Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: AIR DEFENSE BIWEEKLY REPORT, January 16, 1953

CAPE COD

1.0 GENERAL

(C.R. Wieser)

The Lincoln Laboratory has decided to demonstrate to the Air Force the performance of Lincoln's proposed air defense system, and it is most important that this demonstration be held by September, 1953. Needless to say, this is a tight schedule which requires an all-out effort from all the people who are in any way connected with preparation of the Cape Cod system.

A series of meetings are being held by J.W. Forrester in which Groups 61 and 64 are formulating plans for the September demonstration. These meetings, which are still going on, are aimed at freezing plans for September so that equipment construction and programming needs will be defined. The goal is to complete all construction by July 1 to allow time for program testing and operating practice.

At the moment, the delivery date for the buffer drum looks too late to allow completion of equipment by July 1. An alternate scheme which does not require the buffer drum is being studied and might have to be used (the drum will be used if available).

The proposals arrived at so far should be regarded as tentative, and as the plans become firm they will be reported on. Briefly, the objective is to include as many features of the Transition System as can be built in time. The Transition System is described in Lincoln report TM-20 (SECRET), which is available through Marilyn Susskind.

2.0 EQUIPMENT ENGINEERING

(H.J. Kirshner)

Group 60 has modified the circuitry connected with the push button in Test Control, formerly labelled "Selective FFS Reset-Manual" so that it now operates in "Automatic." The two selective reset push buttons are now labelled "#1 FFS Selective Reset and Restart" and "#2 FFS Selective Reset and Restart." A push button in Room 222 is connected in parallel with push button #1 above and is located at the left-hand 16" scope light gun selector switch. Push buttons in parallel with push button #2 above are located on the G.O.C. Box and on the right-hand 16" scope light gun selector switch.

2.0 EQUIPMENT ENGINEERING (CONTINUED)

(H.J. Kirshner) (Continued)

After January 19, two light guns will be available in Room 222 each having access, through a selector switch, to the sign digit and one of digits one through eight inclusive of the I.O.R.

Installation of cabling for the video mapper has been delayed by construction required for the above installation and the loss of technician availability caused by early morning (11 p.m. to 3 a.m. and 4 a.m. to 7 a.m.) Group 61 computer operation. To alleviate this latter difficulty, Group 61 computer operators are being trained in Group 61 special equipment operation and another assigned technician is to be employed when one reasonably well-qualified is found. In addition, Group 60 night shift technicians may also be trained in equipment operation. Group 61 computer operators and Group 60 technicians should not be expected to perform quick repairs on Group 61 equipment during night operations.

As was mentioned in a previous biweekly report, the Blue Coder (Automatic Ground-Air Data Link terminal equipment) has been cabled to the computer as a 16-digit system. It is now operating satisfactorily and was used in a successful flight test on January 16.

The H.F. radio equipment, installed for point-to-point communication has not, in its present state of installation, shown itself to be reliable enough for our use. The problems are those normally encountered with equipment of this sort, namely, propagation change with time of day and siting.

A new type S.D.V. demodulator was tested using Scituate data and is operable. It has been returned to the In-Out Group for use with the M.I.T.E.

(B. Morriss)

It has been proposed that the introduction of data from the N. Truro radar site take place in three phases:

1. Direct connection of a single S.D.V. to polar coordinate conversion unit (M.I.T.E.) through the in-out system.

2. The addition to M.I.T.E. of sufficient flip-flop buffer storage to store four ranges per azimuth.

3. Connection through the buffer magnetic drum as previously proposed.

2.0 EQUIPMENT ENGINEERING (CONTINUED)

(B. Morriss) (Continued)

Rough block diagrams have been prepared for phases 1 and 2. During phase 1 data is available to the computer only during the range increment in which it arrived so that it will be necessary to sample approximately every 250μs to insure that no data will be lost.

Sampling is done by selecting the set with an si instruction and following this with an rd. If data exists it will be introduced into the accumulator, while if none is available the program will skip an instruction. It would be just as easy to have the program skip if data is present and not to skip if no data is present.

For phase 2 there exist many ways of providing buffer storage. One which has been investigated and appears to be simple and straightforward is to provide two banks of four 8-digit registers. During an azimuth interval one bank will be available for storing ranges while the other is available for reading together with the contents of the azimuth counter to the computer. The principle disadvantage of such a system is that a maximum of four returns per azimuth may be obtained no matter how fast the sampling by the computer takes place. Other buffering systems will be investigated during the next period.

(J.H. Newitt)

Most of the past biweekly period was spent in planning for the new WWI equipment program. A survey of shop, drafting, stockroom, production control and outside vendor facilities is now underway so that the new burden can be absorbed as efficiently as possible.

The Minneapolis-Honeywell control system submitted for the new air conditioning system has several objectionable features from our standpoint. Since these were in direct violation of my specification, I called a meeting between Minneapolis-Honeywell, E.A. Berman Co. (the installing contractor), Francis Associates (our consultants) to straighten the matter out. Joe Gano and Jim Lynch attended the meeting to air their experiences and difficulties with the present WWI air conditioning system. After numerous sessions with air conditioning contractors and with the Minneapolis-Honeywell representative, I have reached the firm conclusion that most installation contractors are not well informed about control systems and that the Minneapolis-Honeywell representative is not too well versed about air conditioning. Since both relied heavily upon each other, some obvious gaps developed which had to be resolved. Our consultants were most valuable in this respect since they added considerably to the edification of both parties. Most air conditioning work is based on comfort rather than process conditions. The philosophy of design in each case is quite different; this is one source of the present difficulty. The present squabble over the control system will in no way affect the installation work now going on in Barta since much remains to be done before the controls can be installed. It is expected that the penthouse on the Barta roof will be completed before the end of February and the system will be operative in March.

2.0 EQUIPMENT ENGINEERING (CONTINUED)

(F. Sandy)

Room 156 Power Distribution. The starter arrived for the motor-generator set which will supply power to the magnetic drums. However, it is too small. It is planned to replace it with one a size larger.

Gavitt Mfg. has completed the delivery of the power cables for M.I.T.E.

(A.V. Shortell, Jr.)

Work on the portable rack setup for the video mapper is nearly complete. The mount for the scope is due from the machine shop next week, all necessary panels have been built, and cables and switches from Rm. 224 to Rm. 222 have been provided by H. Kirshner. It is expected that this equipment will be tried out in Room 222 during the next biweekly period.

(G.A. Young)

During the last biweekly period, a program was written to aid in checking the Auxiliary Drum while it is being installed.

Block diagrams were drawn to show how the new Ground-to-Air Link Unit being constructed by AFCRC may be tied into the computer.

A pulse will be received from this unit when it is ready to record. It will record two 16-digit binary words in a fixed sequence.

With the proposed means of control the unit will operate on an si and an rc. Only one rc may be used with each si. If a second rc is given, the computer will stop.

si - the content of AC will be recorded (record #1) if the unit is ready to receive a word.

rc - the content of AC will be recorded (record #2) if the unit is ready to receive a word. If the unit is not ready, an order will be skipped in the program.

A program is being written to be used with marginal checking of the Auxiliary Drum.

A note describing the operation of the paper tape units is being written and will soon be completed.

2.0 EQUIPMENT ENGINEERING (CONTINUED)

(C.A. Zraket)

The major part of the past biweekly period has been spent in completing the research work on the thesis, "Test Checking a Magnetic Drum Buffer Storage System." The formal write-up of the thesis will be undertaken during the next academic term.

3.0 BEDFORD EXPERIMENT

(F.M. Garth)

Need has arisen for a check out program to test any in-out equipment which might be used during flight tests or operation of various programs. William Lemnios and I have been collaborating on such a program. Combined with it will be parameters to calibrate radars as well as scopes. The automatic initiation method I now use first extrapolates along the scramble heading given the interceptor. After an airborne communication is received it then assumes the interceptor will fly close enough to an extrapolated moving point to be accepted by the search area. I have been planning a more sophisticated technique which will require any aircraft flying into the search area to have some velocity and a heading reasonably close to that of the extrapolation. This should eliminate initiation on any extraneous aircraft or clutter which might enter this critical region.

(C. Gaudette)

In the last biweekly I indicated that azimuths in the MEW data were occasionally coming in out of sequence on both live and recorded data.. The single pair intercept program has been modified so that these irregular azimuths will not affect the operation of the program unless this azimuth belongs to one of the tracked aircraft or is falsely selected as the azimuth producing the best piece of data for one of the tracked aircraft. Since this modification has been incorporated into the program, ten excellent runs have been made; three live runs and seven using Ampex Tape.

The new "Demonstration of Display Techniques" program being written by P. Cioffi, M. Brand, and myself is nearing completion. The program will utilize the new Scope Display Control Boxes now installed in Room 222 in the Barta Building.

(F. Heart)

It is often desirable to observe a representative, successful interception from recorded data, either for analysis or demonstration purposes. In order to facilitate rapid location of such recorded data, a length of tape, called Ampex Tape #236B, has been rewound on a separate reel and is readily available.

3.0 BEDFORD EXPERIMENT (CONTINUED)

(F. Heart) (Continued)

Work has continued, with S. Knapp and A. Ward, on the four-pair interception program. Necessary equipment construction and modification was requested and has been completed. The program has been completed, and preliminary testing will begin during the next biweekly period.

With C. Gaudette, specifications were considered for a program to check various air defense center equipment and radars. F. Garth and W. Lemnios are now working on this program.

One day was spent at N. Truro to observe both the operational G.C.I. and the quick-fix efforts. My particular interests were in the area of "information flow" and "display."

(S. Knapp)

The Four-Pair Intercept Program has been completed and is awaiting trial on the computer.

A successful flight test was held using the Two-on-One Intercept Program. Three runs were taken. In the first, the target started from 20 miles east of Sanford and headed for Alton Bay., N.H. The first fighter started from Alton Bay and a head-on interception was accomplished. The second interceptor started from Grenier and intercepted the target about five minutes after the first. In the second run the same courses were followed but the two interceptions were simultaneous. In the third run the target flew south from a point on his way home and was intercepted from either side. This also was a simultaneous interception.

(W.Z. Lemnios)

A program which will check the three printers, the sixteen scope lines, the eight switch positions of both light guns, the camera, the clock, the punch, the photoelectric reader, and the mechanical reader has been started. The program is being written in conjunction with F. Garth

(C. Zraket)

A flight test was conducted on January 16 to test the operation of the 16-digit VHF automatic ground-to-air data transmission link. The interceptor employed was the Instrumentation Laboratory's B-26 (898) which is equipped with an autopilot (APG-3, George Jr.). This system uses the Blue Coder in Room 224 and ties into the computer via FF3. Three intercepts were attempted, all completely automatic. The interceptor passed directly beneath the target on Runs 1 and 3, and 1,500 yards in front of the target on Run 2. The operation of the data link was excellent.

3.0 BEDFORD EXPERIMENT (CONTINUED)

(C. Zraket) (Continued)

Two more data link systems are envisioned for the future: the first, a 16-digit UHF system using the Blue Coder and FF3; the second, a 33-digit UHF system which will be tied to the computer via IOR, and not via FF3 and the Blue Coder.

When time permits, C. Gaudette and I will modify the present Combined Intercept Program in another attempt to take care of the situation that arises when an aircraft crosses or comes near the path of the main track. The program will also be modified so that it will continue to track the interceptor and target after the interception is completed and will also stop transmitting data link heading angles at this time.

4.0 DATA SCREENING

(R.L. Walquist)

All of the past biweekly period has been spent in helping to settle the specifications for the Cape Cod experiment scheduled for September of this year. It is expected that the buffer drum will not be available for the September demonstration. As a result, alternative methods of collecting data have been studied. The method decided upon requires that the computer sample for data at least once each azimuth quantization unit, (about 55ms between samplings). It is proposed that a system of three radars, comprising the N. Truro CPS-6B and two gap-fillers (such as Rockport and Scituate), make up the radar network for the fall demonstration. The N. Truro set will be limited to four ranges per azimuth, while each of the gap-fillers will be limited to two ranges per azimuth.

S.D.V. data from the N. Truro CPS-6B will be available at the Barta Building around February 1, 1953. Tie-in with the computer should occur shortly after that time. The initial installation of the N. Truro set will allow the computer to receive all ranges for each azimuth as long as the computer samples at least once each 250μsecs. Initial programs utilizing the N. Truro data will be for data analysis studies.

(W.S. Attridge, Jr.)

For the second and third times the maximum effort flight test has been cancelled because of bad weather. We are hopeful of running this test on January 22.

The Data Screening section of the Lincoln Summary Report has been completed.

(D. Goldenberg)

My work on the problem of intersecting tracks has been stopped. An interoffice memo was written summarizing the work to date.

4.0 DATA SCREENING (CONTINUED)

(D. Goldenberg) (Continued)

Work has been started on the problem of determining the error in the positions of a target as reported by two or more radars due to the curvature of the earth.

(J. Ishihara)

Work on preliminary flow diagrams for Muldar Tracking Program (MTP #2) has been started. The possibilities of using MTP correlation methods on live data without a buffer drum is being investigated.

(J. Levenson)

I have completed a program for numerical display of data from MTP#2 and am awaiting computer time to test it.

A major portion of this biweekly period has been spent on plans for correlation with the auxiliary drum. The radar coverage is divided into geographical boxes and tracks are grouped on the drum according to box. The tracks are brought into high-speed storage for comparison with incoming data and again for smoothing and prediction of new positions. In the latter case tracks must be re-stored in a different box, according to new position. If all the tracks cannot be brought into high-speed storage at once, a systematic arrangement of data must be found to minimize the time spent waiting for groups and initial addresses for transfers to and from the drum. As yet no "best" solution has been found.

(H. Peterson)

During this period I wrote and checked out two new three-radar, display and storage (on magnetic tape) programs. These include certain checks to avoid program destruction that we run into. It might be well for others to note the difficulty we ran into on the standard procedure for running a magnetic tape unit backwards: namely, the record in reverse mode. On occasion data was read as block marks and then the next piece of data would be destroyed as the desired distance did not occur between pieces of data.

I also sat in on a conference with J. Levenson on monitoring and with Wells and Potter on altitude correction.

(H.H. Seward)

A program was written for reading blocks of r,θ returns into ES from a magnetic tape unit, each block containing up to 50 returns. Each block of returns is then converted to x,y coordinates and displayed with maximum rapidity. Parameter 1 of this tape (#2331) contains all 256 values of both sine and cosine in ascending magnitude of θ. The program is now awaiting computer time.

4.0 DATA SCREENING (CONTINUED)

(N.S. Potter)

The programmed material mentioned in the previous biweekly has been run with only partial success and will be tried again after appropriate corrections have been made. Work has been done in association with H. Peterson on determining the distribution of errors in the coordinates of an aircraft with respect to a reference plane containing the muldar system. An expression for the expected error has been obtained and an attempt is being made to determine the maximum quantization level which will maintain the error within prescribed limits.

5.0 TRACKING AND CONTROL

(J.A. Arnow)

The major portion of the last biweekly period was spent in attending meetings relevant to the installation of equipment for the Cape Cod System and logical design of WWII.

(S. Best)

I am trying to find out how to program a method for smoothing in the aircraft's coordinates using velocity and heading. (See M-1344). The immediate goal is the determination of workable smoothing constants assuming linear smoothing. Non-linear smoothing will be considered later.

I am writing a program to simulate crossing tracks in order to determine how such quantities as the angle between the lines of flight, the speeds, and the time lag at the crossover point affect the probability that the track will be lost.

(M. Frazier)

A scope calibration program for two small radars has been written. The constants are written in for Rockport and Scituate, but may be varied by flip-flop register settings if a different start-over point is used. The program displays the sites of the radars inner and outer range circles, and a circle externally tangent to the two outer range circles. This program has not yet been checked out, but probably will be during the next biweekly period.

A program to check the maximum number of orders which may be used before inspecting flip-flop registers has been written in connection with semi-real-time programming studies. Work continues on these studies, primary effort being to simplify the technique to the point of practicability.

5.0 TRACKING AND CONTROL (CONTINUED)

(W. Lone)

I am continuing the trouble-shooting of the program which stays fixed on a track when other aircraft cross its path. Most of the errors centered about setting the size of the search circles to zero which is the procedure when an auxiliary track gets "too close" to the main track.

The program would track properly for a while and then for no discernible reason would smooth continuously. Only under exceptionally fortunate circumstances is it possible to discover the source of these errors while operating the computer. The next day the reason for the error was uncovered and corrected but another week elapsed before it could be tried again. Then another error was found and another week passed before it could be tried.

If more total computer time per week cannot be permitted the group, it is recommended that the available time be distributed so that there is less waiting between successive program modifications.

(W. Lone, A. Mathiasen)

Some time is being spent standardizing the use of the light gun, scope lines, flip-flops, parameter tapes, and miscellany in two radar tracking programs and modifications thereof in order to enable various members of this section to run each other's programs without memorizing varied and complicated operating instructions.

(A. Mathiasen)

The error in the current two-radar tracking program mentioned in the biweekly of December 19 was traced to an arctangent routine. The program has since worked satisfactorily. It was used in corroboration of the calibration of the Halibut Point radar in behalf of R. Mechlin of Group 22.

(H.D. Neumann)

This biweekly period was spent studying Michigan WRRC and Boeing reports describing the Bomarc project.

The controling equations given in these reports were examined, and a program is being written now to determine the time required to solve them.

6.0 AIR DEFENSE CENTER OPERATIONS

(D. R. Israel)

The majority of the biweekly period was spent in meetings devoted to an analysis and discussion of the most recent proposal for a non-buffer drum Cape Cod System to be operative in September. In addition to previously prepared proposals for the implementation of various non-track-while-scan functions, separate hectographed sheets have been parepared showing (a) the proposed allocation of 32 display lines, (b) the personnel complement of the center, (c) an organization chart.

The discussions of the past two weeks have indicated the advisability of changes in the proposal; these changes will be made as soon as possible. However, it is not contemplated that an M or E series note combining up-to-date descriptions of all the functions will be available before three or four weeks. In the interim period, several people have been asked to undertake detailed consideration and preparatory studies of the September system.

(M. I. Brand)

Work has continued with C. Gaudette and Peter Cioffi on the new "Demonstration of Display Techniques" program. This program is about 75 per cent completed.

(M. I. Brand, P. O. Cioffi, A. B. Ward)

Work has continued on the Identification Section of the September Cape Cod System. During this period trips to North Truro were made for the purpose of observation of the Identification Section of both the Air Force GCI Station and the Project Lincoln Quick Fix Section. Talks were held while there with R. Enticknap of Project Lincoln and Captain Chaipin, Identification Officer at Project Lincoln, regarding phone lines necessary for the ID system we plan. Several more talks were held with R. Davis of Project Lincoln. A visit was made to the Air Route Traffic Control Center to observe operation.

A tentative work outline has been prepared and submitted showing a schedule of tests and projects we plan to conduct in the near future.

We were presented several days collection of flight plan cards by Miss Ann Smalley of Project Lincoln. These will be analysed with respect to frequency, quantity, routes, destinations, departure points and check points.

Work is progressing on a program flow diagram for the Identification program.

6.0 AIR DEFENSE CENTER OPERATIONS (CONTINUED)

(O. T. Conant)

This period was taken up with preliminary considerations of organization of the non-track-while-scan functions of the Cape Cod System Operations Center on the basis of internal communication. The immediate purpose of this study is a complete simulation of computer functions and displays in order to study the problems of timing, positions, saturation of the system, etc. and the information channel requirements. This project will be continued in the next biweekly period, and also standardization of a library of sub-routines to be used in interception calculations and scope displays will be undertaken.

(J. J. Cahill, Jr.)

A modification of the Combined Intercept Program,(T-2187-M5) has been written which displays the r, θ coordinates from the Scituate TPS-10 Height-Finder, as well as from Rockport. The AAA section has been rewritten to display the θ & ϕ (elevation angle) in mils and the r in thousandths of yards.

The AAA test and Height-Finder Calibration test of January 6 were both cancelled. The AAA test was cancelled due to aircraft unavailability. This seems to be getting to be a habit. A standby aircraft will be requested for the next AAA test.

During the three-dimensional interception of January 16, a time record was kept of the height-finder procedure both at the site and at Barta. Except for the fact that massive clutter kept the usable range of the weapon below normal, results were on the whole very satisfactory. A description of the results will be issued as Supplement No. 1 to M-1728, on the MPS-4 Height-Finder.

It now seems safe to consider MPS-4 as completely checked out and concentrate in the future on the Scituate TPS-10.

During the past two weeks, trips were made to the Rockport site and to the sites of the AAA Batteries in the Whirlwind system to acquaint M. Geraghty with procedures and equipment.

Material has been gathered together for the Cape Cod System proposal for height-finding and antiaircraft features for September.

6.0 AIR DEFENSE CENTER OPERATIONS (CONTINUED)

(M. A. Geraghty)

At the beginning of the last two weeks, I went up to the Height Finder Rockport site and the antiaircraft sites near Lynn, in company with Jack Cahill, in order to familiarize myself with the layout and procedures at these sites.

Since then I have been studying the rough drafts and other material on the September Cape Cod System and assisting Jack Cahill in the preparation of proposals for height finder and antiaircraft equipment and functions within this project.

(F. E. Heart)

An informal organization chart of the "operations" part of the 6520th Test Support Wing has been prepared and copies are available from the writer.

A "Fighter-Director" vocabulary list, taken from a Navy C.I.C. magazine has been duplicated and is available from the writer.

An attempt is being made to keep a log in Room 222, Barta. Persons making equipment changes in Room 222 are requested to make appropriate entries in this log. Persons using equipment are requested to note any troubles in this log. The log is kept on the desk in Room 222. Art Hill is responsible for this log and questions may be directed to him or to the writer.

In order to permit operation of a Four-Pair Interception Program, as well as to improve the generality of operation, several changes have been requested in light gun and G.O.C. box operation. These changes are described by H. Kirshner in this biweekly.

A serious effort is being made to obtain photographs of interception experiments and other aerial work. A check has been made as to the facilities of various photo groups in the area.

An attempt was made to install a 16 mm sound movie camera in the nose of a B-25 aircraft. Various mechanical details forced a delay, but this attempt will be repeated. The camera was obtained from Mr. Henry Lane of the Lincoln Photo Laboratory.

Permission was obtained to move the present private line phone (connecting Bedford MEW Hill to Barta) from MEW Hill to operations of the 6520th Squadron. This move, when completed, will permit closer and easier contact with the flight test squadron.

6.0 AIR DEFENSE CENTER OPERATIONS (CONTINUED)

(F. E. Heart) (Continued)

An effort is being made to install a private line phone at Grenier Airbase, as an extension to an existing line connecting Barta to Londonderry, N. H. This installation is awaiting official approval of the Grenier people.

(F. A. Webster)

A talk entitled, "Some Problems of Learning by Computers", was given to the Seminar on Machine Methods of Computation, and has since been typed up. It was designed as a brief introduction to possible practical applications of learning devices to closed-loop systems with partially unpredictable properties.

During the second week I have read part of the proposals dealing with the September Air Defense Center. An attempt is being made to pre-evaluate the probable load distributions in certain of the human linkages. With respect to any given position the problem tends to fall into three main portions: (1) the coding, transmission and reception problems of the in-channel (this, for example, might involve spoken numbers over radio to a headset into which other messages are also channelled), (2) problems of interpretation and decision (particularly with regard to number, time and accuracy), and (3) the method and transmission problems of the out-channel (this, for example, might involve words, symbols or patterns drawn on cards and dropped in a slot). It is clear that the loads must not be such that the system tends to jam at critical points.

(C. A. Zraket)

Studies are currently being made of what simple tests can be performed to simulate the functions of the Weapons Assigner and Squadron Operations Officer in the proposed September Cape Cod System. The tests will be as relatively simple as possible and will not use the computer. Present programs now in use are also being studied to see how they can be used to test the proposed system.

7.C ASSOCIATED STUDIES

(E.J. Craig)

The general line along which a doctoral thesis will follow has now been established. Recent literature especially in the field of Applied Mathematics has given physical insight to the convergence of iteration procedures. In particular it has pictured the solution of n-simultaneous equations as the n-coordinates of the point which is the bottom of an n+1-dimensional cavity. To be less general, for n = z, and for linear simultaneous equations, the cavity can be thought of as a vertical cone (or paraboloid, et.al.) in three dimensions.

The idea behind iteration procedures and those behind sampled-data systems are quite analogous. As a result, several iteration procedures can be represented as multiloop servos.

A report clarifying these two ideas is now in the process of being written. It should be completed or near completion at the time of the next biweekly report.

(W.I. Wells)

The work of the past few months has been concerned with the question of exactly how a system, which must operate on the basis of noisy sampled data, should be analyzed. The approach I have used is to characterize the process which is being described by the data in a statistical sense. Then the noise which contaminates the data is also described statistically. On the basis of these statistical characteristics, probability distribution functions, based upon the values of the individual samples, are calculated. From these distribution functions one is able to make "guesses" at present and future values of the variable in question.

Some progress has been made, and considerable insight into the method has been obtained. It is hoped that some practical problems can be solved in the near future.

Discussion with some other members of the staff has caused me to realize that it is not obvious to all that this approach is justified. Thus, to justify my position on this idea and to present those results that have been derived so far, a rather comprehensive report is being prepared. It is hoped that this report will be able to separate the problem into its basic parts and interpret them. Then the method of approach will be given. The method is rather general but this report will probably deal exclusively with the applications to the correlation problem.

8.0 COMPUTER OPERATIONS

(M. Brand)

The following is a summary of scheduled computer time used by Group 61 during the past biweekly period.

MEW Tracking and Control		
Flight Tests	10 hrs	10 min
Magnetic Tape	1 hr	10 min
Data Screening	5 hrs	35 min
Multiple Radar Tracking & Control	7 hrs	45 min
Air Defense Center Operations		25 min
Indoctrination Programs	1 hr	55 min
Conversion		10 min
Calibration	1 hr	10 min
Equipment Characteristics	1 hr	15 min
Equipment Check		20 min
Visitors & Demonstration	4 hrs	0 min
Total Time Used	33 hrs	55 min
Time Lost to Computer	7 hrs	35 min
Computer Shutdown	4 hrs	0 min
Transferred to Math Group	8 hrs	30 min
Total Assigned Time	54 hrs	0 min
Percentage Assigned Time Used	100%	

9.0 FLIGHT TESTS

(D.R. Israel)

An estimate of monthly flight test requirements for the remainder of this year has been prepared and copies have been sent to Steve Dodd to aid in the scheduling of computer time, and to Captain Thomas Marks (6520th Wing), for his use in determining aircraft requirements. The estimate indicates a steady growth in the number of aircraft hours per week, reaching a peak during July, August, and September when the Cape Cod System will receive its initial tests and demonstrations.

(F. Heart)

A flight test activity report for December 1952 has been issued as M-1790.

Two efforts were made to run a maximum effort flight test with Attridge and Ishihara. This test involves more than 10 aircraft, and all three radar sets (Bedford, Rockport, Scituate). Poor weather forced cancellation in each case and the test has been rescheduled. This kind of test is fairly hard on the Bedford Squadron, but in each case they have been able to supply about 16 aircraft on three radio frequencies.

(A.P. Hill)

Results of Flight Tests Held

Jan 8 1400-1600 Navy Jet Coverage
A F3D was flown on the following course: Bedford-Rockport-Sanford-Concord-Newburyport-Scituate-Quonset.
Many moving targets were present in the test area plus heavy cloud clutter. This made tracking quite difficult. A blip-scan ratio will be made from the Ampex Tape, for more detailed results.

Jan 13 1400-1600 Two-on-One Intercepts
A B-25 was used as the target starting at a point 20 miles east of Sanford, vectoring for Alton Bay, N.H. One fighter (B-25) started over Grenier, the other fighter (B-26) started over Alton Bay. Four runs were attempted. Results were as follows:

Run #1 Fighter #1 passed directly under target
Fighter #2 passed 1/4 mile to right of target

Run #2 Fighter #1 passed 700 ft. ahead of target
Fighter #2 returned to holding point (computer)

Run #3 Fighter #1 passed 300 ft. in front of target
Fighter #2 passed 300 ft. to rear of target

9.0 FLIGHT TESTS (CONTINUED)

(A.P. Hill)

Run #4 Fighter #1 passed 300 ft. ahead of target
Fighter #2 passed 1/4 mile to rear of target.

Jan 16 1000-1200 Interception (with data link and autopilot)
A B-26 was used as the fighter and started at Concord.
A B-26 was used as the target and started 15 miles east of Rockport. Three runs were made. Results were as follows:

Run #1 Fighter passed under target - 0 yd separation.

Run #2 Fighter passed 1000 yds. ahead of target.

Run #3 Fighter passed under target - 0 yd separation.

DATE	TIME	SCHEDULED TEST A/C	SCHEDULED TEST Description	TEST ACTUALLY RUN A/C	TEST ACTUALLY RUN Description	REASONS FOR CHANGES OR COMMENTS
Jan 6	1000-1200	B-25	AAA Test	-	Cancelled	Aircraft Radio Inoperative
	1400-1600	B-25 B-25	Height Finder	-	Cancelled	Weather
Jan 8	1400-1600	F-3D	Navy Jet Coverage	F-3D	As Scheduled	
Jan 9	1000-1200	16 a/c	Maximum Effort	-	Rescheduled to 1/13/53	Weather
Jan 12	1400-1600	F-86	Jet Coverage	-	Cancelled	Weather
	1000-1200	16 a/c	Maximum Effort	-	Rescheduled to 1/22/53	Weather
Jan 13	1400-1600	B-25 B-25 B-26	Two-on-One Intercepts	B-25 B-25 B-26	As Scheduled	
Jan 14	1400-1600	P2V	Navy Coverage	-	Cancelled	No Aircraft Available
Jan 15	1000-1200	F-80 T-33	Take-Off Initiation	-	Cancelled	Weather
Jan 16	1000-1200	B-26 B-26	Automatic Initiation	B-26 B-26	As Scheduled	
	1400-1600	P2V	3 Radar Coverage	-	Cancelled	Weather

* Added to schedule during week of test

WHIRLWIND II

(W.A. Clark)

At the request of N.H. Taylor, contact with the logical design section in Group 62 was established and some time was spent with J. Jacobs and R. Jeffrey in discussion of the first IBM order-code proposal in preparation for the subsequent meetings with Astrahan and company.

Study of the implementation of the Transition System as described in TM-20 has continued. Emphasis is being directed toward the illumination of problems arising in the cross-telling of information between computers.

C. Grandy)

Considerable time has been spent during this period reading and studying reports issued by other groups concerning air defense systems. I have completed block diagrams showing the proposed operation of the Track Supervision Room and the Identification Room described in TM-20. Communication and information flow diagrams for these two operations have also been completed and included in the master diagram being prepared by the WWII study group. I am now writing a detailed description of the proposed operations including alternative methods in most instances. This description should be completed during the next biweekly period.

One of the more interesting devices encountered in my reading is a conducting-glass data take-off system developed by Division 3. This system shows promise of being an excellent medium of communication between the humans in the air defense system and the computer.

(J. Hayase)

The past biweekly period has been spent studying the Transition Air Defense System described in the unrevised and revised versions of TM-20.

Together with G. Rawling a detailed drawing was made showing the flow of radar data and other information into the input drum located at one of the computer centers in an air defense sector. This drawing showed the communication within the center via voice and scopes, and the output information and orders to other computer centers and weapon bases.

(D.R. Israel)

The IBM proposals regarding the logic and order code of WWII have been studied and considerations have been given to the advantages and disadvantages of a "split" or "dual" accumulator such as is suggested. These considerations have now definitely indicated that the utilization of a "split" accumulator is definitely restricted and that the increased

WHIRLWIND II (CONTINUED)

(D.R. Israel) (Continued)

effective speed and flexibility is not worth the cost in equipment or complexity. As an alternative proposal, investigation is presently being made of the effectiveness of the machine in which an additional storage register in the arithmetic element could be used for the temporary storage of numbers added to or taken from the accumulator. (In some respects this would be like a B-Box associated with an accumulator.) Along these same lines, some study is being given to ways in which greater effective use could be made of the normal registers in arithmetic element such as exists in WWI.

(A.P. Kromer)

The draft of a proposal for the design of Whirlwind II was superseded by a series of three actual reports which were studied by interested parties and discussed in a conference session with the IBM engineers. This discussion is to be continued during the coming week in order to determine certain characteristics of the design of the computer. This is necessary to permit engineering work to continue so that designs may be completed and procurement initiated. Both of these are vital if the desired schedule is to be maintained.

The following reports have been received from IBM:

No.	Title	Classification	Date	Author
IBM 4	Prototype Equipment	SECRET	12/22/52	T.A. Burke
IBM 12	Summary of Meeting with B.E. Morriss, R.P. Mayer, M. Epstein	CONFIDENTIAL	12/5/52	B. Housman
IBM 13	IBM-MIT Tube-Production-Study Trip	UNCLASSIFIED		J. Goetz
IBM 14	Proposed Computer--Project HIGH Report IM 6	CONFIDENTIAL	1/12/53	
IBM 15	Proposed Computer--Project HIGH Report IM 7	CONFIDENTIAL	1/12/53	
IBM 16	Proposed Computer--Project HIGH Report IM 8	CONFIDENTIAL	1/12/53	
IBM 17	Sample Correlation Program	CONFIDENTIAL	1/15/53	

A group of IBM people visited the North Truro Field Station to observe the existing Air Force procedures and the Project Lincoln experimental installation located there.

WHIRLWIND II (CONTINUED)

(A.P. Kromer) (Continued)

Continuing work towards setting up a program and handbook covering standardized apparatus components, people from this Laboratory together with IBM engineers, visited the Signal Corps Standards Laboratory at Ft. Monmouth, New Jersey, to review current activity in this field being carried on under Signal Corps direction.

(G. Rawling)

Preliminary study of several proposed weapons systems* which might be of influence on the transition phase of the air defense system is underway. A detailed first draft of the necessary inputs and outputs (both communications and data) to the drum of the central computer has been drawn, in conjunction with J. Hayase. This includes a breakdown by function of operating personnel, with internal communications and computer-controlled displays and totes.

A chronological flow sheet illustrating the functions of the air defense center during a sector air attack is under construction and may be useful in certain future programming.

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* 1) "An Electronic Air Defense Environment for 1954," McREE-50-44, Engineering Division, Wright-Patterson AFB, Dayton, Ohio.
2) "A Multi-Weapon Antiaircraft Defense System," Memorandum #35, Signal Corps Engr. Lab., Ft. Monmouth, N.J.
3) "Manual of Air Defense," (I) C.O.S. (A.C.S.) (49) (121) Great Britain
4) "Research Proposal for Digitalized Air Defense System," Report No. PD-11, Northrop Aircraft, Inc., Hawthorne, California.
5) "Operational Organization of an All Weather Air Defense System," RCAF-1951.