the human to a machine, there arises the problem of maintaining within the machine the all-important relationship of aircraft position with that of aircraft identity. This paper outlines briefly the problem generated in the transition from man to machine and shows how the introduction of height is expected to relieve this particular situation. A comprehensive description of the Air Height Surveillance Radar, the source of the height data, is given.


The growing complexity of air traffic—both civil and military—has forced air-traffic-control operators to rely more and more on automatic means to prepare surveillance information. Radar is the best means of locating airborne targets, and the plan-position indicator translates this radar information into understandable form. However, human control of air traffic based on observing displays is not sufficient today, because of the high speeds and large numbers of aircraft. Automatic equipment has to be introduced for the routine work, thus freeing the operators for special surveillance and control tasks.
The University of Michigan has developed an airborne radar system for combat surveillance which has a potential for obtaining fine azimuthal resolution at extended ranges.

The equipment is partly airborne and partly ground based. The airborne equipment consists of a side-looking coherent radar employing an antenna of conventional size. The radar output is recorded on film. A ground-based processor operates on the filmed data to produce the equivalent of a radar system with an extremely long focused antenna which increases in length with increasing radar range.

Results of flight tests are presented.
116. WHAT'S AHEAD IN ATC RADAR. (Aerospace Safety, Volume 20, February 1964, pp. 20-21)

Exactly who you are, where you are and how high you are—that's the information air traffic controllers will have on every military pilot by 1967 if the goal established by the Secretary of Defense is realized.

Programmed implementations to achieve this goal include: installation of the new Air Traffic Control Radar Beacon System (ATCRBS/IFF) in all aircraft types being delivered in 1965, action in current production design so as to minimize retrofit, and a 20 per cent retrofit by the end of 1965. Although the above refers to airborne retrofit goals, necessary military ground facilities retrofit requiring interrogator, decoder and display modifications are anticipated in a corollary program.

Also discussed are the Primary (Row) Radar, the Basic Mark X, the Mark X Selective Identification Feature (SIF), and their limitations.


Description of the ARTS electronic system (Advanced Radar Traffic Control System) whose initial installation is scheduled for the Atlanta Terminal area. ARTS is a radar track-while-scan system that accepts inputs from a single radar-beacon combination (ASR-14 and ATCR-1), tracks the video, decodes the beacon, associates alpha-numeric tags (data blocks) with selected video targets on the controller's radar displays, and automatically maintains this association.

2. Beacon

118. ALTITUDE PROCESSING IN ATCRBS. J. Freibaum. (IRE Transactions on Aerospace and Navigational Electronics, Volume ANE-8, Number 4, December 1961, pp. 149-152)

Equipment to process and display beacon-derived altitude information, being developed to enhance operational capability of Air Traffic Control Radar Beacon System, is described; beacon identity and altitude information assists air traffic controller to establish positive identification quickly and reliably; radar handoff procedures are completed more efficiently.
119. ENGINEERING EVALUATION OF AN/ARA-44 (U). V.R. Weidner. (Directorate of Operational Support, Engineering Aeronautical Systems Division, Wright-Patterson Air Force Base, Ohio, ASD TDR 62 890, Final Report, Project Number 921A9057, November 1962, 114 pp., SECRET) AD 336 946L

DESCRIPTORS: Radar beacons, Radar equipment, Simulation, Discriminators, Environmental tests, Display systems, Test methods, Reliability (U).

120. EVALUATION OF GENERAL AVIATION TRANSPONDERS. R.H. Boutillette, et al. (National Aviation Facilities Experimental Center, Atlantic City, New Jersey, Interim Report, Project Number 108-8V, November 1962, 48 pp., UNCLASSIFIED) AD 298 308

DESCRIPTORS: Transponders, Radar beacons, Air traffic control systems, Flight testing, Transmitter-receivers, Airborne, Ultra high frequency.


The purpose of this project was to conduct a technical and operational evaluation of General Aviation Transponders to (1) determine extent of compliance with procurement specifications and with the performance criteria associated with the Air Traffic Control Radar Beacon System (ATCRBS) and (2) assess the performance and utility under actual operational conditions, and the benefits which might be derived from widespread implementation.

122. FAA BEACON INTERROGATION TRAFFIC CONTROL MONOPULSE RESOLUTION IMPROVEMENT AND PHASE SENSITIVE DETECTION. A. Longacre. (Syracuse University, Research Institute, New York, Contract FAA/BRD-3140, Final Report, March 1963, 45 pp., 6 refs., UNCLASSIFIED) X63-15757

Monopulse Resolution Improvement has been applied to a beacon interrogation system so that azimuths of resolved aircraft may be determined with the intrinsic accuracy inherent in an azimuth-scanning pulsed radiation system for aircraft over ranges from 2 to 200 nmi from the interrogate-receive station. The fact that airborne transponders are good point sources which are not immersed in clutter permitted reliable location of the aircraft to one-fifteenth (1/15) of the beamwidth of the interrogate-receive radiation patterns, or to about 0.1°.
123. INTRODUCTION TO AUTOMATIC ALTITUDE REPORTING FOR AIR TRAFFIC
CONTROL. W.T. Carnes, Aeronautical Radio, Incorporated,
Washington, D.C. (IRE Transactions on Aerospace and Navigational
Electronics, Volume ANE-8, Number 4, December, 1961, pp. 122-124)

This article presents a brief history on the development of
Automatic Altitude Reporting via the ATC radar beacon system,
(ATCRBS) and a review of current activities in the field, future
operational needs, and the technical problems involved in
Automatic Altitude Reporting.

124. A MATHEMATICAL ANALYSIS OF THE PERFORMANCE OF THE ATC RADAR
BEACON SYSTEM. A. Ashley, F.H. Battle, Jr. Airborne
Instruments Lab., Division of Cutler-Hammer, Incorporated,
Deer Park, Long Island, New York. (IRE Transactions on
Aeronautical and Navigational Electronics, Volume ANE-7,
Number 3, September, 1960, pp. 77-83)

The Air Traffic Control Radar Beacon System is intended
to provide the air traffic controller with continuous, reliable,
and accurate information concerning the plan position and
identity of any and/or all equipped aircraft in the airspace
under his control. Like any system, however, it has practical
limitations that must be recognized. The Federal Aviation
Agency and the military services have sponsored a series of
studies and test programs intended to reveal and measure these
limitations, with a view toward optimizing their performance.
This paper briefly describes the methods we have used in
mathematically synthesizing system performance, and presents the
major conclusions and recommendations that seem justified by
the results.

(Control Engineering, Vol. 9, No. 1, January 1962, pp. 21-22)

FAA does a turnaround after Project Beacon group criticizes the
agency's special-purpose computer, flight stripe, automatic communica-
tion system, and three-D radar.
Presented are the results of a study of the performance and requirements for decoders in the ATC Radar Beacon System. Many related topics are also presented. The study, essentially analytical, views the decoder from a functional standpoint in the performance of the overall system rather than as a piece of hardware. An extensive list of conclusions and recommendations is presented as a guide for system and component design in order that a continuously improving system may evolve.
J. WEAPON SYSTEMS

DESCRIPTORS: (Aircraft intercept control systems, Air control centers, Ground controlled interception systems, Europe, Antiaircraft defense systems.) (Data processing systems, Display systems, Radar equipment, Ground support equipment, Communication equipment, Radio equipment, Design, Tests.) (Detection, Aerial targets, Tracking, Identification.) (Control systems, Guided missiles, Surface to air, Jet fighters.)

128. AIR WEAPONS CONTROL SYSTEM 112L. SYSTEM DESIGN ANALYSIS REPORT USAFE 112L. SYSTEM EMPLOYMENT DEFENSE OPERATIONS EVALUATION STUDY. VOLUME II. AWCS-MG-6 (SE-DOES) (U). (General Electric Company, Syracuse, New York, Contract AF 19(628)-513, 31 December, 1962, 32 pp., SECRET) AD 334 735

DESCRIPTORS: (Aircraft intercept control systems, Antiaircraft defense systems, Data processing systems, Costs, Kill probabilities, Reliability, Failure (Mechanics), Ranges (Distance), Radar signals, Jet Fighters, Aerial targets, Maintenance, Maintenance personnel, Simulation, Air control centers.)

129. 112L AIR WEAPONS CONTROL SYSTEM. (Automatic Control, February, 1963, pp. 98-99)

A comprehensive and automatic air control system representing a proportionate increase in U.S. defensive ability overseas were needed. The 112L system meets this need, especially during overseas tactical and "limited war" crises. 112L is used principally outside the continental United States, and transportable for air-lifting and installing anywhere in the free world where air hostilities are expected.
130. 412L AIR WEAPONS CONTROL SYSTEM. (Signal, Volume 17, November 1962, p. 46)

The Air Force and General Electric Company are testing part of a mobile air weapons control system which could be used some day by the United States in brush fire warfare in a jungle 12,000 miles away.

It will be the nation's first automated fully mobile air weapons control system, performing these tasks in areas beyond the reach of SAGE.

The purpose of system 412L is a simple one—to give the Air Force eyes, ears and a nervous system over seas. When completed and ready for operation, it will keep foreign skies under constant guard, spot, identify and evaluate flying objects in the air in seconds and tell commanders what weapons they should use to destroy these objects if they prove unfriendly.


DESCRIPTORS: ~Command and control systems, ~Air control centers, ~Fire control centers, ~Radio equipment, ~Radar equipment, Identification, Command guidance, Temperature control, Flight control systems, Radar jamming, Aircraft, Power supplies, Generators, Cooling, Air conditioning equipment, Radio transmitters, Radar tracking, Air traffic control centers, Mobilization, Air force operations, Mobile, Aircraft intercept control systems, Display systems.