Wheelwright

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Memorandum M-1142

Electronic Computer Division
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, PROJECT 6782, December 21, 1950.

To: J. W. Forrester

1. GENERAL

(R. A. Nelson)

Lt. Hartdegen, who has recently joined the Armament Branch of ONR as head of the Guided Missiles Section, spent all day, Thursday, December 21, with us, to learn something of the computer and to discuss our work.

2. THE FIRE CONTROL PROBLEM

2.1 Data Smoothing and Target Position Prediction

(R. A. Nelson)

The Bell Labs Mk 65 report includes a discussion of the errors resulting from linear prediction when the target is actually flying a steady-state curved course. From error formulas that they derive for this case and from those derived for the behavior of curved-course computers, they conclude that best prediction results from switching from helical to linear prediction when the range decreases to some value determined by the maneuver of the target; they show graphs of the single-shot probability of kill for various conditions. One goal of my present effort is to see how easily a digital computer can handle the different kinds of prediction and the choices involved in selecting the proper one.

2.2 Ballistic Considerations

(A. Katz)

During the past bi-weekly period I have continued in my efforts to represent a table of superelevation angle by means of a curved surface whose equation is of the type

$$f(x,y) = f_1(x) + f_2(x)f_3(y)$$

2.2 Ballistic Considerations (Continued)

Thus far, I have reduced a system of 40 condition equations in 12 unknowns to a least-square system of 12 normal equations in 12 unknowns, and am now engaged in solving this system. The necessity for continuous checking of numerical results makes this solution slow and laborious.

3. CODING

(J. M. Dodd)

Final coding of the Mk 47 equations is continuing according to the considerations mentioned in the last bi-weekly. This last major revision is about half completed. Closed computation loops in Mk 47 are being treated by breaking into the loop at some convenient point and using an assumed value of one of the variables concerned to permit solution for the other; thus the entire digital computer solution becomes open ended. The assumed value, in the steady-state condition, is just a linear extrapolation of the last-calculated value. Thus, if target velocity is a quantity whose value is to be assumed in one of these closed loops, v^*, to be used in the nth cycle, will be taken thus:

$$v^* = 2v_{n-1} - v_{n-2}$$

It should be emphasized that this is not future target-behavior prediction in the usual fire control sense, but merely an expedient way of obtaining what seems to be a better value than that last computed of the present velocity, needed (but otherwise unavailable) in the coded section.