Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: GROUP 61 BIWEEKLY REPORT, NOVEMBER 21, 1952

1.0 GENERAL

(P.R. Bagley)

Revision of programming memos. I have commenced bringing up-to-date M-1624, "Short Guide to Coding and Whirlwind I Operation Code," and M-1623, "Programming for In-Out Units."

Visitors. Major Witting of Signal Corps Engineering headquarters, escorted by Colonel T.M. Hahn of Lincoln, made a tour of the Laboratory on November 10 to gain a general idea of our activities.

Lieutenant-Colonel Lewis, Major Cook, Major Koons, and Captain McQuaid, from Grenier Air Force Base, escorted by Captain Marks of the 6520th Flight Test Wing, witnessed a computer-controlled interception on November 14. They met with F. Heart, A. Hill, and H. Kirshner to discuss the problem of communication between Whirlwind and aircraft on the ground at Grenier.

On November 18 the following members of the 6520th Flight Test Wing visited the Laboratory and were shown a canned interception: Captain Gray, Captain Schwikert, Lieutenant Covert, and Lieutenant Taylor. On November 20 four more officers from the 6520th Flight Test Wing visited the computer and the operations room: Captain Deatrick, Lieutenant Turner, Lieutenant Pearce, and Lieutenant Alexander.

Captain Wilson of Air Route Traffic Control Center (Boston) witnessed a flight test on November 21.

Staff members who escort cleared, non-Lincoln visitors are requested to send a brief memo to C.R. Wieser naming the visitors and their mission.

2.0 EQUIPMENT ENGINEERING

(N. Alperin)

The new light gun is installed in Room 222. The panel is in Room 224. To operate it is now necessary to switch the output cable in Room 224 from the old light gun circuit to the new panel. An E-note is being written on the new gun but won't be finished until the gun is evaluated by those who will be using it.

2.0 EQUIPMENT ENGINEERING (CONTINUED)

(A. Heineck, S. Thompson, D. Remis, Group 62)

Blueprints of the IBM plug-in units have been received. It is hoped that the complete plug-in units themselves will arrive within six weeks.

The logic and circuitry as shown on these blueprints are being compared with the logic and circuitry that we developed before the blueprints arrived. From this comparison we will decide whether or not to modify the IBM plug-in units which will make up the proposed four-bit IBM arithmetic element.

(J.F. Jacobs, R. Jeffrey, Group 62)

Block Schematics and wiring diagrams for the IBM 701 Airthmetic Element Pluggable Units have been received. We are in the process of drawing up control circuits for a test arithmetic element which are these units.

(H.J. Kirshner)

In an attempt to alleviate the communication bottleneck which has hampered experiments concerned with automatic initiation of tracking of scrambled interceptors, a conference was held with the Commanding Officer of Grenier A.F.B. and several of his aides. As a consequence of this meeting, permission was granted for Lincoln to install radio and/or telephone facilities at Grenier, such facilities to be operated by Lincoln personnel. It is anticipated that radio facilities will be installed and operating by next week.

Several communication checks, employing H.F. radio, were conducted with the AAA site at Nahant. Reception of signals from the Barta Building at the site was good, however, reception of the site's transmission was poor. This latter condition may be improved by increasing the site's power output (presently approximately 5 watts) by using a receiver better than the one now on hand at the Barta Building, and by shifting to a higher frequency. All three alternatives will be tried.

The design and construction of equipment required for "Four-Pair" experiments is awaiting decision as to the manner in which it is required to operate. Once the specifications are decided upon, design and construction will pose no problem.

2.0 EQUIPMENT ENGINEERING (CONTINUED)

(H.J. Kirshner) (Continued)

Orders are being placed by Ronald Enticknap of Group 21 for three telephone lines to connect the Operations Center at the Barta Building with P-10 at Truro. There lines will be used for monitoring manual cross-telling lines at Truro in conjunction with our experiments involved in aircraft identification. Those lines will be used in lieu of the teletype lines mentioned in a previous biweekly report; the change being made due to the present low volume of traffic on the teletype lines previously mentioned.

Paul Rosen and Richard Krepps of Div. II will be with this group for a period of time to determine what steps may be taken to improve the performance of the two S.D.V. systems presently installed.

(B. Morriss & G. Young)

Effective December 8, the addresses of the si instructions affecting the paper-tape punch and the printers will be changed so that an automatic punching mode can be added. This mode will punch three characters from a 16-digit word in response to a single rc instruction. These characters will be currently assembled into 16-digit words when the tape is read by the mechanical paper-tape unit or PETR using the word-by-word mode. The new addresses will be:

For the punch

si 204 (octal) Punches one character with the 7th digit suppressed
si 205 (octal) Punches one character with the 7th digit punched
si 206 (octal) Punches three characters with the 7th digit suppressed
si 207 (octal) Punches three characters with the 7th digit punched.

For the printers

si 215 (octal) Printer #1 print one character
si 225 (octal) Printer #2 print one character
si 235 (octal) Printer #3 print one character

A note will be distributed describing the changes in more detail.

If an rd instruction is given after an si instruction referring to the scopes the contents of IOR are transfered to AC and a point is displayed corresponding to the settings of the two decoders. This

2.0 EQUIPMENT ENGINEERING (CONTINUED)

(B. Morriss & G. Young)

was originally intended to serve as a method of obtaining any information placed in IOR by light guns, but has been used to display points with a constant vertical deflection. This extra display has apparently caused some confusion in displays in which light guns are involved, and it has been suggested that IOC be modified so that the display on the rd order is prohibited. Suggestions are invited as to whether this change should or should not be made.

Work is continuing on programs for checking the auxiliary magnetid drum and a memo on the operation of the buffer drum and its associated equipment.

(J.H. Newitt)

During the past biweekly period many miscellaneous installation details for the new WWI air conditioning system have been settled. Drawings for the penthouse work in the Barta Building have been supplied to H. Mercer, and he is obtaining detailed constructional specifications and estimates for the required work.

In going over the electrical schematic of the system with the installation group, we have noted the need for further refinement of the air-conditioning control system. This was occasioned by the requirement of turning on either drum, both drums, MITE equipment, or all equipment in 156, from test control. A system is being worked out to exert proper automatic control of the air-conditioning system when the various services are selected in test control.

Installation drawings are now available for the work in 045 and it is expected that this will get under way soon.

(E.S. Rich)

Fourteen-Channel Magnetic Tape Recorder. Several members of the Laboratory discussed details of a 14-channel magnetic tape recording system with Mr. Myron Stolaroff, manager of the Special Products Division of the Ampex Electric Corporation, on November 18. A summary of this meeting is given in M-1726.

Magnetic Drums. Additional talks on the detailed features of the Auxiliary Drum System have been given during the last two weeks to a group of about 20 staff and technicians primarily from Group 64. So far logical operation and timing have been discussed. Further talks will be given next week covering the power control and initial testing plans.

2.0 EQUIPMENT ENGINEERING (CONTINUED)

(F. Sandy)

Power cabling and distribution in Room 156 is proceeding rapidly. Four men are now working on this full-time. We also have a full-time inspector. All the power-distribution and fixed-voltage switching panels have been received and are being wired in. Six voltage-variation panels have been received and are in inspection now. The rack-interlock and fuse-indication panels have not yet been received from the vendor. We do not have the filament-transformer panels yet. Gavitt Mfg. Co. will deliver the preformed cables by the week of December 1.

The surface duct installation for test voltages and 115 AC, regulated and unregulated, is being installed and should be completed in a day or two. A big hitch developed in trying to supply lighting and power to Room 156. The difficulty has arisen because it is nearly impossible to run any more wireways out of the transformer vault. However, a way has been found which involves going through five to six feet of wall. Bill Carroll is taking care of this.

Power-supply control has been completely installed now. It seems to be working fine except for a trouble that developed with one relay. We hope to fix this during installation next Monday morning.

(A.W. Shortell, Jr.)

A new proposal for the operation of the video mapper has caused some revision in our plans. Rather than generating a gate waveform to blank clutter, an attempt will be made to see if all target pulses, less selected clutter, can be regenerated. Preliminary tests indicate that the rise time of the P7 phosphor (about 20μsec.) can be tolerated. At present I am constructing a low-frequency sweep generator to simulate the azimuth sweep of S.D.V. This will provide a test setup for generating a simulated B-scan.

All material for the Teletalk installation has been received. At present Bill Carroll's crew is wiring the junction boxes and one of our technicians is installing the handsets on the master stations. Installation of the system now depends on the availability of Bill Carroll's crew.

(C. Zraket)

In connection with thesis work, two approaches to the problem of test checking the buffer drum have been considered. One is to devise a static check amenable to marginal checking and under computer control. The second is a dynamic check in the form of a monitoring of the input data, as first proposed by Walquist. A combination of these in addition to the use of test patterns from the various inputs should be sufficient to insure that the system is operating reliably.

3.0 BEDFORD EXPERIMENT

(M. Brand)

Aided Tracking

Aided-tracking program T-2179 using NLS-2C-CV smoothing was twice put on the computer but both times the test could not be completed due to machine trouble. It is hoped that the program will run during this next period.

Interceptor Reattack Analysis

Charles Grandy and I have rewritten our memo "Preliminary Consideration of Interceptor Reattack"; the new memo uses the method of minimum time to reattack once an initial attack angle and reattack angle have been selected. Suggestions for sophistication of the method are discussed. The memo will be issued shortly.

Final Turn Interception

I have assisted in the running of final phase interception flight tests. I have worked with other interested people in the Bedford group in the rewriting of the final-phase interception program into a master interception operations program.

Final Turn Guidance

Charles Grandy and I had started on a modernization of T-2025 to provide scope displays rather than flip-flop displays with the idea of using this program as a return-to-base guidance program. We decided, however, that it would be better to wait until the final-turn interception program mentioned above is completed. We would provide proper resets in this program so that it could be converted to final-turn guidance at will.

Special Input Program

I repaired Irwin Mann's original special input program, T-2028, and operated it successfully on the computer. This program is about ten registers shorter than T-2000 which has been previously used. I rewrote Irwin Mann's memo which will be issued complete with flow diagram and program.

(F.M. Garth)

Basic two-aircraft tracking and interception, height finder, and simplified AAA guidance, and automatic fighter initiation with return to base were combined into a single program. Duplications were made and, along with my operating instructions, were distributed to Bedford Experiment personnel.

3.0 BEDFORD EXPERIMENT (CONTINUED)

(F.M. Garth) (Continued)

Testing of this major program was done on several occasions by Charles Gaudette, Frank Heart, John Cahill, and me. When the three parts of the program were read into the computer separately the run was satisfactory. However, this was not true when the combined tape was used. The difficulty has since been located, and the tape is now available for basic flight tests.

In order to include "final turn" in this program, a register-saving rewrite is being done. A committee of which I am a member has been working on this simplification.

(C.H. Gaudette)

Brand, Cahill, Garth, Grandy, and Gaudette are meeting daily to write the general two-aircraft interception program. The programming is proceeding slowly because the use of storage must be minimized in order to include all the refinements desired in this program. The program will probably be operational in a month.

A minor error in the time display of the basic two-aircraft interception program has been discovered and corrected. This error had no effect on the interception calculations, but placed the display of the interception point slightly out of position.

(C. Grandy)

Interceptor Reattack

Milton Brand and I have revised the memo written during the previous biweekly period concerning interceptor reattack. Our investigation shows that it is possible to designate a course for the interceptor to position him for reattack if the initial attack angle and the reattack angle are preselected. The difficulties of the earlier solutions to this problem have been avoided, and a solution can be found quite easily. This memo should be published during the next biweekly period. This investigation also indicated several aspects of the problem that should be investigated more thoroughly, and we are starting on this task.

Final-Phase Interception

Some thought is being given to a proposal to write the final-turn interception program so that it can be used to guide the interceptor back to base and place him in a favorable position for landing. It appears entirely possible to do this and is only a question of working out the details.

3.0 BEDFORD EXPERIMENT (CONTINUED)

(C. Grandy) (Continued)

Basic Interception Program

I have continued working with the group rewriting the basic interception program as mentioned by C. Gaudette in the last biweekly. Since storage space is very valuable in this program some desirable features are being eliminated, and to correct this Milton Brand and I are starting work on a program that will utilize the auxiliary drum system to provide adequate storage space.

(F. Heart)

Single Pair

A single up-to-date tape, program copies and operating instructions, are now available for Program T-2187, Mod. 2. This program includes collision-course interception, use of MPS-4 height finder, use of single battery antiaircraft, return-to-base, and automatic-initiation subprograms, as well as minor display sophistications.

The final-phase program, written by C. Zraket and others, has also reached a stable form in which it will be used for the next month.

Efforts of interested people will continue towards combining the above two programs into one program of less than 1024 registers. In addition, M. Brand and C. Grandy have begun consideration of the auxiliary drum and the ways in which it may be used for program and subprogram storage. It is expected that more sophistication will certainly be possible when the auxiliary drum is available. According to J. Newitt, a conservative estimate for general drum service operation is March; scheduled availability is Feb. 1.

Four Pair

A flow diagram for a program controlling four simultaneous interceptions is available as Drawing SC-53095. Efforts have continued to fully describe operation of this program. S. Knapp and A. Ward have already completed a large part of the program.

(S. Knapp & A. Ward)

Programming of the Four-Pair Interception Program is progressing satisfactorily, and is almost complete. It was found impossible to time-share the smoothing, and this will be done in a small sector at NNW. All displays and interception calculations, however, will be done on zero ranges, so that not more than two pieces of data will be lost in a scan.

3.0 BEDFORD EXPERIMENT (CONTINUED)

(S. Knapp & A. Ward) (Continued)

The Two-on-One Interception Program is still giving trouble, and a lack of computer time has hindered our efforts to track down the difficulty. The error is in the interception calculation section, the displayed heading angle being incorrect by about ten degrees.

(G. Rawling)

Programming for the height phase of the Multiple Aircraft Tracking (MACT-16) Program is continuing.

(C.Zraket)

Two final-turn interceptions were scheduled the past biweekly period. The test on Nov. 14 served as a visitor demonstration. The results of the first run (head-on) were somewhat erratic due to the fact that the interceptor was instructed to turn to the left 355° instead of to the right 5°. This resulted in a 20° displacement from a true head-on interception. The second run was cancelled midway through the interception when the Bedford MEW stopped transmitting range data.

A test scheduled for Nov. 21 was cancelled when no radio contact could be made with the target aircraft.

The condition in the computer program which caused the erratic results described above was discovered and corrected. It is hoped that all future final-turn flight tests will be conducted using a rewritten version of the above program which will contain more sophisticated displays, will be easier to operate and will consider all possible conditions of flight.

4.0 DATA SCREENING

(R.L. Walquist)

The program which displays a numbered grid of 256 boxes was run on the computer. Photographs of the display on the 16" scope were taken. These photographs indicated two important defects in the present displays:

1. The plots of horizontal and vertical grid lines did not coincide at the crossing points as they should have (the deviation in the worst cases was about 1% of full decoder deflection).

4.0 DATA SCREENING (CONTINUED)

(R.L. Walquist) (Continued)

2. Change of the vertical decoder from almost maximum negative deflection to almost maximum positive deflection produced oscillations in the decoder amplifiers (according to R. Gould) which caused plotted points to deviate from their correct positions by about 1% of full decoder deflection, (the 2^{-6} digit position).

Checks of the 5" scopes off-centering and magnification controls indicated that the magnification obtainable is about a factor of 8, while the off-centering controls are sufficient to shift the display completely off the face of the scope. Some trouble was encountered with the beam hitting the walls of the tube and bouncing back onto the scope face for the maximum magnification condition. Further tests of the 5" scope and controls will be made next biweekly period.

Considerable time has been spent on drawing up some specifications for the Cape Cod Control Center.

(W.S. Attridge)

Plans have been made for a 19-aircraft flight test for November 26. Data will be recorded from three radars on the computer magnetic tape equipment for use with Muldar Tracking Program #2 (MTP #2).

MTP #2 has reached its final stage of completion. We should be able to start processing of the data from the above mentioned flight test during the next two weeks.

(W.A. Clark)

The overlap analysis of 12 radar (32 x 5 mile) muldar system has been completed. Results show that the coverage (a total of 18,206 sq. miles) is distributed as follows:

31%	is	covered	by	1 radar
27%	"	"	"	2 radars
19%	"	"	"	3 "
12%	"	"	"	4 "
8%	"	"	"	5 "
3%	"	"	"	6 "

The utilization of this system is 0.483. Pictures of the coverage pattern have been made and several photographic modes of operation of the program are available for further displays.

4.0 DATA SCREENING (CONTINUED)

(D. Goldenberg)

A summary was completed in inter-office correspondence form of my work to date on determining the optimum conditions for the size, shape, and center of the search area for tracking. The results were adapted to the Muldar system. It was found that the center of the search area should be the center of the next switching-time interval, one switching-time prediction ahead. Two sizes of search area should be used, the larger 10 miles on a side and the smaller 6 miles on a side. Because a return may be reported at any time, within the switching-time interval, the search area should be centered at a point predicted ahead for the same amount of time as the return. This requires that the search area be oriented with respect to the line of flight of the aircraft. If such an orientation is accomplished, the size of the search area should be 3 1/2 miles on a side.

Therefore, the recommended procedure should be to 1) determine whether the return is within 5 miles of the center of the switching-time interval predicted point, 2) if it is time, correct the return to the center of the switching-time interval, 3) determine whether the return is within 1 3/4 of the predicted point. The last step will decide whether the return correlates with a particular track. If no return occurs within the 3 1/2 mile area for a track but some occur within 5 miles of the predicted point, the possibility of a turning track arises. If this condition repeats itself on one of two succeeding scans, a turn can be assumed. The new velocity components are then calculated using the last two or three returns only and the new characteristics of the track immediately substituted for the past ones. This should enable the computer to maintain a track through turns.

(J. Ishihara)

The correlation section of Muldar Tracking Program #2 (MTP #2) has been put into final form. Test parameters are now being coded in order to check out the various parts of this program before its actual use in MTP #2. Further checking will be continued.

(J. Levenson)

In conjunction with the work done by Ishihara to revise MTP #2, I have written several subroutines. Also, I have written a program to test the visual effect of a continuous display, from a drum, of arrows and other symbols.

The problem of correlation schemes is still being considered; at present I am analysing a method of ordering both tracks and radar data in the x-dimension before correlating them. All correlation schemes are being studied to see how they may be used with a drum.

4.0 DATA SCREENING (CONTINUED)

(H. Peterson)

During the past two weeks I have endeavored to iron out the difference between my data storage tape and Mr. Potter's display tape. I also have written a program to put an arrow head-on every nth return to give direction of track, a tape display of my own, and a program to center and expand any part of a tracking display program.

(N.S. Potter)

Work has continued, in association with H. Peterson, on the data-recording and display programs. There is an as yet unexplainable shift in the reference center of the Scituate data, the operation being satisfactory otherwise.

The special display programs mentioned previously are undergoing critical examination in an attempt to reduce their length.

(H.H. Seward)

J. Levenson and I checked out J. Ishihara's revised track sort and correlation sections of Muldar Tracking Program #2. I am presently writing a parameter for checking the operation of the track-sort routine.

5.0 TRACKING AND CONTROL

(J. Hayase)

Work is progressing on the problem of tracking an aircraft with two radars.

(M. Frazier)

The Bedford-Rockport single-aircraft tracking program seems to operate correctly, but has only been tested on stationary targets. A modification of this program printing r and θ (for each radar seeing the aircraft) once per scan awaits testing.

The two-radar single-aircraft tracking program for simulated data using the common-velocity separate-track method of data combination is being debugged.

A single-radar single-aircraft tracking program using the "semi-real time" technique is being written to gain experience with the method before going on to more complex programs.

(B. Lone)

A program has been written to investigate the display problem caused by an "rc" followed by an "rd" order as explained in the past biweekly. When two horizontal lines are displayed far apart by displaying a point on one and then a point on the other with the same horizontal deflection setting a double line appears in both places. This is not correctible by the insertion of three dummy orders between the "rc" and "rd". However, when the same method is used to display two horizontal lines which are fairly close together the undesired double display disappears. The findings have been relayed to Bob Gould who will attempt to correct the situation.

The simulated version of the two radar tracking program which averages the times of returns and positions observed seems to be working properly. There are errors in the non-linear smoothing method of this program, probably in the values of "a" and "α". This program will be tested with additional data tapes as soon as they become available.

(A. Mathiasen)

Although the simulated data program (SYMULDATA) is still not working quite as intended, one data tape was punched allowing some simulated data programs to be tested. Trouble was had with the old data tapes.

The two-radar tracking program using the best data from the two radars (TRASACT-3PBF) and a single-radar tracking program (RTPR) were both tested. Except for trouble with one of the non-linear smoothing methods, NLS-2b, TRASACT-3PBF worked well and should produce all the data

5.0 TRACKING AND CONTROL (Continued)

(A. Mathiasen) (Continued)

needed for study within a short time. RTPR was satisfactory in all respects. On the one track used in testing all the smoothing methods, NLS-2b showed up best.

A live-data two-radar tracking program (TRASACT-1PBF) was run with a test pattern. The correction of one program error enabled the program to run satisfactorily.

(B. Stahl)

The TRASACT BF (two-radar aircraft tracking, best fit) program is now coded and is being checked over with Frazier before being put on tape. A small part of the biweekly period was spent running the selective three-radar display program, for the first with live data. As explained before, the purpose of the program is to superimpose on the scope data from one, two or three radars, using the largest display. With live data, several very close parallel tracks were observed which indicated an error arising from slant-range returns or misplaced coordinates of the Rockport or Scituate sites. More study will be given to this problem as soon as TRASACT BF is on tape.

6.0 AIR DEFENSE CENTER OPERATIONS

(D.R. Israel)

This biweekly period was completely devoted to planning for the Cape Cod System, this work being carried out together with J. Arnow, R. Everett, R. Walquist and C.R. Wieser. A preliminary description and set of sketches have been prepared.

(J.J. Cahill, Jr.)

The Simplified Height-Finder and AAA Program is now operative, and forms a part of the Single-Pair Intercept Program, T2187.

An AA Guidance flight-test was performed on November 19, but due to sub-standard operation of the AAA Radar, no useful data was obtained. Word was given to Col. Guy of the AA Operations Center of the alarming number of times when the Btty. presently being used for this series of tests (A Btty. 704 Bn.) has been unavailable letely, chiefly because of maintenance difficulties connected with the radar equipment. The colonel suggested that other batteries in the command be briefed regarding the tests, so that these can be used when A Btty. is unavailable. Steps in that direction have been taken, and it is hoped that two additional batteries of the 704 Bn. will be included in the system by the middle of next week.

6.0 AIR DEFENSE CENTER OPERATIONS (Continued)

(J.J. Cahill, Jr.) (Continued)

Col. Guy expressed encouraging interest in the AAA aspects of Group 61 activities. He invited the author to visit the Operation Center and discuss mutual problems with his officers. This will be done at the earliest possible moment. The colonel also seemed anxious to have one of his officers visit the laboratory and see the computer end of an AAA Guidance test. This will also be done shortly.

(P.O. Cioffi)

My activity with the Air Traffic Control Center now has me in a better position regarding the problem of aircraft identification by flight plan data in an automatic system. I have begun to put together some ideas concerning identification and further, to make some proposals for the mechanization of such a system. I expect to have this completed and in writing during the next period.

(F. Heart)

Procedures. Efforts have continued to achieve a more useful record of flight tests. Flight test records now include a complete list of "troubles" encountered prior to and during a test. In addition, an attempt is being made to procure pilot reports for each mission. Several such reports have arrived and will be included in the Flight Test Record Book kept by S. Chaplain. Before inclusion in the Record Book, such reports will be channeled to the person in charge of the particular test.

A. Hill and P. Dolan are now preparing a blip-scan ratio (ratio of radar "hits" to total scans) for each flight test involving either a single-engine piston or Jet aircraft. A summary to date will be issued shortly.

In an attempt to familiarize members of the Bedford Flight Test Squadron with Group 61 work, several small groups of officers have already visited the Laboratory, and others will follow.

Height-Finder. With J. Cahill, P. Cioffi, and Group 22 personnel, efforts have continued to test several recent changes in equipment and procedure at the Rockport MPS-4 Height-Finding Radar.

(F. Webster)

Certain problems concerning the transfer and processing of information -- particularly as they relate to bottlenecks in a man-computer system -- are being investigated. One bottleneck (in time) is the current need for persons to meditate in the collection, manipulation, and interpretation of statistical data dealing with the operation of a computer in complex control applications. The problem

6.0 AIR DEFENSE CENTER OPERATIONS (Continued)

(F. Webster) (Continued)

seems to warrant looking into such questions as: to what extent might a computer itself analyze the statistics of its performance? If it did this, what tabulations and analyses should be made? How should these be used to govern the details of operation? If a system collects its own probability distributions, how many divisions or categories should be used at a given time, and what confidence-levels should be associated with decisions based on the data? How might the decision-structure be automatically shifted to fit the data?

In connection with some of these questions, a paper by J. von Neumann is being studied. This deals with the reliability of decisions based on systems using unreliable components or sub-systems.

7.0 ASSOCIATED STUDIES

(W. Linvill)

I have spent the last biweekly period preparing a report on design of sampled-data systems and on extending the compensation techniques previously worked out. Bob Sittler and I have submitted a paper on these results for the I.R.E. Convention. He has a way to apply flow-graph techniques used in continuous servo systems to any sampled-data system. By allowing use of digital filters it is possible to compensate any sampled-data servo system similar to the way continuous systems would be compensated. I am now trying to find a continuous equivalent to the digital filter used so one can use either continuous or digital filters for the corrective network. All these results will be published in a report as soon as they are complete.

(E.J. Craig)

Sampled-data equivalent circuits to be used for studying the convergence properties of iteration procedures are being formed. Such procedures as Newton's Method, and one type of integral-equation iteration process are studied in this manner.

Significant results have also been obtained for linear simultaneous equations. For one iteration method a circuit (block diagram or flow graph) can be drawn and stability studies show a remarkably simple condition for convergence. No specific requirements have been placed on the set of equations except that they be an independent set.

Current efforts are to be directed towards other representations, of iteration procedures for simultaneous linear equations with an eye to the circumspection afforded by an equivalent circuit.

7.0 ASSOCIATED STUDIES (Continued)

(C.H. Gaudette)

A program to check the sine-cosine subroutine given in M-1631, Supplement 1 (SLR #13) has been written and operated successfully. The program computed and printed the sine and cosine for all azimuth units. The maximum error obtained was 2^{-10}, which is slightly less than 0.001.

(D. Goldenberg)

A program was completed which tests the subroutines for recording blocks of orders from ES to magnetic tape and reading any selected block from magnetic tape to ES. The only run of this program was unsuccessful because the human error was committed of not turning on a desired printer.

(W.I. Wells)

In connection with the work on handling of noisy data, the case of straight-line smoothing was worked out. For the type of quantization considered it is shown conclusively that "least squares" smoothing is optimum. The more general approach also allows one to accept and use "multiple returns" in an optimum manner. Dan Goldenberg and I discussed this at some length recently, since he arrived at about the same process by assuming that "least squares" would be optimum. The extension to "multiple returns" is a very important and useful device.

8.0 COMPUTER OPERATIONS

(M. Brand)

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

MEW Tracking and Central Experiments	3	hrs.
Data Screening	5.60	hrs.
Multiple Radar Tracking and Control	8.40	hrs.
Indoctrination Programs	.40	hrs.
Miscellaneous	2.50	hrs.
Subtotal	19.90	hrs.
Flight Tests	4.80	hrs.
Calibration	.50	hrs.
Demonstration *	9.75	hrs.
Time Lost	4.25	hrs.
Time Not Used	10.75	hrs.
	49.95	

* Includes special project display programs

9.0 FLIGHT TESTS

(A.P. Hill)

BREAKDOWN OF FLIGHT TEST SCHEDULE

Date	Scheduled Test	Test Held	Reasons for Change in Schedule
Nov. 10	1000-1200 Cahill Height Finder Two A/C 4	Cancelled 0	Weather
	1400-1600 Arnow Coverage Rockport & Scituate 2	Cancelled 0	Weather
Nov. 12	1000-1200 Gaudette Three Dim. Intercepts 4	As Scheduled 4	Note: Fighter A/C 40" late-returned to Base 1130 due mechanical trouble
Nov. 14	1000-1200 Zraket Final-Phase Intercepts 4	As Scheduled 4	-----
Nov. 18	1000-1200 Cahill Height Finder Two A/C 4	Cancelled 0	Height Finder Inoperative
	1400-1600 Arnow Coverage Rock. & Scit. 2	As Scheduled 2	-----
Nov. 19	1000-1100 Cahill 1	Held from 10-1200 2	Extra hour due to cancellation of T/O Initiation Test from 11-1200
	1100-1200 Garth Take-off Initiation 2	Cancelled 0	F-80 Mechanical trouble
	1400-1600 Heart Coverage Test 2	As Scheduled 2	-----
Nov. 20	1000-1200 Knapp Two-on-one Intercepts 6	Cancelled 0	Program not ready
Nov. 21	1000-1200 Zraket 2	Cancelled 0	Aircraft Radio Receiver Inoperative

Total Hours Scheduled = 33 Total Hours Held = 14

9.0 FLIGHT TESTS (Continued)

(A.P. Hill) (Continued)

Results of Flight Tests held:

Nov. 12 1000 - 1200 C. Gaudette
Three-dimensional intercepts
One run was made using an F-52 for an interceptor and a B-25 for a target.
Results: target passed 500 ahead of fighter

Nov. 14 1000-1200 Final-Phase Intercepts
See Section by C. Zraket

Nov. 18 1400-1600 Coverage Rockport and Scituate

Nov. 19 1000-1200 AAA Test Cahill
Results: using an F-51 flying from a point 15 miles east of Hampton Beach at 9,000 ft. IAS 200. AAA Battery did not pick up A/C at any time, AAA radar operation sub-standard.

Nov. 19 1400-1600- Jet coverage test F. Heart
Results: No Jets available--used an F-51. Because of many "close in" targets in area of test, coverage on this aircraft was rather poor.

10.0 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 Organization List, Lincoln Division 6," M-1715, November 12, 1952, pp. 1-12.
RESTRICTED

2. "Ampex Tape Recordings," P.F. Dolan, M-1716, November 7, 1952, pp. 1-2.
CONFIDENTIAL

3. "Group 61 Biweekly Report November 12, 1952," M-1717, pp. 1-20.
CONFIDENTIAL

TECHNICAL REPORTS

1. "Combined Bimonthly Summary No. 31," for period covering June 20, 1952 to August 20, 1952, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, September 20, 1952, Lib. No. 489C.
CONFIDENTIAL

2. "A Method for Determining the Optimum Gear Ratios for Radar Aided-Tracking Mechanisms," J.H. Poirier, Systems Division, U.S. Navy Electronics Laboratory, San Diego, California, June 27, 1952, Lib. No. 2133R.
RESTRICTED

3. "Water Ripple Analogue of Electro-Magnetic Wave Propagation," Engineering Experiment Station, University of Vermont and State Agricultural College, September 1952, Lib. No. 2134R.
RESTRICTED

4. "Measurements of Blast Pressures from 47,000-Pound-Thrust JATO Units," D. Cozen, Test Department, NAVORD Report 1966, U.S. Naval Ordnance Test Station, Inyokern, China Lake, California, April 18, 1952, Lib. No. 2144C.
CONFIDENTIAL

5. "Ultrasonic Solid Delay Line for Digital Computer," Twelfth Report on Mark 65, Bell Telephone Laboratories, Inc., for the Bureau of Ordnance, May 15, 1952, Lib. No. 2145C.
CONFIDENTIAL