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SUBJECT: BI-WEEKLY REPORT, PROJECT 6673, AUGUST 18, 1950

1. ANALYSIS

(D. R. Israel)

In preparing for the formulation of programs for tracking while scanning it became apparent that a much more detailed understanding of the quantization and errors in the radar data was necessary. Based upon what knowledge was then available, an interoffice memorandum (dated 8/10/50) was written, describing the quantizing process and analysing the errors which could be expected therein. This memo provided the basis for a detailed discussion with Jack Harrington of ACRL when he visited us last week. As a result of this visit a revised version of the memo is being prepared and will be available during the early part of next week. Briefly, the conclusions are that the range data will be good to $\pm 1/2$ unit (mile), the azimuth data will be good to ± 1 unit (1.4 degrees), and that little additional information can be obtained from double indications of the same target.

Harrington discussed the matter of calibration of the radar set, and it was tentatively decided that they (ACRL) would provide proper calibration of azimuth, while we would add a small corrective quantity to the range values. While discussing the matter of lack of synchronization between the radar and quantizing equipment, Harrington mentioned a possible minor modification which could be made in the equipment at Bedford to provide some relief. This matter is discussed in fuller detail in the memo described above.

Using the current information regarding radar quantization and errors, R.L. Walquist has started the programming of a simple tracking procedure. Some attention has been given to a means of decreasing the size of the tracking box, this method to involve certain probability considerations. Full details of this scheme are now being worked out.

The Main Display Program which will serve as the nucleus of other programs has been completed--a short description of the program, operating details, and a flow diagram are available. The program includes provisions for Manual Intervention (MIV)--the details of which have been completed in conjunction with C. W. Adams. The sexadecimal-coded, checked (with complements)

1. ANALYSIS (continued)

(D. R. Israel)

paper tape for the main display program has been prepared.

Together with C. W. Adams, some preliminary thought has been given to the preparation of punched paper tapes--including preparation procedures, storage, numbering, usage, etc. The experience to date with the Flexowriter equipment has indicated that extreme care must be taken to obtain error-free tapes.

Jane Littmann has been taught to use the tape preparation equipment and has practiced the conversion from the written form of a program to the sexadecimal mode which will be used for the present. Since it appears that the conversion is best done while actually typing, the present plans are for Mrs. Littmann to prepare the unchecked tapes, while Miss Lemhan will prepare the final checked tapes.

Polar grids for the three 5-inch display scopes are being prepared. These three scopes have been named the M-scope, D-scope, and F-scope. The D and F-scopes, to be used at the remote viewing position (presently in the shop adjoining the computer room), are so named because of the two selective display orders--qf and qd. The M-scope will be situated in the test control room and will have provisions for displaying the presentations of the D and/or F-scopes. Aeronautical maps of the area within a 150 mile radius of Bedford have been secured and will be appropriately mounted for reference.

On August 7th the computer was used between 5 and 9 P.M. At this time three programs were run--spot movement by the joy stick, spot movement by rate of change of heading, and spot size and inter-reaction. These experiments are written up in the Records of Computer Operation as Numbers 2, 3, and 4. The joy stick program gave proper operation; however, it appeared that the speed ratios of 31-15-1 were too high and a change to 15-7-1 will be made and tested. Spot movement by rate of change of heading was not satisfactory as programmed, and the program has been corrected for future experimentation. The spot size program indicated that with spots displayed at one mile intervals and with the 2 1/2 inches equal to 127 miles, the spots overlapped by about 50%. The focus of the scope was noted to be extremely poor near the edges.

(R. L. Walquist)

In conjunction with D. Israel, several of the programs which were written in the last bi-weekly period have been tested.

1. ANALYSIS (continued)

(R. L. Walquist) (continued)

Corrections were made to a few of the programs and they were written up on the forms provided. A slightly revised form of the variable-heading spot control program was written in order to overcome some of the difficulties encountered in the previous program. As yet, this revised program has not been run on the computer.

Considerable thought has been given to the problem of prediction of the aircraft flight path. A set of curves has been drawn for various constant angles of bank showing how far an aircraft could deviate from a straight-line extrapolation for both one and two antenna revolutions. Several prediction formulas were studied in conjunction with the above set of curves in order to see how accurately a prediction could be made. A memo or inter-office note will be written covering this work as soon as the results are consolidated.

Conferences with C. R. Wieser and D. Israel helped clarify the various sources and magnitudes of the errors entering into the incoming radar data. In line with the above discussions, work has been started on a tracking program which will follow along the lines of the flow diagram drawn during the last bi-weekly period. It was decided that the initial size of the tracking box and the number of searches for a lost aircraft should be under the control of the operator.

(E. J. Samario)

A tentative signal discrimination program to be used in conjunction with the nine-digit input has been written. This program, it is expected, will reject a large portion of the spurious signals originating at Bedford and in the connecting telephone lines. The rejection of spurious signals due to radar saturation at Bedford may not be complete inasmuch as all such signals cannot be detected without rather complex programming. Detection can also be accomplished by some sort of predicting program but this cannot be written with information presently available here on the radar installation at Bedford. Certain types of signals may be completely undetectable.

A program is currently being written to detect stationary targets--mountains and other ground clutter.

2. ENGINEERING

(C. R. Wieser)

The demultiplexer and test equipment have been operated together successfully. The trouble caused by overheating crystals in the ACRL equipment has been eliminated by removing the cans from the plug-in units and using a blower.

Further inquiries have been made to determine the advisability of magnetic deflection for the large display scopes. The Radar Laboratory of the ACRL has done a good deal of development work on special high-speed deflection yokes. Mr. Cahalan of the Radar Laboratory estimates that he can design and build special yokes which would allow full deflection in 10 μ sec. and that only 5 to 10 μ sec. would be required for intensification. This sort of performance is superior to electrostatic deflection, where the cathode-ray tube is the limitation in a long-persistence system.

We will try to arrange procurement of the special deflection yokes. Also, the feasibility of using tubes larger than 12-inch will be investigated.

Work is under way to install the five-inch interim display scopes with 100 μ sec. intensification time.

(D. A. Buck)

Mechanical construction has been completed and springs added for centering the joy stick. A pushbutton in the joy stick handle and a relay were added to reverse the sign digit of the joy stick relay panel output when the pushbutton is depressed.

The three speeds in each direction were changed

from	1:1	to	1:1
	15:1		7:1
	31:1		15:1

Changes of this nature are made on a terminal strip in the relay panel.

A switch and fuse were added for the + 48 volt lead from the computer power supply and a seventy-five-foot cable was made so that the joy stick could be moved to the far corner of the test control room.

It was decided to use the existing interlock on the in-out control for display control. This involves the addition

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2. ENGINEERING (continued)

(D. A. Buck) (continued)

of four crystals (two for order qd and two for order qf) in the control matrix to accomplish the actual interlocking plus a synchronized continue operation pulse to start the computer again.

The wires for the crystals are already installed, so that the crystals will have merely to be placed at the proper inter-sections.

The lead carrying the synchronized continue-operation pulse can neatly be patched in via Jack 2-2 of standardizing amplifier 9.

Circuitry has been designed and is near completion to provide this synchronized continue-operation pulse a short time (adjustable) after the end of the intensification of the scopes. The short time is required for the decoders to relax after one display order in preparation for the next.

In addition, the circuitry provides the 100 μ sec. (adjustable) intensification gates with the restorer pulses gated out and provision for mixing these two gates for the third scope (M-scope).

(L. S. Bensky)

Two changes were made in the ACRL demultiplexer in Room 138. It was found that the original phasing adjustment, which centers the leading edge of the shaped timing pulse on the digit pulses, did not allow enough phase shift for centering. The constants of the RC network used were changed to enable proper phasing. Second, a blower was installed to force air circulation around the circuits which detect and shape the digit pulses. 1N34 crystals, which previously were found defective due to over-heating, now behave satisfactorily. The crystal checker was used to select 10 spare crystals with back resistance greater than 300 K Ω and little drift.

After removing a bench from Room 138, the 3 racks of equipment were arranged in a more orderly fashion. Interconnecting cables were routed so as to afford the best access to the equipment.

Installation of 4 x 4 wireway from WMI on 2nd floor has begun, with estimated completion by August 23.

2. ENGINEERING (continued)

(L. S. Bensky) (continued)

A metal cover was built around the basic recorder and auxiliary spooling mechanism to keep dust from the precision parts.

In order to check the setup for converting radar data to WWI pulses, a complementing system was used in conjunction with a Dumont 304H scope. To make the standard 0.1 μ sec. pulses visible on the scope they were passed through Gate and Delay circuits, used as pulse "stretchers". By playing back a recorded radar data test pattern, the operation of the conversion setup was found to be satisfactory.