

Memorandum M-1431
6889

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Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

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

SUBJECT: GROUP 6100 BI-WEEKLY REPORT, March 14, 1952

1.0 GENERAL

(C. R. Wieser)

A paper entitled "The Digital Computer as a Control Element" was given at the IRE Convention in New York.

A series of meetings with a committee from the Rand Corporation and later with the Getting Committee were attended. Both groups saw demonstrations of WWI running on recorded radar data (bad weather prevented live tests). A third demonstration with live data was held for the Ground-to-Air Data link working group, which met in Cambridge. The test for the data link group was the first successful interception using WWI to guide the interceptor via its autopilot. Results were very good, with a final separation of 200 yards.

Data from the Rockport radar has been fed into WWI and superposed with the Bedford MEW data to give a combined display.

(D. R. Israel)

M-1421, written in conjunction with W. S. Attridge, Jr., describes the latest version of the indoctrination course which is presently underway. The 20 lectures given by staff members will be recorded and will be transcribed by Mrs. Sylvia Chaplain, who is a new secretary with the 6889 Application Group. Walter Attridge will supervise the indoctrination program.

(W. S. Attridge, Jr.)

A new time for the Air Defense Group staff meetings has been agreed upon. The new time is Tuesdays from 1530 to 1700 which is satisfactory to the majority. A recording was made of the meeting of March 13 and we may continue to record future meetings.

A new indoctrination program has been started which is expected to extend over six weeks. We plan to record these lectures and have them typed up. This will be the beginning of a sorely needed comprehensive indoctrination text.

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2.0 EQUIPMENT ENGINEERING

(H. J. Kirshner)

The transfer of Rockport terminal equipment to eight-foot racks will take place during the coming bi-weekly period.

The MEW will be shut down until March 18 for the purpose of installing a beacon receiver and antenna.

An operating schedule of from 0830 to 1700 daily except Monday has been decided upon for the Rockport radar.

It has been learned that new VHF facilities for the Cape Cod System will probably be installed at a site near the Lexington Field Station some time in June.

The telephone switchboard for various private lines entering the Barta Building is now in the process of installation.

Burroughs test equipment for use in synchronizing the Time Register with Whirlwind is now special order and should be delivered March 18. Installation of the Time Register will be made upon receipt of the test equipment.

A visit was made to the White Plains (N. Y.) Ground Observer Corps Filter Center. Recordings were made of incoming data for the purpose of study here.

(B. Morriss)

The preparation of a set of drawings which show all of the in-out system which is presently planned is nearing completion. Sketches of magnetic tape, scopes, auxiliary drum, in-out register, and in-out control have been completed. A drawing of paper tape units by P. Stephen is nearing completion, and the major jobs remaining are the buffer drum, IOS, and a drawing which shows all of the interconnections of external units, their control, and IOE.

The installation of the ground-to-air link as a piece of terminal equipment appears to be straight-forward and utilizes little in IOE besides IOS. It will also be included in the drawings.

One method of incorporating light guns in the in-out system, which was proposed by R. Walquist, is to have each of the guns (up to 15) connected to different digit columns of IOR and all guns connected to digit column 0. Thus, if each scope display is followed by a rd order to place the contents of IOR in AC, a cp will tell if any light gun picked up the display, and a sf will tell which gun. This procedure is being incorporated in the drawings being prepared, and appears to require a minimum of equipment and changes while yielding a very handy way of utilizing several light guns.

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2.0 EQUIPMENT ENGINEERING (Continued)

(F. Heart)

Consideration has been given to the question of a block diagram showing the sequence and logic of the proposed scope output operation with the new in-out system. So far no finished results.

(J. H. Newitt)

The subject period has been spent in the study of the telephone line terminal equipment for the Cape Cod Muldar Experiment, the buffer drum storage system and the auxiliary drum storage system.

Organization and coordination of the overall Muldar equipment development is to be preceded by both simplified and detailed documentation of the functional aspects of the equipment. Preparation of this data has been started. In addition to such data being useful in the coordination work as a reference source, it is expected that it will facilitate the indoctrination of interested personnel. The unitized division of the material into simplified explanations and detailed explanations should serve the individual interests of both programmers and engineers.

(A. V. Shortell, Jr.)

An improved band-pass filter has been designed for use in the recorder multiplexing scheme. However, its attenuation on the low frequency end still leaves something to be desired. During this period information was received from Federal Telephone and Radio Corporation concerning band-pass filters which would meet our specifications. Though their prices seem a little high, the cost of these filters is actually less than the cost of a satisfactory filter using UTC High-Q Toroids. We are still awaiting a reply from Graybar concerning specifications and availability of Western Electric filters which would suit our needs.

Some time has been spent studying the circuitry and the block diagrams of the SDV terminal equipment.

Measurement of the readout gates on the low speed counter, used in the real time clock, indicates a rise time of 18 to 20 microseconds. During these measurements some trouble has been encountered with the read out gates reacting on the flip-flops and upsetting the counting operation. The difficulty will be corrected during the next bi-weekly period.

3.0 BEDFORD EXPERIMENTS

(D. R. Israel)

Successful flight tests involving the use of the auto-pilot have been held. The MEW will be shut down for several days in order to permit installation of beacon facilities.

Several informal discussions have been held regarding the progress of the work on final phase and multiple intercepts. Work on these two subjects is being pressed, but will necessarily lag due to insufficient programmers and computer time. In recent months, there has been little or no attention paid to multiple tracking programs which track more than two aircraft. A five aircraft tracking program written by R. L. Walquist needs to be brought up-to-date, and if it is modified to take full advantage of the present storage capacity it should be able to handle a greater capacity -- say 10 to 15 aircraft. It is felt that the development of such a multiple tracking program would aid considerably in studies of automatic initiation.

(C. Zraket)

Flight Tests:

A Flight Test using the B-26 equipped with the auto-pilot as the interceptor and a B-17 as the target was held on March 4. Both runs resulted in large separations (3,000 yards and 1,100 yards respectively) due to trouble with the auto-pilot and to spotty Radar coverage. The spotty Radar coverage was probably due to the low altitude at which the runs were made (4,000') because of the bad weather.

A similar run was cancelled on March 10 when one of the aircraft had to be grounded because of an electrical fire.

The radar coverage of both the MEW at Bedford and the 584 at Rockport was tested on the morning of March 12. The aircraft made several runs between Rockport and Scituate, satisfactory coverage being obtained during all runs. Some question as to the calibration of the Rockport radar was brought up due to differences noted in the over-lapping range of both sets.

A Flight Test using the auto-pilot was held on the afternoon of March 12, this test serving as a visitor demonstration. The run resulted in the interceptor (B-26) finishing 200 yards ahead of the target (B-25). A large wind correction had to be made due to an 80 knot Northwest wind.

3.0 BEDFORD EXPERIMENTS (Continued)

(P. O. Cioffi)

Lack of computer time during this period has delayed the continuation of studies on the programs which have been referred to in previous reports. These programs still await final checking.

I have begun thinking about contributions to the group subroutine library which is contemplated.

(F. Heart)

Additional time has been spent writing and checking modifications to the basic Display Interception Program. A modification has been written and tried which displays the target range and azimuth from Rockport as a base point. This display may be used to direct a height finder via manual phoned instructions. Due to a deficiency in computer time, this modification has not been checked out as yet. Another small modification has been made to eliminate the vector display previously incorporated. This display was eliminated in order to avoid the "confusing direction" of the vectors in the period immediately after initiation.

Some consideration is being given to the distribution of displays among the D, F and S scopes now available.

The wind question was considered further, and data on a straight line constant velocity path was "tracked", and will be plotted as soon as possible.

(C. Gaudette)

Data Tape Analysis using PWTFT Programs (Printing While Tracking From Tape) has been slowed down during the last period by a lack of computer time. A SIMRADATA (Simulated Radar Data) Parameter Tape, which will be used to produce a new Data Tape with a simulated turn, has been prepared. Most of the desired data on existing Data Tapes have been obtained and are now being plotted.

I have written a Decimal Display Subprogram, which displays decimal integers by displaying selected points of a rectangular box of $7 \times 4 = 28$ points. A test program has been written, and the program will now be rewritten in standard subroutine form.

(S. Knapp)

Work on the 3 Aircraft Tracking and Interception Program has been held up because of both tape preparation errors and lack of computer time. Some thought has been given to the problem of extending the program to handle four aircraft. So far study has indicated that this will be possible, although some changes in the logic of the program

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3.0 BEDFORD EXPERIMENTS (Continued)

(S. Knapp) (Continued)

will be necessary. These changes, however, will not be drastic ones, so that as soon as some definite progress is made toward troubleshooting the 3A/C problem the extension will probably not be difficult.

A table of sines and cosines calculated in the octal system has been drawn up and will be distributed in the near future. In this table, the angles are measured in azimuth units.

The data tape analysis work continues as computer time permits.

(C. Zraket)

Due to lack of computer time, the Interception Test Program (832) and the modifications to the Interception Display Program (1000) discussed in previous bi-weeklies have not been checked out. The present Interception Display Program (T-1000-5) uses NLS-2c, eliminates the velocity vector display, and gives a PCEC pulse once per scan at south for purposes of automatic transmission of heading angle via FF1.

Work has recommenced on the Final Approach Guidance after a discussion with Israel, Attridge, and Gaudette.

Much time has been spent during the past bi-weekly period being present at Flight Tests and visitor demonstrations.

4.0 DATA SCREENING

(R.L. Walquist)

Some attention is being given to the problem of height-finder data utilization in the Cape Cod Muldar system. If the computer is to request altitude information from a limited number of height-finders about a much larger number of aircraft, some sort of evaluation must be made in order to determine about which of the aircraft one needs altitude information the soonest. This evaluation might include such things as:

1. The elapsed time since the last altitude reading on this aircraft;
2. The type of aircraft;
3. The action being taken on this aircraft.

This problem appears to be quite similar to the problem of target threat evaluation and interceptor assignment.

(P.R. Bagley)

The program for Stationary Clutter Table Construction for N Radars (T908) was not run this period principally due to an oversight in requesting computer time.

Data Recording for 3 Radars (T909), described in previous bi-weeklies, is being coded.

The program for Stationary Clutter Rejection (T-716) was not run during this period due to the lack of the simultaneous availability of the camera and of computer time. Photographs of the displays will be made as soon as the program can be run.

Considerable time has been spent in mulling over the problems of clutter rejection and automatic initiation. Some thoughts have crystallized and will form the basis for an interoffice memorandum.

(J. Ishihara)

Work continues on modifying and coding of sections of the "Three-Stage Correlation" program. A completed draft of the entire program should be ready during the next period.

(N.S. Potter)

During the past bi-weekly period the indoctrination problem was finished, and further work was done on the statistical tracking program. The latter has been largely rewritten to reduce the statistical processing time and to remove several programming errors.

5.0 TRACKING AND CONTROL

(J. Arnow)

The data link for the Rockport 584 was tied in to the computer during the past bi-weekly period. Some preliminary tests were made with very satisfactory results. A flight test was held with a B-25, and the data from both the MEW and Rockport radars were superimposed. Outside of a discrepancy in the measurement of the relative co-ordinates of the two sites the test was highly successful as the B-25 was observed out to about 30 miles on the Rockport radar.

Experiments in tracking aircraft will have to be delayed until the clock has been installed.

(W.S. Attridge, Jr.)

I have made a flow diagram for a proposed method of data fitting. This method uses averages of D_y , D_x , and t in the smoothing equations.

(M. Frazier)

The staff indoctrination problem has been rewritten and is awaiting correction by Arnow. It is written for the Rockport radar.

The three-radar display program has been run for demonstration and test of the new data link. Very heavy clutter obscures the northwest quadrant. With the range gate at 5.5 miles, returns were observed at about 14 and 29 miles toward the east; these were printed out by the SDV print-out program, but were not to be seen on the B-scan. Also, they were not observed during earlier runs with the range gate further out. Study of the sheets indicates that the range gate should be kept out at least beyond six miles.

SDV Data Analysis was also written, but indicated no data link malfunction of the type it was designed to detect. In the SDV print-out, however, one double range return was found with the two ranges identical.

The Bedford-Rockport tracking program is nearing completion. The program is designed for a clock, but gets along on a time counter. Range and azimuth are punched out for each radar after smoothing. A special PWTFT will be written to study this data.

(W. Lone)

I have written a program which tracks a single aircraft with two radars. Immediately following initiation two search sectors are set up, one for the second radar and one for the initiating radar.

5.0 TRACKING AND CONTROL (continued)

(W. Lone) (continued)

A best fit from the search sector of the radar that is next expected to see the aircraft is used to smooth the velocity and predict positions, this being done at the end of the search sector of the other radar. Should no best fit be available from the search sector of the first radar expected to see the aircraft, the best fit from the search sector of the second radar is used. In the event both radars miss the aircraft on a scan, velocity is assumed constant and positions are extrapolated in the normal manner. This program is as yet untested.

Work is being continued on the indoctrination problem for new staff members.

(A. Mathiasen)

TRASACT was rerun with more success than on previous occasions. Over a period of 40 scans, one radar saw the aircraft 100% of the time; the second, however, saw it only 30% of the time. The reason for this discrepancy is not yet known. There were, moreover, rather violent jumps in the velocity estimates. Whether this was due to the quasi-steady state phenomenon or to some other cause has not yet been discovered.

The tracking program for the Rockport radar (T-792) tracked successfully on simulated data with good smoothing of velocity.

An (r,θ) print program of selected radar data has been written for use in calibrating the Rockport radar.

6.0 AIR DEFENSE CENTER OPERATIONS

(D.R. Israel)

A letter has been received from Mr. Millea, Chief Controller of the Boston Air Route Traffic Control Center. Mr. Millea has approved our suggestion that a staff member be permitted to make frequent visits to the Center. P. Cioffi will undertake this as soon as his SECRET clearance has been processed.

In answer to a letter to the Evans Signal Corps Laboratory, we have been notified that five people from that laboratory will visit us on April 2 to discuss matters concerning the computer and anti-aircraft units.

On Friday and Saturday, March 14 and 15, a trip was made to the Ground Observer Corps Filter Center at White Plains, N.Y. Other staff members making the visit were Kirshner, I. Mann, and Webster. The trip was highly instructive, and we left the Center with a good deal of technical data and a number of Magnecorder

6.0 AIR DEFENSE CENTER OPERATIONS (continued)

(D.R. Israel) (continued)

recordings made during a small exercise on Saturday, March 15. The planning for the first single-aircraft tracking program utilizing ground observer corps data will begin immediately.

(F.A. Webster)

The first portion of the period was spent at I.R.E. meetings; the latter portion was devoted chiefly to an indoctrination problem.

7.0 ASSOCIATED STUDIES

(P.R. Bagley)

The single-aircraft tracking program assigned as an indoctrination problem has been coded and turned over to Attridge for checking.

The data input section of the Interceptor Assignment Demonstration has again been modified, this time to accept data tapes punched in new Flexowriter code. This modification has not yet been tested.

(G. Cooper and A. Katz)

Repeated attempts to run GESP-1 met with failure because of a sequence of tape preparation errors. We believe the current copy is finally free of such errors, but have not been able to get the computer time to try it out. An attempt to get more data with ESP-1 (a tried and true tape) also met with failure, presumably because of computer malfunction.

A report is being written on the statistical design of predictors by A. Katz.

(H. R. J. Grosch)

During the past two weeks my main interest has been in crystal and core matrix elements for WW 1.5 and WW 2.0, both binary and ternary.

I gave a talk on the construction and use of optimum interval mathematical tables at the numerical analysis seminar on March 13, and attended a meeting of Committee Y15 of the American Standards Association in New York on March 14.

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7.0 ASSOCIATED STUDIES (continued)

(A.J. Perlis)

While waiting for the indoctrination program to commence, I have been reading various reports pertinent to the smoothing and correlation problem.

(R.L. Walquist)

In order to help indoctrinate both our own staff and some of the Lincoln personnel in our use of a magnetic drum as a buffer storage device, two block diagrams have been drawn of the multiple radar input to the computer. One of these diagrams shows the logical arrangement of the terminal equipment associated with each telephone line: Range and azimuth counters and decoders; C.R.T. for clutter rejection; read-out gates; etc. The other diagram shows the buffer drum equipment itself: Reading and writing control circuitry; field switching control; control signals to and from WWI; information storage channels and control channels on the drum; etc. A discussion of the logical operation of this equipment is being planned by Wieser for the near future.

8.0 COMPUTER OPERATIONS

(J. Arnow)

Radar and Relay Link	5.00 hours
Clutter Rejection	0.75 hours
Tracking Programs	1.75 hours
Smoothing Study	3.50 hours
Aircraft Control	1.75 hours
Miscellaneous	1.25 hours
Flight Tests	3.00 hours
Visitors	6.25 hours
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Time Used	23.25 hours
Time Lost	11.75 hours

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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 February 15, 1952," Taylor, N.H., Mayer, R.P., M-1407, February 26, 1952, pp.1-4. CONFIDENTIAL
2. "Whirlwind II Meeting of February 29, 1952," Taylor, N.H., Mayer, R.P., M-1417, March 3, 1952, pp.1-2. CONFIDENTIAL
3. "Whirlwind II Meeting of March 7, 1952," Taylor, N.H., Mayer, R.P., M-1420, March 10, 1952, pp.1-2. CONFIDENTIAL
4. "Outline of Indoctrination Course," Israel, D.R., Attridge, W.S., M-1421, March 11, 1952, pp.1-2. CONFIDENTIAL

TECHNICAL REPORTS

1. "The Effect of Noise on Limited-Acceleration Homing Missiles," Booton, R.C., Jr., Seifert, W.W., Dynamic Analysis and Control Laboratory, M.I.T., Cambridge, 39, Mass., January 2, 1952, Lib. No. 1719. CONFIDENTIAL
2. "Jet-Vane Controlled Bomber Defense Missile," Quarterly Progress Report No. 1, April-June 1951, Aero-Mechanics Dept., Cornell Aeronautical Laboratory, Inc., Buffalo, New York, December 11, 1951, Lib. No. 1721. CONFIDENTIAL
3. "Automatic Oboe Guidance System," **Final Report**, Doolittle, J.H., Cornell Aeronautical Laboratory, Inc., Buffalo, New York, December 29, 1951, Lib. No. 1722. CONFIDENTIAL
4. "Resumé of Characteristics," Model I, Command-Control Data Link as developed by The General Electric Company, March 6, 1952, Lib. No. 1724. CONFIDENTIAL
5. "Data-Link Status Report," Data Link Branch, Air Defense Office, AFCRC, Cambridge, Mass., March 1, 1952, Lib. No. 1725. CONFIDENTIAL

9.0 PUBLICATIONS (continued)

(M.R. Susskind) (continued)

6. "Study and Investigation of Data Computing Techniques," and "Design and Construction of General Purpose Computer," Final Report for AFCRC, Cambridge, Mass., Computer Research Corporation, 3348 W. El Segundo Blvd., Hawthorne, California, January 15, 1952, Lib. No. 1334.

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7. "Integrated Fire Control System for Terrier," Monthly Progress Report, RCA Victor Division, Radio Corporation of America, Camden, N.J., January, 1952, Lib. No. 1487.

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BOOKS

1. "Stick and Rudder," Langeweische, Whittlesey House, 1944.

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