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Data Processing Summary as of June 26, 1961

NRL EFFORT:

NRL started their effort by first carefully examining the raw data to ascertain signal-to-noise ratio, interference, densities, unusual PRF's, and optimum methods of extracting time/frequency data. As byproducts of this effort, a spinning-head technique was developed to permit handling poor signal-to-noise ratio situations, and a compression technique was evolved which permitted a spectral analysis of rotation rates. The next step was to convert a highly-accurate, and completely manual readout process giving PRF-sort and time data, into digital language so that statistical studies of the data could be performed by machine. These data included histograms of PRF densities, and "synthetic [redacted] type" records, and are intended to show optimum selection parameters which might be used for machine-processed data. Since data completely processed by machine suffers from noise perturbations far more than manually processed data, and since the density of modern collection methods is ever increasing, it is the firm belief of NRL that optimum "selection parameters" and other "input aids" for computers are a paramount requirement in order to make machine processing feasible. And if the data available, and soon to be available are to be handled, machine processing must be used, in an optimum form. NRL has searched for information on parameter variation of equipments so that the ability of this intercept system to [redacted] might also be established. Lastly, a few hand calculations of possible site locations have been made using certain assumptions regarding the characteristics of [redacted] radars.

NSA EFFORT:

The NSA effort to date has been designed primarily to complement the NRL work in that manual readout was at first done to assure the best possible input to experimental computer location programs, and next, attempts were made to effect direct digitalization of the raw data. The noise disturbance and other anomolies indicated further "spoon feeding" of the computers was needed, at least until more accurate programs and digitizing devices could be achieved. Accordingly, NSA has been working with NRL in this direction.

SAC EFFORT:

The SAC effort has been directed toward the solution of SAC's current operational problem, (the updating of the ROB) and has been primarily manual in nature, rather than being directed toward the eventual usage of more complete machine processing. Although a computer was used to perform some arithmetic, the basic sorting and measuring process was manual. Further, effort was limited almost entirely to [redacted] type devices which possess characteristics permitting the simplest sorting and locating techniques. With respect to their urgent requirement (updating the ROB), the work of SAC to date is considered very significant, whereas with respect to solving the need for eventual machine processing, it is virtually non-applicable.

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It is understood that SAC measured the ratio of the interval between adjacent beams and adjacent rotations in arbitrary units by hand measurement in order to obtain angle information to the radar, and then used an approximate absolute time to relate this information to geography. Therefore exact absolute time measurement of each individual burst was not required or obtained. This method works very well for [redacted] types only, and when hand PRF and scan rate sorting is employed. When machine sort and machine location are to be used, it is felt that the time of occurrence of each burst should be expressed in absolute time to the highest accuracy possible, and that prf should also be obtained to the maximum achievable accuracy in order to permit narrowing the selection limits to the smallest practical values. Stability measurements of newer type radars indicate that we can use all of the accuracy we can achieve.

With respect to SAC's measurements of the "test tapes" furnished by NRL, these tapes were designed for the more general case and did not include a simulation of [redacted] equipments. Therefore measurements of the "time-ratio" type described above could not be made on these tapes, and thus results from the test tapes do not serve as an indicator of the accuracy of the measurements actually made by SAC on the raw data.

Two measurement approaches were used on one sample NRL test tape by SAC, both of which were different from the procedure used on the raw data. These two methods were as follows; [redacted] and both are manual: The first approach used a method similar to the optical system of NSA in which the analog pulse chain is recorded on film alongside a precision 1000 cps reference tone, the number of pulses in the burst and the number of cycles of 1000 cps tone they encompasses are counted by hand, and the average PRF of the burst is then calculated. The standard deviation of the PRF was approx. 0.5 % but this is considered a rough estimate because measurements were grouped into integral cycles (each cycle being about 0.5% in itself) and because measurements were made on only one tape. The time-of-burst measurements were [redacted] made with the same optical comparator against the time code generator. In general, it can be said that these results OF BOTH PRF + TIME are nearly identical with NSA's optical read-out accuracies: they represent near the optimum in accuracy achievable and are very slow and laborious to produce. NRL's graphic readout, by comparison, is several times faster, (but still very slow) and produces a moderate increase of about 50 percent in the standard deviation.

The second method of PRF measurement used on a test tape by SAC was also a film manual readout technique in which every other pulse of a train serves as a trigger for a calibrated sweep, and the remaining pulses serve to unblank the CRT trace. Then the average distance between the trigger point and the unblanked point is determined by eye. Since the calibration is not tied to the tape motion, and since half of the available intervals are not used, this method gave approx. twice the spread of measured values, including increased average or "DC" error.

In summary, SAC's work on the test tapes represents an accurrate but very laborious approach very similar to that of NSA. The work on the raw data is limited to hand readout of [redacted] type equipments only and is not applicable to the general machine-sort problem nor to all types of equipments.

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