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Memorandum M-1698

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Digital Computer Laboratory  
Massachusetts Institute of Technology  
Cambridge, Massachusetts

SUBJECT: GROUP 61 AIR DEFENSE BI-WEEKLY, October 24, 1952

CLASSIFICATION CHANGED TO:
Auth: <i>DD 254</i>
By: <i>R. R. Everett</i>
Date: <i>2-1-60</i>

1.0 GENERAL

(J. Arnow)

The major portion of the last bi-weekly period was spent in conjunction with visits to IBM.

(P. R. Bagley)

I have begun to familiarize myself with activities both inside and outside the laboratory in the general field of air defense systems. The purpose is two-fold--to be able to discuss air defense matters intelligently with visitors, and to bring to the attention of various members of the group any ideas which may be relevant to their work.

2.0 EQUIPMENT ENGINEERING

(N. Alperin)

The circuit instabilities appear to be corrected and the light gun is ready to be tested. In order to provide a sense of security for the operators both the old and new light guns will be available for use. Only one cable need be switched to change from one gun to the other. This cable is the one going to the input of the coder in room 222.

(H. J. Kirshner)

A four channel gas-tube synchronizer is now under construction. This device will be used in conjunction with interim data input units to be located in room 222.

An antenna system has been erected for the high frequency radio equipment recently procured. The receiver provided with this equipment is in very poor condition and will probably have to be replaced.

Dependable performance has not yet been realized from the S.D.V. receiver recently delivered. A major source of difficulty is that selected 6SN7's must be used in certain blocking oscillator circuits. Circuit modifications will be made to remove this source of trouble.

(B. Morriss)

The first part of the period was spent preparing sketches of the Buffer Magnetic Drum and all associated equipment in preparation for a visit to ERA. The visit to ERA indicated certain changes to conform to

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2.0 EQUIPMENT ENGINEERING (Continued)

(B. Morriss)(Continued)

work which they have done and assumptions with which they have been working. They were left with a set of drawings showing the system which we expect to install and a rough dividing line between the equipment they are to provide and what we will build. Present work is on checking to see that no details were overlooked. A report on the visit by E.S. Rich, J.A. O'Brien, K.E. McVicar and myself will be written by E. S. Rich. The changes in the in-out orders and In-out Control which will be necessary have been outlined and are being taken care of by R. Gould and J. Hughes.

Guy Young and myself discussed the problem of a decimal display with a group from Raytheon and they will visit us again next period.

(J. H. Newitt)

During the subject period I have been successful in ferreting out and resolving the necessary details to produce a finally frozen schedule for WWI new equipment that can be adhered to by all groups. The schedule has been sent to the drafting dept. (to make it easily legible) and a liaison report which will accompany it is near completion. Distribution of this material should take place within a week. As in the past, criticisms of the material are earnestly solicited.

(A. V. Shortell, Jr.)

The cause of the jumps in position of the beam on the video mapper scope has not been definitely located. Microphonic tubes are partly to blame but part of the trouble seems to be peculiar to this particular scope. However I am modifying this scope by reducing the sensitivity according to the method developed by D. Neville.

(C. W. Watt)

Installation of the racks and wireways in Room 156 was almost completed during the past two weeks by Arlex, the fabricator.

Installation of hardware and terminal strips has begun, and will continue at full speed. Three of our own technicians are now on the installation work full time.

The installation and wiring of the power supply control additions to take care of the MITE and the two drums is now completed except for tying into the existing system. The separate equipment, comprising three panels, is now being tested, and it is hoped to partially integrate this equipment with the WWI Power Supply Control on Tuesday, October 25. The panels now installed are the Power Control Panel #2, in Rack TCO of Test Control; the Power Control Indicator panel in Room 156; and the Power Supply Control panel #2 in Room 041. If all goes as planned, the complete system, including the connections to the two filament alternators, will be operational by November 12.

2.0 EQUIPMENT ENGINEERING (Continued)

(C. W. Watt)(Continued)

The arrangement of the Multiple Input Terminal Equipment (MITE) in Room 156 has been decided. The rows of racks have been designated J, K, L, and M. J row is nearest the inner wall, and racks J1 through J8 will house power distribution equipment. The rest of J row is unassigned. K row is next, and racks K1 through K8 will contain 8 sets of MITE gear. K9 through K15 are unassigned. L row is the last row of standard racks. L1 through L8 will contain 8 more sets of MITE gear, L9 through L14 are unassigned, and L15 will contain control equipment for the auxiliary drum. Rack numbers begin nearest the door leading into 156, and run from 1 through 15. M row will be the grouping of the Buffer and Auxiliary Drum Bays, nearest the windows in 156. Wireways overhead will interconnect all the rows and wireways will go up through the ceiling of 156 to the computer room near racks C7, F15, and P7, and to two locations in Test Control. In addition a wireway will connect room 222 and the computer room, and will extend down through 138 and across to 156. R. Dickie has complete layouts of all wireway runs.

(G. A. Young)

Test programs for the Auxiliary Drum are still being written.

Letters have been sent to several companies asking for descriptions of decimal indicators which could be used with a decimal display system. Some companies have already indicated that they are interested in the work. Little helpful information has as yet been received.

3.0 BEDFORD EXPERIMENT

(A. P. Hill)

The following is a breakdown of flight test activities for the period from October 14 through October 24.

Date	Scheduled Test	Tests Held	Reasons for Change in Schedule
Oct. 14	1300-1700 (Brand & Webster) GROUND OBSERVER (4)	As scheduled (4)	
Oct. 15	1000-1200 (Gaudette) TWO AIRCRAFT INTERCEPTS WITH AT AND H.F. (4)	As scheduled (4)	Airborne radar inoperative
	1400-1600 (Heart) F-51 COVERAGE (2)	Test started, not completed (0)	Returned due weather
Oct. 16	1000-1200 (Arnow) (2) COVERAGE Rockport & Scituate	As scheduled (2)	
	1400-1600 (Heart) JET COVERAGE TWO AIRCRAFT (4)	As scheduled (4)	
Oct. 17	1000-1200 (Zraket) FINAL PHASE INTERCEPTS (4)	Test started, not completed (0)	Returned due program
Oct. 20	1000-1200 (Gaudette) TWO AIRCRAFT INTERCEPTS (4)	Cancelled (0)	Testing program
	1400-1600 (Heart) TAKE-OFF INITIATION (4)	Cancelled (0)	Fighter aircraft not available
Oct. 21	1000-1200 (Heart) TAKE-OFF INITIATION (4)	Cancelled (0)	Aircraft mechanical trouble
	1300-1500 (Brand & Webster) GROUND OBSERVER (2)	As scheduled (2)	
Oct. 22	1000-1200 (Gaudette) TWO AIRCRAFT INTERCEPTS (4)	One hour only (2)	Testing program second hour
Oct. 23	1000-1200 (Gaudette) TWO AIRCRAFT INTERCEPTS (4)	Cancelled (0)	Aircraft returned to base. Computer inop.
	1400-1600 (Gaudette) TWO AIRCRAFT INTERCEPTS (4)	Cancelled (0)	Mechanical trouble with aircraft
Oct. 24	0900-1200 (Gaudette) TWO AIRCRAFT INTERCEPTS (6)	Ran from 0900-1100 (4)	For demonstration
Total aircraft hours scheduled. . . . . 50		Total A/C hours flown. . . . . 22	

3.0 BEDFORD EXPERIMENT (Continued)

(A. P. Hill)(Continued)

Results of Flight Tests held:

Oct. 14 1300-1700 (Brand &amp; Webster) Ground Observer Test

Using a B-17 course flown is as follows:

Bedford-Lowell-Biddeford-Portland-Presque Isle-Houlton-Augusta-Portland-York Beach-Boston, back to Bedford

Total ground observer reports, "two."

Oct. 15 1000-1200 (Gaudette) Two Aircraft Intercepts, with Height Finder and Airborne Radar

Four runs were made using a B-25 as the interceptor and a B-25 as the target. Course in all runs: Interceptor - starting over Grenier 8,000' IAS 225, Target - 15 miles east of Rockport 8,500' IAS 180.

Run #1 Fighter passed 100 yds ahead of target

Run #2 Fighter passed one mile ahead of target

Run #3 No interception - tracked wrong target

Run #4 Fighter passed 1/4 mile to rear of target

Comments:

1. Height finder - satisfactory
2. Program - calculations not good on evasion course
3. Radar data - generally good

1400-1600 (Heart) F-51 Coverage Test

Aircraft returned to base due to excessive cloud clutter, also F-51 had mechanical trouble and "just about" made it back to base.

Oct. 16 1000-1200 Calibration Rockport &amp; Scituate

For results see report by J. Arnow.

Oct. 16 1400-1600 (Heart) Jet Coverage (F-80)

Radar data was very poor - unable to track aircraft successfully at any altitude. Fair radar coverage was noted at close range at 5000' and 7,000'.

Oct. 21 1300-1500 (Brand &amp; Webster) Ground Observer Test

Using a B-17 course flown as follows:

Bedford-Worcester-Fitchburg-Nashua-Manchester-Concord-Laconia-Portland-Portsmouth-Newburyport-Lowell-back to Bedford.

Ground observer reports, "three."

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3.0 BEDFORD EXPERIMENT (Continued)

(A. P. Hill)(Continued)

Oct. 22 1000-1100 (Gaudette) Two Aircraft Intercepts

Using an F-80 as the fighter, and a B-25 as the target, two runs were made as follows:

F-80 - over Grenier 9,500' IAS 275

B-25 - 15 miles east of Rockport 9,000' IAS 225.

Vectoring 345°.

Run #1 No interception - unable to track F-80

Run #2 Fighter passed one mile ahead of target

Comments:

As in the past - tracking F-80 very poor

Oct. 24 0900-1100 (Gaudette) Two Aircraft Intercepts

The M.I.T. Inst. Lab. B-26 was used as the interceptor as we were unable to obtain the type aircraft desired from the 6531st Flight Test Group.

The target was a B-17.

Interceptor: Starting over Concord 8,000' IAS 225

Target: 15 miles east of Rockport 8,000' IAS 175

One run was attempted, with the interceptor passing four miles ahead of the target.

(M. Brand)

Aided Tracking. Analysis is proceeding on the data coming in from the one-aircraft printing analysis. When this analysis is completed, the smoothing will be tried out with the guidance program.

Interceptor Reattack Analysis. Charles Grandy and myself have been working on a mathematical analysis so that given an initial attack situation a standard maneuver may be defined for optimum re-attack. We are considering the inclusion of this method in the final phase interception program. At this point we have two available methods one of which is accurate and guarantees minimum time to reattack. This method, however, yields a complicated equation which presents difficulties storage-wise and program-time-wise. The second method is also accurate and shows promise of being a simple equation. It would cause, however, a longer time for reattack. We plan to write up our results in a memo during the coming bi-weekly period.

(F. M. Garth)

In the automatic initiation program I have written the Ground Observer Corps Box will be used to determine fighter status (airborne or standby at Grenier Air Base, or normal tracking). Since this is done by introducing three digits into FF 3, I have now made provision for the fighter "return to base" mode by including a fourth digit.

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3.0 BEDFORD EXPERIMENT (Continued)

(F. M. Garth)(Continued)

After the computer has interrogated FF 3 and found the return-to-base digit to be present, it will replace the position coordinates of the target by those of G.A.B. and also temporarily set the target velocities to zero. It should then make the desired calculations--heading, bearing, and distance--between the fighter and G.A.B. Immediately after these calculations are made and their results stored, the still active position coordinates and velocities of the true target will be restored, thus allowing a display of the target as well as the needed directional information for the interceptor.

Though the programming for the further sophistication of the Basic Two Aircraft Program has been completed, as yet no computer time has been secured for testing.

(C. Gaudette)

The new two aircraft tracking and interception program is still being checked out. A parameter, which substitutes a 7x4 point display for the standard 5x3 point display, seems to be operating satisfactorily. This parameter produces a more readable display at a cost of 17 additional constants and 5 additional orders.

(C. Grandy)

Final Phase Interception: Milt Brand and I are studying the problem of reattack by the interceptor after the initial final phase interception is made. We have developed equations by which the course for reattack can be calculated as soon as the initial attack angle is specified. The equations are complicated and some difficulty is being had finding an approximation that will be practical for use in WWI. We plan to investigate variations in the reattack course for other equations that may be more easily solved. Preliminary work on this indicates that much simplified equations will result if greater time is allowed between attack and reattack. Some attention will also be given to finding optimum initial attack angle.

(F. Heart)

16 A/C Program. This program has been operated several times by S. Knapp and A. Ward. It is not yet completely checked out, and the main obstacle has been computer time. (Night computer time has not been satisfactory due to lack of adequate Group 61 technician scheduling.)

Single Pair Program. The various sections of the program are nearing completion. Computer time has continued to be at a premium.

a) Main program. This has been tested, but requires further operational testing.

3.0 BEDFORD EXPERIMENT (Continued)

(F. Heart)(Continued)

b) Height Finder. This has been used operationally and appears satisfactory. A meeting was held by several group 61 people and several group 22 people in regard to the MPS-4 radar at Rockport. As a result of this meeting a flight test to study the MPS-4 operations was held on Oct. 27. The results of this test are now being studied.

c) A.A. A delay in the study of "AA coordination" has been caused by other responsibilities of the AA group. Study will be resumed soon; this program is now checked out.

d) Automatic Initiation. F. Garth has been studying this problem in conjunction with several information input problems. Testing has awaited checking of the main program.

e) Final Phase. Although the final phase effort has been independent, it is hoped that a rewritten version can be combined with the other program sections sometime soon.

Four-Pair. Work is continuing in an attempt to define clearly the methods for handling 4 interceptions. S. Knapp and A. Ward have begun programming those sections which were most clearly defined. Equipment requirements are being studied.

Indoctrinee. H. D. Neumann has progressed through preliminary exercises and is now preparing several indoctrination problems for computer trial.

(G. Rawling)

Study of Multiple Aircraft Track Program (MACT-16) was continued preparatory to incorporation of height finding phase.

(A. Ward-S. Knapp)

Due to lack of computer time further work on the Multiple Aircraft Tracking Program (MACT-16) has been held up. One error was discovered during this period, but the corrected program has not been tried. Similar difficulties have been encountered with the Two-on-One Interception Program, except that tape preparation errors have been thrown in.

Preliminary work has been started on a Four Pair Interception Program.

(C. A. Zraket)

Two test runs of the Final-Phase Interception Program were made during the past bi-weekly period using recorded data. Results were quite encouraging although no thorough dynamic check could be



3.0 BEDFORD EXPERIMENT (Continued)

(C. A. Zraket)(Continued)

made since there are no final-phase interceptions recorded on tape to simulate an actual run. Test problems run through the calculation section of the program indicated that all final-phase parameters were being calculated correctly. In general, this program will vector an interceptor to an offset point with respect to a target aircraft such that a pre-determined turn can be made by the interceptor which will put him at the desired attack angle and final approach distance upon rolling out of the turn. The interceptor will be instructed when to make the turn and at what angle to roll out, thereby rendering the final-phase maneuvers a "dead-reckoning" procedure. The program is general in the respect that any desired attack angle, final-approach distance, and relative bearing of interceptor to target upon completion of turn can be used. Provision is made to change the attack angle at any time during the course of the interception if it is found more advantageous to do so. A Flight Test attempted with the above program was inconclusive due to an inability to initiate upon and track the interceptor. It was later discovered that this was due to an anomaly in the initiation section of the program. Another Flight Test will be attempted during the next bi-weekly period.

F. Heart, A. Hill, and myself visited Bedford on Oct. 16 to attend a briefing of the pilots who have been flying for this project during Flight Tests. The pilots were oriented as to the type of tests we are conducting, especially final-phase maneuvers, in order that they would be able to fly the required courses correctly and also would be able to send back reports which would aid us in evaluating the results of tests.

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4.0 DATA SCREENING

(R.L. Walquist)

A finished version of Muldar Tracking Program #2 (MTP-2) is being delayed due to extensive effort in trying to fit the program into the available ES space. In line with this, a study is being made of how we can most efficiently use the 1,024 ES registers and 32 TS registers in the initial Cape Cod experiments (before the second bank of ES becomes available).

Additional study is being made of the magnitude of the difference in positions at which two radars with overlapping coverage can see the same target. Of particular interest is the difference caused by the velocity of the target and the difference in time at which the two returns occur. It appears that this difference may be important when trying to associate a radar return with the closest target.

Two days were spent at IBM discussing with them some of our plans for the Cape Cod System and familiarizing them with some of the problems of air defense.

(W.S. Attridge, Jr.)

Several parts of the tracking section of Muldar Tracking Program #2 are being rewritten in an attempt to conserve storage. The programming for the positional tracking has turned out to be quite complex and rather lengthy, especially in those sections dealing with automatic cessation and track shuffling. Our original supposition that positional tracking would save storage (M-1583, Bi-weekly report 1 August 1952) may be in error when final tabulation is made on how much storage is necessary to accomplish this positional tracking.

(W.A. Clark)

The problem of representing points on the surface of the earth within the Cape Cod system as equivalent points in a suitably-chosen plane is being investigated. For a system of small extent (less than about three degrees of arc) such as the proposed muldar system, the positional errors introduced by the assumption that the radars are coplanar appear to be of the order of 0.05 miles, provided the polar coordinate axes of all radars lie in parallel planes. This would involve the adjustment of each radar antenna so that its polar axis deviates from true north by a predetermined amount, but otherwise requires no special corrections. When this study is completed, a list of the coordinate positions of the proposed muldar sites and their polar axis deviations will be computed and issued.

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4.0 DATA SCREENING (Continued)

(D. Goldenberg)

This bi-weekly period was spent in analyzing the problem of determining the size, shape and the center of a search area for tracking in the muldar system. The most important conclusion derived from this analysis is concerned with the search area which is necessary to prevent the track from being lost when the aircraft makes a sharp turn. It is always possible to center a search area of a particular size so that one scan after the turn is started, the aircraft will be found within this area. Such an area is a square  $3\frac{1}{2}$  to 4 miles on the side centered at the predicted position. The past muldar tracking program used such a search area, yet the track was lost during a sharp turn. This loss was due, not to the size and centering of the search area, but mainly to the fact that the smoothing formulas indicated relatively no change in position and velocities for the first scan after the turn was started and predicted and established a search area at a point far removed from the area within which the turning aircraft could possibly lie.

The solution to this problem must be a significantly larger search area, varying with the vector magnitude of velocity, centered close to the last smoothed or, preferably, the last observed position. The main disadvantage of the larger area is that the possibility of interference of noise and other tracks is greater. Centering the area close to the last smoothed or observed position is disadvantageous because velocity tracking is necessary to carry a track thru stationary clutter. The proposed Muldar Tracking Program II of J. Ishihara and W. Attridge will offer experimental help in resolving these conflicting requirements of tracking.

(J. Ishihara, J. Levenson, H.H. Seward)

We have now completed a preliminary draft of the correlation program for Muldar Tracking Program #2 (MTP #2) and are now checking it for errors and also polishing up the programming.

Study will be made during the interim period before MTP #2 data becomes available of errors that may be introduced by the neglecting of time and velocity corrections during correlation. As has been mentioned before, programming (counters et al) have been introduced to make MTP #2 a data screening study program. When this data has been processed, we should have more basis for our assumptions and decisions.

Work on a "box" track sort scheme for MTP-correlation will be resumed.

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4.0 DATA SCREENING (Continued)

(H. Peterson)

Tape 2092 which transforms radar data to block form on magnetic tape has been checked out. Certain modifications and refinements have been suggested by R. Walquist and these have been made into a new tape (#2128) which is awaiting computer time to check out. A memorandum on the use of these tapes is in preparation. Also during this time Mr. Potter's and my display program has been worked out and we hope it will be operative by early next week. In addition to the above, I have spent considerable time on various height correction formula in an attempt to find a most expedient one.

(N.S. Potter)

The data storage and display program has been run correctly. Its functions are to transfer radar data from magnetic tape to ES in converted form, display it and a reference grid, and index the camera. It will now be modified to include provisions for the display of Rockport, Scituate, and Bedford data separately, magnified to full scope size.

Some time was spent working in association with W. Clark on the problem of selecting an optimum projection for the mapping of points known by their Earth (spherical) coordinates on a universal x-y grid that would correspond to a fictitious muldar reference plane. The error functions for two typical mappings were found, but the project was abandoned because the magnitude of the dispersion of the error seemed inappreciable relative to our level of quantization.

5.0 TRACKING AND CONTROL

(M. Frazier)

The Bedford-Rockport tracking program has been written and will be tested as soon as possible.

Some thought is being given to continuing the simulated data studies of this summer. Presently available data on the "separate track-common velocity" method of data combination is not considered adequate for comparison with other methods.

(J. Hayase)

Work is being continued in the problem of tracking a single aircraft with two radars. A considerable amount of effort was devoted towards correcting the incoming slant range, but no definite conclusions have been reached.

(Bill Lone)

The two radar single aircraft tracking (TRASACT) program,

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5.0 TRACKING AND CONTROL (Continued)

(Bill Lofe)

which averages observed positions and times of observation, has developed unexpected, and as yet unexplained errors.

In the display section of the Rockport and Scituate test patterns the two range per azimuth display increases to three or four per azimuth closely packed when the Rockport and Scituate patterns are displayed simultaneously. It clears up when one or the other is eliminated. Speculation that the terminal equipment was faulty was shown to be erroneous when a similiar program displayed properly. Investigation is continuing.

The parameter to A. Mathiasen's S.D.V. (Slowed Down Video) program which saves up the data in a search sector and determines the pattern of returns about the best fit needs a slight change, but by and large the results are satisfactory. The change is being made.

(A. Mathiasen)

The two radar tracking program (TRASACT-3PAD) was further tested. No suitable targets were found during the time of test, but indications are that the program runs as intended.

The Simulated Muldar Data (SYMULDATA) program has been completed.

A survey of the relative merits of the various tracking methods which have been tried with simulated data is now under way.

(B.R. Stahl)

A Rockport azimuth examining program has been awaiting computer time for checking out. This is one of a group of radar data checking programs which have recently been rewritten and modified. Of this group, two other programs, a revolution timer, and a three-radar display, have proved quite useful in examining the characteristics of data obtained for multiple-radar tracking programs. With the aid of these two programs it has been possible to analyse quickly the behavior of the tracking programs.

6.0 AIR DEFENSE OPERATIONS

(F. Heart)

Work is proceeding towards more systematizations of flight test procedures. For all but the simplest tests a "briefing" has been instituted 1/2 hour prior to the test. A room 222 check-out procedure has been outlined and it is hoped that this check-out will be accomplished by 9:30 a.m. every morning except those days when group 61 is using neither aircraft nor the computer.

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## 6.0 AIR DEFENSE CENTER OPERATIONS (Continued)

(F. Heart)

The major difficulty of past weeks has been aircraft procurement. The 6531 Flight Test Detachment at Bedford has appeared unable to supply even nominal numbers of aircraft of the requested types. The main trouble, as indicated by the squadron, has been maintenance and parts difficulties. Some aircraft have been obtained through the M.I.T. Instrumentation Laboratory, but it is felt that this is a poor practice, to be used only when necessary. A summary of aircraft procurement troubles is being prepared.

Continued consideration is being given to output display equipment.

(M. Brand)

GOC. I have written a memo covering the results of the past two Group 61 - Manchester Filter Center GOC tests.

It has been decided to suspend further tests until spring.

(John J. Cahill, Jr.)

The Height Finder Program, T2116, for use with the Two-Aircraft Tracking Program T2061 MOD 10, is operative, except for a defect in the angular display. A program error has been found which would account for the defect, and it is felt that the program will be completely checked out in a day or two.

The simplified AA Guidance and Height Finder Program, T2115-M1, has not been checked out yet, since the Single Pair Interception Program, T2104-M7, of which T2115 forms a part, is not yet operative.

Some progress has been made on the Automatic Target and Battery Evaluation Program, but this goes slowly, chiefly because of demands on my time made by flight-test operations. This has been especially true during the past week, because of the preparation for the demonstration.

(P.O. Cioffi)

My visits to the Air Traffic Control Center continued this period. This work is in connection with a study of air traffic in the Cape Cod area.

I visited also Dr. Comstock and Mr. Wheeler at the Air Force Instruments Laboratory in Long Island to discuss the details of a similar survey which they made of another area.

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6.0 AIR DEFENSE CENTER OPERATIONS (Continued)

(F.A. Webster)

Study is being made of the linkages between human operators and automatic sub-systems in an air defense network. Difficulties appear to be greatly accentuated under conditions of heavy loading; but it seems likely that much improvement could be achieved by more versatile communication between automatic equipment and the human decision and control links. On the presentation side two lines of improvement seem worth investigating. One has to do with the segregation and classification of incoming data so that it can be sorted out by a machine and sent to the correct human control groups. Each group should only have to consider what it is supposed to deal with. The other has to do with the level of detail that any group should have to consider under conditions of overload. This implies a better assessment of primacy of data, better symbolic representation of complex relations, and possibly the manipulation of the time base for certain command personnel. This latter would permit periodic rapid review of a developing situation in a way well adapted for human analysis. On the input side (to the equipment) the problem of course arises as to whether or not human operators should be able to communicate in other ways than by the activation of wholly preset programs and patterns. One thinks, for example, of the possible usefulness of being able to draw a line on the scope with a light gun and have the computer generate instructions that would cause an aircraft to follow it.

7.0 ASSOCIATED STUDIES

(W. Linvill)

A report is being prepared on design of sampled-data control systems. The latter part of this period was spent on preparation of a talk for the EE staff colloquium on "Significant Characteristics of Sampled-Data Systems".

(W.A. Clark and C. Grandy)

WWII STUDIES. Work on the analytical description of various correlation schemes has been continued during the past bi-weekly period. A definition of a "stage of correlation" on this basis has been formulated and the nature of the dependence of the time and storage functions of one stage upon those of another stage is currently being investigated.

(Edward J. Craig)

Problem of determining in advance an accurate estimate of the error when specified interpolation procedure is used is partially solved. The error involved in a polynomial approximation of a function  $f(x)$  by a polynomial of degree  $n$  can be accurately estimated.

Investigation is currently being made concerning the use of

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7.0 ASSOCIATED STUDIES (Continued)

(Edward J. Craig)

such polynomials in estimating derivatives and integrals of the original function.

Concurrent with this work is an attempt to organize numerical methods in general with the general intent being to educate myself, and if possible, my co-workers, with the significant achievements to date.

(J.W. Craig)

Discussions have continued with Walter Wells concerning noisy data and variable velocity flight.

A summary of the method of analysis used in the Mark 65 Reports is being prepared.

(W.I. Wells)

Work is continuing on the filtering of different types of sampled data. The principles are pretty well in hand but some methods of approximation must be devised. The actual optimum methods are too lengthy, and require too much storage. Several examples have been worked with excellent results. The examples chosen were simple so the hand computation would not be burdensome, however the methods are perfectly general.

8.0 COMPUTER OPERATIONS

(C. Gaudette)

Equipment Characteristics	0.75 hours
MEW Tracking and Control	9.25
Data Screening	5.50
Multiple Radar Tracking and Control	1.75
Indoctrination Programs	0.50
Subtotal	17.75 hours
Flight Tests	8.75 hours
Calibration	0.50
Demonstration	3.50
Equipment	1.50
Time lost	6.75
Time not used	13.25
	<u>52.00 hours</u>

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9.0 PUBLICATIONS

(M.R. Susskind)

The following material has been received in the Library, Whittemore Building, and is available to Laboratory personnel:

LABORATORY REPORTS

1. "Group 61 Air Defense Bi-Weekly, October 10, 1952," M-1678, pp. 1-17.  
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