

MEMORANDUM

June 13, 1966

TO: Dr. W. E. Baker

FROM: Don Saathoff

SUBJECT: Solution of Simultaneous Second Order Non-Linear
Differential Equations

The equations are as follows:

$$\begin{aligned}(M_1 + M_p) \ddot{X}_1 + C_1 \dot{X}_1 + C_2 \dot{X}_1 |\dot{X}_1| \\ - C_3 (\dot{X}_2 - \dot{X}_1) - K_2 (X_2 - X_1) + K_1 X_1 = 0 \\ M_2 \ddot{X}_2 + C_3 (\dot{X}_2 - \dot{X}_1) + K_2 (X_2 - X_1) = 0\end{aligned}$$

These equations can be solved by the Runge-Kutta Method in use on the GE 225. Let

$$Y_1 = X_1$$

$$Y_2 = \dot{X}_1$$

$$Y_3 = X_2$$

$$Y_4 = \dot{X}_2$$

The evaluation portion of the program would be as follows:

$$DY(1) = Y(2)$$

$$DY(3) = Y(4)$$

$$DY(2) = (-C_1 * Y(2) - C_2 * Y(2) * \text{ABS.}(Y(2)) + C_3 * (Y(4) - Y(2)) + K_2 * (Y(3) - Y(1)) - K_1 * Y(1)) / (M_1 + M_P)$$

$$DY(4) = (-C_3 * (Y(4) - Y(2)) - K_2 * (Y(3) - Y(1))) / M_2$$

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The solutions could be obtained without much effort, but obtaining the periods accurately might require some other numerical procedure.

Assuming that two methods would be explored and that the CDC-3600 Computer would be used in the double precision mode, a maximum of one man-month and four hours ^{of CDC-3600/11R} of CDC-3600 time would be required. This is a maximum; a minimum would be one man-week and fifteen minutes of CDC-3600 time.

DRS

DRS:cjs