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STATUS REPORT OF ANALYSIS ON

PROJECT GRAB I

1 May 1961

NSA (COEA-5)



"WORKING PAPERS"

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Page of pages

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1. Since the 1 February Status Report, progress has been made along several of the avenues described in that report. Tentative results of the fully automatic burst-sort/scan-sort programs are being compared with results of manual analysis of Mission 905. The modified GERBER oscillograph Reader at NRL and the BAUSCH & LOMB Film Comparator in COSA-5 are in operation and their uses on the project being checked out. The NRL scan sorting technique of playing accelerated signal tapes into the RAYSPAN has proved useful. These points will be treated more fully in the following paragraphs.

2. Concurrent with efforts to develop new rapid and accurate analytical techniques, processing with means presently available has continued in order to extract intelligence information from the recordings. This processing has taken the form of density studies and search for signals of interest by aural scanning methods and through use of the NRL accelerated RAYSPAN method. The report of initial intelligence results, issued 1 March, summarized the results of these approaches and described the signals isolated by manual analysis of Mission 905.

3. The requirement for additional intercepts of unique radars, mentioned in the 1 February report, has been partially satisfied by the identification in Mission 907 of an [redacted] radar and the discovery in Mission 905 of a unique [redacted] type radar [redacted]

4. Because timely production of GRAB intelligence is largely contingent upon the success of fully automatic processing, primary emphasis has been maintained on the AUDICO I.- BOGART program.

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Page 1 of 7 pages

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A. AUDICO I converts analog data from the magnetic recordings into digital form. Its output is a series of numbers representing time between successive pulses. The present SERVO control system, which uses the 1000 cps component of the time channel as a reference to regulate tape speed, successfully compensates for long term speed variations, but short term variations remain a problem. Although reasonably good results have been achieved on this part of the process, amplitude threshold settings are very critical, and optimum settings for varying signal-to-noise ratios can only be achieved through experience. At present a method is being developed to reduce timing errors resulting from short term tape speed variations.

B. For burst-selection, the BOGART computer first recognizes and records measurements on all illuminations which comprise (From the digital output of AUDICO) The recorded measurements are: time of the end of each illumination, the average pulse interval expressed in 67-usec units, and the number of pulses in each illumination. Two interlaced signals will be recorded provided at least one pulse interval occurs before the overlap and at least 3 pulse intervals of the other signal extend beyond the end of the overlap.

C. For scan-sorting, BOGART then groups together and records these same parameters for any series of 5 or more illuminations, the ends of which occur at regular intervals and whose interpulse intervals are the same within $\pm$ one machine unit (67 usec). Actually this is done by first extracting all the 3 and 6 rpm radars, leaving a residue of unmatched illuminations, which in turn can be searched for radars with other scan rates. Rotation is considered regular if each scan period is within 2% of an adjacent scan period.

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Page 2 of 7 pages

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D. A complete automatic readout of mission 905 has been made, using the above-described process. Although comparison between machine and manual analyses of this mission has not produced fully satisfactory results, it is believed that such discrepancies as have so far come to light may be minimized by improved tape speed regulation and by adjusting the acceptance limits in the BOGART program. The presently-used limits were arrived at empirically and may be altered easily to produce the best results.

LOCATION

5. Assumed Elevation angles - a signal from a rotating radar is first intercepted when the E.S.V. comes over the horizon of the radar (elevation angle equals zero). The signal ceases when the elevation of the E.S.V. exceeds the angular height of the radar beam. As the E.S.V. continues past the radar, intercept resumes when the vehicles elevation is small enough to permit reentry of the beam and finally ceases when the vehicle passes beyond the horizon. Each of these four situations can, potentially, provide a line of position, and knowledge of the time of any two of them, provided vertical beamwidths is known, will permit emitter location to within two geographical areas, only one of which, of course, is the right one. The 704 computer program which gives the two locations is operational. Following are some limiting factors, some of which can be minimized and some accepted:

a. Because only rarely will a radar be looking in the direction of the E.S.V. at the instant it crosses the horizon, an uncertainty exists of up to one half a rotation period in measuring the time of any of the four events described above. For a 3 rpm radar this will result in an uncertainty of up to 100 miles in the lines of position.

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Page 3 of 7

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b. At present, knowledge of the vertical beamwidths of the different radars is so limited that only the times of the two horizon crossings are usable for location in most cases.

c. Only with unique radars is it possible to correlate the two sets of illuminations intercepted during one orbit. This means that this method will provide reasonably good location of common emitters only in the cases when the E.S.V. passes the emitter at such a distance that its elevation angle exceeds the radar's vertical beamwidth only briefly or not at all.

6. V-Beam Back Plotting - a 704 computer routine is operational for locating V-beam radars from beam separation. There exists a need for intercepts of distinctive V-beam radars of known location for checking the program.

7. Rotation Rate Doppler - If the rotation period of a radar is sufficiently constant, it is possible to reduce the size of the probable area of location by using the method of least squares to analyze the complete record of illuminations. The program for this is not yet completed, but research into rotation rate stability, ^{from} other source data is being conducted.

8. Nodding Heightfinders - A method of determining location by back-plotting when satellite altitude is known appears to show promise. The SAC method applied to another collection platform has not yet been received.

9. Semi-automatic Processes

The modified ⁹BERBER oscillograph reader is now installed and tested at NRL and readout has started. In this process, real time and PRF values for each illumination are measured from RAYSPAN charts. Using the NAREC computer this information can be presented (a) in chronological sequence, (b) as histograms of numbers of illuminations versus discrete PRF values and

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Copy 4 of 7 copies
Page 4 of 7 pages

~~TOP SECRET~~

(c) as quantized histograms of numbers of illuminations having PRFs within pre-selected PRF ranges. Each of these PRF ranges can be processed separately using an X-Y plotter to produce QRC-26 type displays, which can be used for scan sorting and, ultimately, for location.

10. Readout of one mission from film has started using the BAUSCH & LOMB Film Comparator. In addition to providing time and PRF measurements for each illumination, this method has the advantage of enabling the operator to observe pulse peculiarities such as staggering and other pulse position variations. It is superior also in that it permits analysis of two or more simultaneous illuminations and detection of rapid modulation such as conical scan.

11. The above processes are slow but may provide acceptable inputs to BOGART, should AUBICO I prove inadequate.

12. The NRL process of playing highly accelerated tape into the RAYSPAN has proven to be a useful quick look tool. By using it with filters it is possible to determine approximate values of a signal's time of occurrence, PRF and scan rate.

Intelligence Information

13. The report "Initial Intelligence Results", issued 1 March, was based on the manual analysis of Mission 905, on density studies of the other missions of Phase I and on signals of interest extracted from Phase I missions by means of aural scanning and the NRL high-speed RAYSPAN process. Graphs in which minute-by-minute density data are plotted against satellite altitude, time of day and subsatellite coordinates have been made for all of the 21 missions for which ephemeris information is available. Aural scanning, which was found to be a quick means of isolating signals of interest in Phase I material, is being applied to Phase II missions. Missions coinciding with periods of known ICHM range activity have been rechecked for intercepts

Copy 4
Page 5

7
7 page

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of missile-related S-band beacons. Results were negative.

Signals of interest

14. Aural scanning has turned up a number of non-routine signals since the 1 March intelligence report. Most of these have either proved to be from friendly radars or were of insufficient duration for certain identification. Several signals, however, are of considerable interest as follows:

a. Mission 907, 25 August - [redacted]

There are believed to be at least two of these equipments in [redacted]. Although only three illuminations were detected, one was by the leading and two by the trailing edge of the annulus. The origin of this signal was fixed by hand plotting methods to within about 150 miles of the known location of the nearest of the two radars. Several bursts from two different emitters of this type have been isolated in Mission 1286 of 21 September.

b. A 618 pps signal sectoring at 1.8 seconds per cycle also ^{occurred} in Mission 907. This corresponds with the group of unknown Soviet signals designated [redacted]. There is some indication that this intercept emanated from central Russia, possibly in the ARAL Sea region.

c. Mission 905, 25 August - a 10 minute intercept of [redacted] a unique [redacted] type signal with PRF of 395 pps and 20.4 s/r. Hand plotting provides a location in northern [redacted]. Computer location has not yet been obtained.

Future Plans

15. Efforts are continuing toward the development of fully automatic processing in the production of intelligence information. At the same time, work is going ahead on the GERBER and BAUSCH & LOMB processes to determine their accuracy and feasibility. A bank of filters, optimized for the project

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Page 6 of 7 pages

~~TOP SECRET~~

are being obtained for use with the NRL accelerated RAYSPAN process.

Several fairly good indicator radars are now known to exist and further analysis of missions by the GERBER, BAUSCH & LOMB or automatic processes is expected to produce intercepts which will be useful in checking out the location programs.

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12 May 1961

	<u>Earliest Date</u>	<u>Megacycles</u>
TAKI I SOCTOP	26 May 1961	100-1000, 160-170 2300-3800
TAKI II SOCTOP V	29 June 1961	100-1000 160-170 2300-3800
WILD BILL SOCTOP VI	11 July 1961	40-120 2300-3800
PINT	July 1961	100-150 COMINT
TOPSOC I	8 August 1961	400-800 800-1600
TOPSOC I	13 August 1961	400-800 800-1600
TOPSOC I	21 August 1961	400-800 800-1600
TOPSOC I	3 October 1961	400-800 800-1600
GRAPE JUICE	November 1961	60-70 COMINT
102 SAMOS-F	26 January 1962	2500-3200 9000-10,000
102	May 1962	59-130 8200-12,400
162	August-November 1962	130-290 290-650 2500-3200

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