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6732
Memorandum M-1114

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CLASSIFICATION CHANGED TO:
Auth: DD 254
By: R. A. Nelson
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SUBJECT: BI-WEEKLY REPORT, Project 6732, October 13, 1950

To: J. W. Forrester

1. GENERAL

(R. A. Nelson)

I have been attending the weekly meetings of the 6673 group. The points to which they attach a lower priority at present (radar errors, synthetic data for simulation, targets with crossing paths, and smoothing theory) are also of interest to us. There are important differences between our viewpoints: they are immediately interested in fitting workable sequences into 256 registers of ES; they, unlike us, can control their "projectile" in flight, so that they can send it correcting orders as necessary; we must have access somehow to large quantities of ballistic data which probably cannot be generated simply.

A first draft of a quarterly report for July, August, and September was written.

2. THE FIRE CONTROL PROBLEM

2.1 Data Smoothing and Target Position Prediction.

(R. A. Nelson)

Some thought was given to the significance of the different smoothing methods employed by Mk 47 (where a smoothed acceleration is obtained from an acceleration calculated from a smoothed velocity) and by Project Thumper (where the smoothed acceleration is obtained from an acceleration calculated from an unsmoothed velocity). For Mk 47, then, the weighting function applied to the acceleration obtained from observed positional data is composed of time multiplied by an exponential, whereas for Thumper, the weighting function is a simple exponential. For our initial coding we shall use the Mk 47 method. (In general, we are trying to follow Mk 47's equations when these represent a philosophy of fire control, but not to be bound by them when they result only from the special requirements or characteristics of analog equipment.)

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2.1 Data Smoothing and Target Position Prediction. (Continued)

I have also been trying to figure out with Dodd the functions performed by the linear rates section of the Mk 47 computer. The text accompanying this is not amply written, and there are several inconsistencies in notation. Since the network, which involves two interdependent loops, accomplishes the velocity smoothing, it is important to analyze it.

3. CODING

(J. M. Dodd)

A rough flow diagram describing the general functioning of the Mk 47 computer has been prepared. In accordance with the Mk 47 report, the overall system has been divided into nine sections which are, in order:

1. Present Position Section
2. Apparent Wind Section
3. Linear Rates Section
4. Acceleration Smoothing Section
5. Prediction Section
6. Ballistic Section
7. Fuze Order Section
8. Parallax Correction Section
9. Gun Order Section

(One additional section may be added to compute initial values of some of the variables when targets are first acquired.)

Preliminary work has been completed on all except sections 3 and 4 above. In these two, considerable difficulty has resulted from the fact that some of the symbols used are not rigorously defined; furthermore, the notation used in these sections (and in related sections) is not always consistent. In addition, the description of the computer mechanism is incomplete.

Final coding can begin when the difficulties in sections 3 and 4 have been overcome.

(A. Katz)

A program was developed for determining $\theta_a = \arctan \frac{Y}{X}$. In this problem, Y and X might be the predicted values of the rectangular components of range -- being $R \sin \theta$ and $R \cos \theta$ respectively. At Israel's suggestion, Newton's Method for determining the roots of the equation, $f(\theta) = \tan \theta - \frac{Y}{X} = 0$ was made. The function $\tan \theta$ was approximated by a power series of five terms.

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3. CODING (Continued)

This code uses 66 orders and 19 storage registers. If one uses the temporary storage more efficiently and the Modified Newton's Method (involving use of a constant maximum slope as suggested by F. C. Helwig), the resulting program will use 60 orders and 18 storage registers.

In view of the fact that these codes are lengthier than that developed by R. L. Walquist (47 orders, 12 storage) and give a maximum error of the same order of magnitude, it is felt that the last mentioned code is more desirable.

4. DATA CONVERSION

(R. A. Nelson)

The requirements on converting digitally-expressed gun orders to the analog form representing gun position and movement are tied up with the response characteristics of the guns. Katz has started to work on the general problem of what is necessary in the way of gun orders to achieve suitably smooth positioning of the guns. When he has some background information, we shall discuss the problem with Linvill. Possible help can come from work being done at Building 32 on the Parsons milling machine problem, where a similar problem is encountered.

(A. Katz)

During this period considerable time was devoted to further orientation with respect to the fire control problem and to the work of D.I.C. Project 6694 in applying digital techniques to the control of the Parsons Milling Machine. On the basis of preliminary reading, it is felt that some of the techniques used for machine control may be applied to the control of power drives for guns and directors.

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