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Memorandum M-1093

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Electronic Computer Division
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Cambridge, Massachusetts

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Auth: DD 254
By: R.R. Everett
Date: 12/2/59

M-1093

SUBJECT: BI-WEEKLY REPORT, PROJECT 6782, SEPTEMBER 1, 1950

To: J. W. Forrester

1. GENERAL

(R. A. Nelson)

Lt. Cdr. S. J. Riordan and Mr. Arnold Shostak of the Armament Branch of ONR visited the Laboratory on August 24.

The following literature requested from ONR was received: reports on the Mk 47 and Mk 56 fire control systems; report on Mk 22 computer (relay machine built by BTL for NRL for fire control system evaluation); and two BTL reports on curved course prediction. It had been recommended that the Mk 47 functions should be the basis for our programming of the fire control problem for digital solution; this work is now being started. In its prediction, Mk 47 takes account of possible acceleration of the target.

In addition to the bi-weekly classifications given in M-1078, the following will be used:

2.3 Coordinate Transformation

2. THE FIRE CONTROL PROBLEM

2.2 Ballistic Considerations

(J. M. Dodd)

The ballistic problem has been set aside temporarily in favor of the deck-tilt-correction problem.

2.3 Coordinate Transformation

(R. A. Nelson)

The exact equation for deck-tilt correction was derived for the case of elevation measured in a stabilized vertical plane; when the Mk 47 report was received, it was found that our results agreed with those stated there.

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2.3 Coordinate Transformation - continued

(R. A. Nelson) - continued

Dodd is now determining the validity of various approximate expressions for the exact relation to indicate the number of computer operations and amount of storage to be required.

He will then do the corresponding programming (starting with exact equations given in the Mk 47 report) for the conversion of elevation and train in earth coordinates to gun orders referred to a tilted check (trunnion-tilt correction). This differs from the transformation we have been working on in that the guns do not "elevate" in a vertical plane when the deck is tilted, as does the director.

(J. M. Dodd)

Most of my time during this period has been devoted to work on the deck-tilt-correction problem. The following exact solution was obtained by means of spherical trigonometry:

$$(1) \quad \tan Br = \frac{\cos Zd \tan B'r}{\cos L - \sin L \sin Zd \tan B'r},$$

where Br is relative target bearing (horizontal plane)
B'r is measured director train (deck plane)
Zd is cross-level angle) measures of deck-tilt
L is level angle)

Standard fire-control symbols are used. The above expression (1) agrees with the result obtained independently by R. A. Nelson (by means of analytic geometry), and with an implicit expression in the Mark 47 Engineering Report of July 1949.

One method of obtaining Br is by using

$$(2) \quad Br = B'r + jB'r,$$

where, from the exact expression (1),

(3)

$$\tan jB'r = \frac{\sin B'r \cos B'r(\cos Zd - \cos L) - \sin L \sin Zd \sin^2 B'r}{\cos Zd \sin^2 B'r + \cos L \cos^2 B'r - \sin L \sin Zd \sin B'r \cos B'r}$$

Use of (2) and (3), rather than direct application of (1), eliminates the necessity of working with tangents of large angles.

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2.3 Coordinate Transformation - continued

(J. M. Dodd) - continued

Computer Mark I uses the approximation

(4) $jB'r = ZdL \sin^2 B'r + 1/2\, L^2 \sin B'r \cos B'r.$

This expression follows from (3) by using certain assumptions which are valid in some instances; but considerable error may result if the target is in front of or behind the ship (as opposed to being to the side).

3. <u>CODING</u>

(J. M. Dodd)

Length of the program for computing jB'r will depend upon whether the exact expression (3) or the approximate expression is used. Tentative first estimates of the number of orders required for each are:

Exact expression (3)	150 orders
Approximate expression (4)	50 orders.

cc: ~~J. M.~~ Dodd
R. R. Everett
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