#1328

Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

SUBJECT: GROUP 61 BI-WEEKLY REPORT June 6, 1952

1.0 GENERAL

(C. R. Wieser)

By the end of June 8 Air Force aircraft are expected to be available for Project Lincoln. These will include one B-29, one B-25, two B-26's, three F-80's, and one C-45. In addition, the Air Force Cambridge Research Center (AFCRC) will get additional aircraft. The number of flight tests required by Lincoln and AFCRC is increasing, and estimates of aircraft requirements for each month must be submitted in advance. Howard Kirshner will collect the requirements for Group 61, and the cooperation of all members is needed.

During this bi-weekly period a demonstration was held for Mr. W. Whitman of the Research and Development Board and another for General Barnes of the Air Force.

The local Antiaircraft people were visited to discuss cooperation with Project Lincoln. They have agreed to let us run experiments with one of their local batteries as soon as we provide communications.

2.0 EQUIPMENT ENGINEERING

(H. J. Kirshner)

As noted by others in the unclassified 6889 Bi-Weekly Report, the demands on the laboratory power supply system have now reached a point where frequent overloads, with ensuing voltage drops, are encountered. These overloads have made for erratic operation of the terminal equipment in Room 224. In one instance, during the visit of Dr. Whitman to the laboratory, a scheduled flight test was delayed while equipment difficulty was being traced to low line voltages. The situation was remedied by switching terminal equipment to Whirlwind D.C. power — a practice not encouraged by the Systems Group except in case of an emergency such as the one just described.

It is anticipated that a considerable improvement in the data from Rockport may be expected next week when the azimuth commutator is replaced. Despite the absence of perfection in Rockport data, it was possible to feed recorded Rockport S.D.V. of sufficient accuracy into the computer to enable an S.D.V. tracking program to operate reasonably well. (See also "5.0: Tracking and Control")

2.0 EQUIPMENT ENGINEERING (Continued)

(J. H. Newitt)

The past bi-weekly period has been devoted to further installation considerations for Room #156. It is hoped that personnel now in Room #156 will be very shortly transferred to the Whittemore Building and that room preparation work in #156 can get under way.

Tentative summary schedules for fabrication and installation of the new WWI equipment have now been prepared for distribution. These schedules will be distributed to various supervisors in the near future. The schedules will be kept realistic by periodic examination and revision.

(A. V. Shortell, Jr.)

Work on the video-mapping equipment has shown that successive range increments may be resolved by the phototube. However, drift in the vertical amplifier of the 'scope may present somewhat of a problem. The mask being used at present eliminates the effect of this drift while the problems of resolution and prf sensitivity are studied.

Permission to make minor modifications to the 'scope has been obtained from Division 2. Initial modifications include the addition of vernier position controls in both the horizontal and vertical amplifiers.

(P. W. Stephan)

A block diagram has been made of the paper tape recorders and printers as they are connected in the final in-out system of WWI. It is more detailed than that on SC-51149, Block Diagram of Printers and Paper Tape Units.

I am now investigating the way in which the Ferranti photo-electric tape reader can be connected to the WWI in-out system.

3.0 BEDFORD EXPERIMENTS

(D. R. Israel)

Although several very successful interception flight tests were held during the past two weeks, other phases of our flight test activity suffered as a result of the use of available time for visitor demonstrations. Beacon response, final guidance, jet tracking, height-finder, and evasive target tests were cancelled. We have just about reached the point where the lack of flight tests (whether due to a lack of computer time, lack of aircraft, poor weather, or temporary unavailability of beacon, height-finder, etc.) is delaying the progress of our work.

Some material prepared for the Lincoln Quarterly Report has been revised and will be issued in M-note form for use in the training of new staff members. This material will replace sections of M-1343.

(C. Zraket)

FLIGHT TESTS

A test held on May 27 to check the coverage of the Bedford MEW using a jet aircraft (F-94) flying at 10,000 feet was successful. Two runs were made; the first from Concord to Sanford at an IAS of 400 knots, the second from Sanford to Bedford at a reduced power setting. This test was recorded on MT 140.

A 2 a/c interception employing a T-11 as target and a F-51 as interceptor was held on June 4. The F-51 passed directly over the T-11, the respective altitudes being 11,000 and 9,000 feet. The test was recorded on MT 141.

A 2 a/c interception was conducted on June 5 to check the operation of the auto-pilot in the B-26 used as interceptor. A B-26 was also used as the target aircraft. The test was completely trouble-free, resulting in a good interception. This interception was recorded on MT 142.

(M. Brand)

Worked in conjunction with Frank Heart on a possible testing method for the Elimination of Multiple Beacon Response Program. This program has not yet been put on the computer.

(P. O. Cioffi)

The "Basic 2 a/c Tracking-Interception Program" has been written. This program will be checked out as soon as computer time is assigned for testing.

Some time was spent on Flight Test activities.

3.0 BEDFORD EXPERIMENTS (Continued)

(F. Heart)

Time was spent assisting at the visitor demonstrations of June 4 and June 5.

Some consideration was given to: scope displays, interception methods, and wind data.

Recently, a jet flight test was recorded, but it has not been convenient to attempt tracking this data as yet. Likewise, the second Beacon-Response Program, written with M. Brand, is waiting for the first combination of engineer-time and computer-time.

(S. Knapp)

The Basic Multiple Aircraft Tracking Program has been run on the computer and seemed to work satisfactorily except for a minor error which has been corrected. Work has been started on a modification to the program which will allow automatic initiation. Special displays are being worked out for this portion of the program.

(C. Zraket)

Work is continuing with P. Cioffi on the Basic 2 a/c Interception Program.

Modifications to the Final Phase Guidance Program discussed in the previous bi-weekly have been written but not tried on the computer as yet.

Some reading has been done relative to the proposed Magnetic Drum system in preparation for a thesis proposal the latter half of the summer.

The last half of the bi-weekly period was spent on vacation.

4.0 DATA SCREENING

(R. L. Walquist)

A program which records radar information from the MEW onto the computer magnetic tape unit has been written in order to assist in checking Muldar Tracking Program #1. This program (T 1290) will be used until Bagley's more complex recording program (T 909) is operational.

By using T 1290 to put radar information onto magnetic tape and T 910 (Recorded Data Display) to read this information back into the computer and display it, a speed increase of somewhere between 30 and 45 can be obtained. As a result, successive 15 second scans of the MEW can be displayed at a rate of about 2-3 scans per second. With

4.0 DATA SCREENING (Continued)

(P. Bagley) (Continued)

data recorded by my Filtered Data Recording program (T909) and by Walquist's program (T1290).

Several days were spent in assisting Attridge, Ishihara, and Goldenberg to become familiar with my three programs mentioned above.

Clutter Rejection. The new clutter rejection program (T1255) described in the previous bi-weekly has been run successfully and has given good results. Photographs have been taken of the "filtered displays" (radar data with nearly all of the stationary clutter removed). This program does as effective a job in building up a table of stationary clutter in about seven minutes as previous programs could do in an hour. Therefore, I believe that this program should be revised to accommodate any one radar at a time and punch out a stationary clutter table on paper tape. (It is advantageous to have clutter tables in semi-permanent form so that the tables may be reinstated in the computer in case of computer failure.) This suggested program, then, could provide clutter tables for three radars in about a half hour, and would supersede the present Clutter Table Construction For Three Radars (T908).

(D. Goldenberg)

On June 2, work was begun on writing programs for several methods of sorting of azimuths and ranges in ascending order of azimuth for up to 100 pieces of data. After the programs have been completed, graphs will be constructed showing the variation of time of sorting and number of storage registers with the number of pieces of data. To date, the following four methods have been programmed:

1. Using the azimuth to determine an address, storing the azimuth and range, combined as a sixteen digit word, in one of 256 registers, and compressing the table after all have been sorted.

2. Finding the smallest of all the sixteen digit words in azimuth and range, finding the next smallest, etc.

3. "Partial Sorting" by comparing data in two consecutive registers and interchanging the data to ascending order.

4. Sorting the sixteen digit words in azimuth and range by digits in the azimuth values.

(J. Ishihara)

With the full cooperation of the people in this section, errors were detected, diagnosed, and corrected in the correlation section of Muldar Tracking Program #1. The program should now be ready, after

4.0 DATA SCREENING (Continued

(J. Ishihara) (Continued)

checking out on the computer, for studies under operational conditions.

Considerations for the next Muldar Program should be of invaluable aid.

5.0 TRACKING AND CONTROL

(J. Arnow)

The data from Rockport has shown considerable improvement towards the end of the period. Data recorded on Friday, June 6 was played back that evening. Outside of a number of shifts in azimuth which were caused by a bad commutator, the data looked very clear. Two targets were tracked using Mathiasen's tracking program for the Rockport radar for 30 and 40 scans. The tracks lasted to a range of about twenty-five miles.

Two sources of trouble were noticed during the run. One is the search area size. It would appear that with the finer quantization every effort should be made to reduce the size of the search circle or box to a minimum or else find another method for data selection. There is a large possibility of a spurious return occurring in this area in the event of a miss due to the large number of boxes included in this area.

The other cause of trouble was a result of the change in antenna speed during the course of the run. This caused the program to lose the target after one or two successive misses.

(M. Frazier)

Little progress has been made with polysmooth. The very fast sin-cos routine, with some modifications, remains not quite good enough, and this problem is being dropped for the time being.

The second half of this bi-weekly period was spent on vacation.

(B. Lone)

The TRASACT program which averages times and positions was completed at the beginning of this bi-weekly period. The lack of computer time has prevented my testing it.

5.0 TRACKING AND CONTROL (CONTINUED)

(B. Lone) (Continued)

I have written a non-linear smoothing parameter for TRASACT FF (first fit). This also is awaiting computer time.

I have started to write a TRASACT FF program which tracks from live data.

(A. Mathiasen)

The non-linear smoothing sections for TRASACT I and II have been written but not tried.

TRASACT I is being adapted for use with live data with a few minor changes in logic which speed up the program somewhat.

A run of a tracking program (RTPR) on recorded data from Rockport showed the program to work fairly well. Some trouble on misses was encountered in which the track went off wildly. J. Arnow suggests that this is due to the high probability of noise returns within the search circle.

(B. Stahl)

During this period more work has been done on the Indoctrination Problem. It is now close to completion.

Two testing programs have also been written for the Rockport radar to determine: (1) Time of rotation in seconds per scan (T-1299); and (2) The number of azimuths occurring between north markers (T-1287). (This number should normally be 255.)

6.0 AIR DEFENSE CENTER OPERATIONS

(D. R. Israel)

On June 2, Jack Arnow and I visited the Manchester GOC Filter Center and made arrangements for the installation of a telephone line between that Center and the Barta Building. The single line to be installed in the near future will permit us to monitor incoming calls from the Cordell Sector which overlaps the area of our flight test activities. Approval for this installation is being awaited from the 32nd Air Division at Syracuse.

We have received from Manchester a list of their operating observer posts and their locations. These posts have been marked with pins on a map of New England; pins of a different color are used to indicate those posts in the Cordell Sector.

6.0 AIR DEFENSE CENTER OPERATIONS (Continued)

(D. R. Israel) (Continued)

On June 3 a visit was made to Fort Banks at Winthrop where Wieser and I talked with Colonel Guy and Major DeRosa of the 197th AAA. We visited their Operations Room and were briefed on its functioning. Definite plans have now been made for experiments in conjunction with the local AA installations. The first step will be to see if it is possible to use radio communication between the Barta Building and the various AA sites.

At Fort Banks we saw in operation a special type of slide projector which can be used to project information written on a transparent material (glass or cellophane) onto a vertical screen. This device provides a simple means of displaying information (such as might be received over a telephone line from tellers at remote points) to a large number of people. A similar type of projector has been found in the Barta Building, and we are looking into the possible use of such devices for the display of information in our Air Defense Center.

(M. Brand)

Have drawn up a flow diagram for a possible single aircraft tracking program using GOC data. This diagram is continually being modified as members of the group come up with new ideas.

In conjunction with F. Webster and C. Gaudette have established new criteria for the scoring of data. The present plan is to assign a score to a new piece of data relative to established track by one of two methods:

(1) By use of a scoring table for number of a/c, type and altitude.

(2) By use of a formula for heading, velocity.

It was decided that the tabular score for heading could be eliminated and the no. of a/c and the type tables lumped together.

Have started work on a program which will test the scoring system by reading into the computer whole tracks determined from plots in the GOC room. The program will assign a score to each piece of data in a track. These scopes will aid us in the determination of proper weighting factors for individual scores.

6.0 AIR DEFENSE CENTER OPERATIONS (Continued)

(C. Gaudette)

A memorandum describing a method of storing the coordinates of the observer posts controlled by White Plains Filter Center has been written.

Several meetings with the members of the Ground Observer Corps Group have produced a basic outline for a one aircraft tracking program using GOC Data. Sections of the program are now being coded by the members of the group.

(F. A. Webster)

Most of this period has been spent revising and extending the memorandum written during the previous week. It concerns the procedures used in "manual tracking" of aircraft under the GOC (Ground Observer Corps) System.

7.0 ASSOCIATED STUDIES

(W. Linvill)

The work of the associated studies group will be divided into 3 categories. First, we will work on problems of practical interest to the Cape Cod project. Second, we will search the reports of the other groups using computers as control systems components. Third, we will work on whatever special theoretical problems seem of significance as a result of the first two activities.

A discussion with Wieser, Israel, Walquist, and Arnow some time ago indicated that we should direct our Cape Cod activities toward three problems: (1) interceptor guidance, (2) correlation of returns with aircraft, (3) smoothing of data necessary to accomplish the first two objectives. Initially we are working on the interceptor guidance problem.

(P. R. Bagley)

Indoctrination Course. Two afternoons a week are spent regularly assisting with the indoctrination course. A guided tour of the laboratory is given on Monday afternoons. Simple experiments with test equipment, in connection with the study of block diagrams, are supervised on Wednesday afternoons.

Computer Night Operations. I have been assisting for a week in running Air Defense programs at night since no regular operator has been available.

Industrial Liaison Symposium. A talk on an electronic digital scanner for high speed information searching has been prepared for the Industrial Liaison Symposium on Machine Techniques for Information Selection to be held on June 10-11 at M.I.T.

(G. Cooper)

The problem of finding a recursion formula for the filter with a delay has proved quite troublesome. Several attempts at solving it have been unsuccessful. The approach now being considered will work, but the result seems unduly cumbersome. Of course, it is to be expected that this type of filter is more complicated, but I didn't think it would be as complex as it now seems. It should be noted that the filter with delay is not likely to be used for aircraft tracking because we cannot afford any additional delays in the system — in fact, we would like to eliminate some of the delay that exists now. Hence, the problem is mainly of academic interest.

(J. W. Craig)

Some work has been done to analyze the error (for small errors) that quantization introduces in the heading angle (Φ) given an interceptor (assuming that the speeds of the target and interceptor are known precisely). With this assumption, errors in the measurement of the

7.0 ASSOCIATED STUDIES (Continued)

(J. W. Craig) (Continued)

heading of the target (θ) and errors in the measurement of the angle of the line between target and interceptor (γ) contribute to the above error. The magnitude of this error, in general, depends upon the ratio of the speeds of the two planes and the difference of the angles γ and θ. If the errors in γ and θ are the same, the error in ϕ is the same as that in γ.

(F. Heart)

Further time was spent revising a memo on interim in-out equipment. It is expected that this memo will be issued as M-1514.

With B. Morriss, an outline was prepared for a $\frac{1}{2}$ hour indoctrination lecture on "Terminal Equipment".

(A. Perlis)

1. Work is continuing on the development of differential correction techniques.

2. The adaptation of block assembly techniques is being discussed with programming personnel. A definite recommendation on forms, block programming techniques, etc. is to be made in the near future. The proposed air defense sub-routine library will begin with those arithmetic routines useful in the present tracking programs.

(W. I. Wells)

Preparatory to the analysis of the control problems involved in the interception programs, it was necessary to try to separate the limitations imposed by the type of data available and those imposed by the characteristics of the computer and associated equipment.

An analysis has been started which evaluated the number of miles or fraction thereof that an interceptor and a target aircraft will miss each other at the closest point of the interception run. This miss is given in terms of the relative speeds and positions of the aircraft, and in terms of the measurement errors caused by sampling, quantization, time delays, and the dynamics of the aircraft. An attempt was made to evaluate the same quantities for both straight and curved paths of flight.

Although numbers have been obtained in specific cases, the analysis is by no means complete. Some trends of importance have been noted but are still being investigated.

7.0 ASSOCIATED STUDIES (Continued)

(H. R. J. Grosch)

Have been reviewing offensive and defensive guided missile characteristics, fleet air defense, and the Charles Report. M-1496 on ternary arithmetic was distributed.

8.0 COMPUTER OPERATIONS

(J. Arnow)

Radar and Relay Link	0.25 hours
Data Screening	11.25
Tracking and Smoothing	12.5
Aircraft Control	0.25
Miscellaneous*	19.25
Sub Total	43.5 hours
Flight Test	2.0 hours
Visitors (prep. etc.)	10.0
Training	0.5
Calibration	0.75
Time Lost	3.75
Total	60.5 hours

* The amount of time used in this category probably indicates that a redesign of program classification is in order.

9.0 PUBLICATIONS

(M.R. Susskind)

The following material has been received in the Library, Rm. 217, and is available to Laboratory personnel:

LABORATORY REPORTS

1. "Whirlwind II Meeting of April 25, 1952," Taylor, N.H., Mayer, R.P., Papian, W., M-1495, May 21, 1952, pp. 1-8.
   CONFIDENTIAL

2. "Whirlwind II Meeting of May 9, 1952," Taylor, N.H., Mayer, R.P., M-1498, May 23, 1952, pp. 1-4.
   CONFIDENTIAL

3. "Whirlwind II Meeting of May 16, 1952," Taylor, N.H., Hosier, W., M-1500, May 23, 1952, pp. 1-5.
   CONFIDENTIAL

4. "WWII Block Diagrams Group Meetings of May 13 & 15, 1952," Hosier, W., M-1504, May 27, 1952, pp.1-5.
   CONFIDENTIAL

TECHNICAL REPORTS

1. "Integrated Fire Control System for Terrier," Monthly Progress Report, RCA Victor Division, Radio Corporation of America, Camden, New Jersey, April, 1952, Lib. No. 1487.
   CONFIDENTIAL

2. "Technical Data Digest," Vol. 17 No. 6, Armed Services Technical Information Agency, Document Service Center, U.B. Building, Dayton 2, Ohio, June 1952, Lib. No. 1690.
   RESTRICTED

3. "Feasibility of Actuating Trainers by Digital Computers," Progress Report No. 2, Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, May 1, 1952, Lib. No. 1774.
   RESTRICTED

4. "Delay Line Test Set," Report CRG-30, Combined Research Group Naval Research Laboratory, Anacostia Station, Washington 20, D.C., August 14, 1944, Lib. No. 1850.
   CONFIDENTIAL

9.0 PUBLICATIONS (Continued)

(M.R. Susskind) (Continued)

5. "Electronic Miniaturization and Maintenance-Minimization in England," Office of Naval Research, Stanford Research Institute, Applied Research Center for the West, Stanford, California, November 28, 1949, Lib. No. 1851.

CONFIDENTIAL

6. "Printed, Sprayed and Pressed Wiring Techniques in the United Kingdom and Their Application to Radar Equipments," Dummer, G.W.A., Telecommunications Research Establishment, Ministry of Supply, London, September, 1948, Lib. No. 1874.

RESTRICTED

7. "The Propagation of Errors in the Determination of the Missile-To-Target Distance," Haynes, W.A., Memorandum Report No. 572, Ballistic Research Laboratories, Project No. TB3-0538C of the Research and Development Division, Ordnance Corps, Aberdeen Proving Ground, Maryland, January 1952, Lib. No. 1866.

RESTRICTED

8. "Rand Publications Index," The Rand Corporation, May, 1952, Lib. No. 142/S.

SECRET

9. "Theoretical Scintillation Spectra," Muchmore, R.B., Guided Missile Laboratories, Research and Development Laboratories, Hughes Aircraft Companu, Culver City, California, March 1, 1952, Lib. No. 252/S.

SECRET