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TECHNICAL REPORT

NONLINEAR AND DIGITAL MAN-MACHINE CONTROL SYSTEMS MODELING

by

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ABSTRACT

This study examines the utility of an adaptive modeling technique by which controllers can be synthesized to provide corrective dynamics to a human operator's mathematical model in closed loop control systems. The technique utilizes a class of Liapunov functions formulated for this purpose, Liapunov's stability criterion and a model-reference system configuration. The Liapunov function is formulated to possess variable characteristics to take into consideration the identification dynamics. The time derivative of the Liapunov function generates the identification and control laws for the mathematical model system. These laws permit the realization of a controller which updates the human operator's mathematical model parameters so that model and human operator produce the same response when subjected to the same stimulus.

A very useful feature of this study is the development of a digital computer program which is easily implemented and modified concurrent with experimentation. The program permits the modeling process to interact with the experimentation process in a mutually beneficial way.

1. INTRODUCTION

This study presents an adaptive modeling technique which one may utilize to identify and control a human operator's mathematical model. The technique is based upon a model-reference system configuration, as shown in Figs. 1 & 2, a Liapunov function formulated for this model-reference system and Liapunov's stability criterion. The reference system in the configuration represents the actual human operator. The model system in the configuration is constructed initially as an approximate mathematical representation of the reference system and is derived from consideration of the physiological processes evident in the actual human operator when performing a given tracking task. The Liapunov function is formulated to possess variable characteristics in order to derive the required identification dynamics. The time derivative of the Liapunov function generates the identification and control laws for the mathematical model. These identification and control laws permit the realization of a controller which updates the mathematical model parameters so that model and human operator give the same response when subjected to the same input signal.

The identification technique offers a theoretically consistent approach for modeling human operator activities from experimental data. That is, the approach is theoretically capable of operating on the available experimental data and identifying a model system that can be used in place of the human operator.

A very useful feature of this study is the development of a digital computer program which is easily implemented and modified concurrent with experimentation. In this way, the modeling process interacts with

the experimentation process in a mutually benefical way.

It was the intent of this study that the modeling technique contain "learning" capabilities in order for the technique to be versatile enough to be applied to as broad a range of human operator activities as possible, including nonlinear phenomena. This "learning" feature is incorporated into the adaptive controller structure.

One of the basic tasks of this modeling technique is to synthesize an adaptive controller and a mathematical model representing the human operator in the model-reference system. The realization of such a model system depends upon the desired choice of the state variables. There exist several useful choices which lead to different realizations. In this study two types of realizations for the human operator mathematical model is presented. The first is the controllable realization of the model system and the second is the observable canonical realization of the model system. The advantages and disadvantages of both these realizations are described in this report. Particular attention is given to the convergence time of the identifying dynamics. It is shown in this study that the parameter identification time for the observable canonical realized model is much less than the parameter identification time required for the controllable realization. The disadvantage of the observable realization is that one cannot directly measure all of the state variables except the first state. This becomes apparent in the report.

This report consists of two basic parts. The first part of the report discusses two theoretical modeling approaches which lead to a

controllable realization and to an observable canonical realization of the human operator mathematical model. The second part presents examples and experimental evidence to substantiate the validity of the mathematical results. In this second part of the report the reference system is represented by reels of tape containing recorded digital input-output data of an artificial human operator when performing a given tracking task. A digital computer is used to generate the identification dynamics for the mathematical model.

The report is organized in the following manner. First, a mathematical description of the problem is presented, illustrating the formulation of the model-reference system and the error differential equation. Next, the formulation of a Liapunov function and its time derivative is given. Imposing constraints on the Liapunov function and its time derivative permits one to obtain the identification and control laws which realize an adaptive controller. After establishing a relationship among several equations the mathematical model representing the human operator is derived.

2. STATEMENT OF PROBLEM

Before considering the derivation of the modeling approaches, a statement of the basic problem is given. Consider the model-reference system configurations depicted in Figs. 1 & 2. The reference system may represent the actual human operator. The stimulus-response data for the human operator are available from experimentation. It is assumed that the human operator when performing a control task may be described by a vector differential equation

$$\dot{\underline{z}} = A\underline{z} + H\underline{r} \tag{1}$$

where $\underline{z}$ denotes the response state vector, $\dot{\underline{z}} = d\underline{z}/dt$ and $\underline{r}$ represents the stimulus vector. The square matrices A and H are unknown. The objective is to find a set of elements for matrices A and H so that the response of Eq. (1) matches very closely the response of the human operator when both Eq. (1) and human operator are subjected to the same stimulus.

As a starting point for the modeling approaches, one may choose a tentative mathematical model system of the same form as Eq. (1). Let the model representing the controllable realization be described by

$$\dot{\underline{x}} = B\underline{x} + C\underline{r} \tag{2}$$

where $\underline{r}$ is the same stimulus state vector as for Eq. (1), $\underline{x}$ denotes the mathematical model's response vector and $\dot{\underline{x}} = d\underline{x}/dt$. The square matrices B and C are also unknown except that one may assign a set of initial values to the elements of these matrices. Let these initial matrices be denoted by B_o & C_o. The initial values must be chosen to

be within the stability region of the tentative mathematical model system as defined by a formulated Liapunov function. The problem is to identify matrices B and C so that at the end of the identification interval $(B_o - B) \longrightarrow A$ and $(C_o - C) \longrightarrow H$. The mathematical model system is then considered identified and representing the human operator.

There are several approaches one may take in order to solve this modeling problem. This study considers two approaches and points out the advantages and disadvantages of either approach. In addition, the study discusses the trade offs one must consider when switching from one approach to the other.

The next section presents the modeling technique which leads to a mathematical model called the controllable form. First a nonlinear model is derived, then the reduction to a linear model system is shown.

3. HUMAN OPERATOR MODELING - CONTROLLABLE FORM

3.1 Introduction

There are several methods for realizing relationships such as given by Eq. (2). The realization depends upon the particular choice of the state variables. The state variables chosen in this section are referred to as the phase variables, a name that stems from the coordinates of the phase space. This choice of state variables is a natural one for the engineer, as these variables have a ready physical interpretation. For example, for the human operator the output (response) may be chosen as the first state variable, the rate of change with respect to time of the first variable then is chosen as the second state variable, the rate of change with respect to time of the second state variable is further chosen as the third state variable etc. For an n-th order system n state variables are necessary and sufficient to represent the dynamic behavior of the system. Note that the second and third state variables represent the velocity and acceleration of the human operator's response.

In order to derive the identification dynamics for the controllable form of the human operator's mathematical model system depicted in Fig. 1 or Fig. 2, one must first formulate the error vector differential equation for the model-reference system in terms of these phase variables.

3.2 Model-Reference Error Equation

It is obvious from Fig. 1. that initially the response of the

human operator (reference system) will not be the same as the response of the tentative mathematical model, when both are subjected to the same stimulus. This is due to the fact that the tentative model's parameters are initially assumed. As long as these parameters satisfy Liapunov's stability conditions, they qualify as initial parameter values for the model. The difference between the model's response and the human operator's (reference system) response is the model-reference system error. Let this error be denoted by vector $\underline{e}$ and defined as

$$\underline{e} = \underline{x} - \underline{z} \tag{3}$$

Note that $\underline{e}$, $\underline{x}$ and $\underline{z}$ are time varying vectors. Differentiating Eq. (3) with respect to time yields

$$\dot{\underline{e}} = \dot{\underline{x}} - \dot{\underline{z}} \tag{4}$$

where the dot denotes the time derivative. Substitution of Eqs. (1) and (2) into Eq. (4) yields, after some algebraic manipulations, the vector error differential equation for the model-reference system

$$\dot{\underline{e}} = B\underline{e} + \underline{bu}^T\underline{z} + \underline{dw}^T\underline{r} \tag{5}$$

where

$$\underline{bu}^T = (B - A) \tag{6}$$

$$\underline{dw}^T = (C - H) \tag{7}$$

Note that superscript T denotes the transpose. The form of Eq. (5) is derived using a phase variable representation of the tentative model

system. The choice for this type of model representation was governed by the desire to obtain a controllable realization of the final mathematical model system. Note also that Eqs. (6) & (7) contain the identification dynamics for the mathematical model's parameters. It should be pointed out that other realizations of the model system are possible. A different realization, based on a different choice of state variables, is presented later in this report.

Note that vectors $\underline{e}$, $\underline{u}$ and $\underline{w}$ denote the model-reference system error and parameter misalignment vectors. One may now formulate a Liapunov function and its time derivative that incorporate the error and these misalignments. Before one proceeds with the formulation of a Liapunov function and its time derivative it is useful at this point to become familiar with the detailed forms of matrices and vectors used in this section. This information is presented in Appendix A.

3.3 Formulation of a Liapunov Function

Equation (5) may be viewed as consisting of three perturbational vectors, namely $\underline{e}$, $\underline{u}$ and $\underline{w}$. An appropriate Liapunov function should be positive definite in the error as well as in the parameter misalignments. Therefore, one may choose a Liapunov function of the form

$$V = \underline{e}^T M \underline{e} + \underline{u}^T N \underline{u} + \underline{w}^T Q \underline{w} \tag{8}$$

where matrices M, N and Q are symmetric square matrices. The elements of these matrices may be constants, time varying and/or functions of the state variables[3]. When considering a linear mathematical model of the

human operator one may restrict matrices M, N and Q to consist of constant elements only.

Differentiating Eq. (8) with respect to time and then substituting Eq. (5) and its transpose given by

$$\dot{\underline{e}}^T = \underline{e}^T B^T + \underline{z}^T \underline{u} \underline{b}^T + \underline{r}^T \underline{w} \underline{d}^T \tag{9}$$

one may obtain the time derivative of the Liapunov function in the form

$$\dot{V} = -\underline{e}^T D_1 \underline{e} + 2\left[\dot{\underline{u}}^T N + \tfrac{1}{2}\underline{u}^T \dot{N} + \underline{z}^T (\underline{b}^T M \underline{e})\right] \underline{u} +$$

$$+ 2\left[\dot{\underline{w}}^T Q + \tfrac{1}{2}\underline{w}^T \dot{Q} + \underline{r}^T (\underline{d}^T M \underline{e})\right] \underline{w} \tag{10}$$

where

$$D_1 = (B^T M + MB + \dot{M}) \tag{11}$$

and the dot denotes the time derivative.

Liapunov's criterion for stability calls for $V > 0$ and $\dot{V} \leq 0$. One way to comply with Liapunov's criterion for stability is to constrain the elements of the D_1 matrix, denoted by d_{ii} and d_{ij}, to satisfy the conditions

$$d_{ii} > 0 \tag{12}$$

and

$$d_{ij} + d_{ji} = 0 \tag{13}$$

where i and j denote row and column respectively and let

$$\left[\dot{\underline{u}}^T N + \tfrac{1}{2}\underline{u}^T \dot{N} + \underline{z}^T (\underline{b}^T M \underline{e})\right] = 0 \tag{14}$$

and

$$\left[\dot{\underline{w}}^T Q + \tfrac{1}{2}\underline{w}^T \dot{Q} + \underline{r}^T(\underline{d}^T M \underline{e}) \right] = 0 \qquad (15)$$

The conditions given by Eqs. (12) & (13) enable one to evaluate the elements of D_1 and M matrices[3]. At this point one must perform a test to insure the positive definitness of these matrices. Matrices N and Q must also satisfy the conditions $N > 0$, $Q > 0$ and are used as free design parameters in order to influence the convergence time of the identification dynamics. Equations (14) & (15) constitute the basic equations from which the identification dynamics and the adaptive controller are realized.

It should be noted that the resulting $\dot{V}$ is negative semidefinite because it depends only upon the model-reference system error and does not depend on the vectors $\underline{u}$ and $\underline{w}$. This suggests that one should expect some oscillations in the model parameters at the end of the identification interval, even if the model-reference system error $\underline{e}$ is zero.

3.4 Adaptive Identification Controller

As mentioned before, Eqs. (14) & (15) give rise to the identification dynamics. In order to realize the adaptive identification controller one has to rearrange Eqs. (14) & (15). Since $(\underline{b}^T M \underline{e})$ and $(\underline{d}^T M \underline{e})$ are scalar quantities, one may obtain from Eqs. (14) & (15) the following relationships

$$\dot{\underline{u}}^T = -\tfrac{1}{2}\underline{u}^T \dot{N} N^{-1} - \underline{z}^T N^{-1}(\underline{b}^T M \underline{e}) \qquad (16)$$

$$\dot{\underline{w}}^T = -\tfrac{1}{2}\underline{w}^T \dot{Q} Q^{-1} - \underline{r}^T Q^{-1}(\underline{d}^T M \underline{e}) \qquad (17)$$

The transpose of Eqs. (16) & (17) yields

$$\dot{\underline{u}} = -\tfrac{1}{2}N^{-1T}\dot{N}^{T}\underline{u} - N^{-1T}\underline{z}(\underline{b}^{T}M\underline{e}) \tag{18}$$

$$\dot{\underline{w}} = -\tfrac{1}{2}Q^{-1T}\dot{Q}^{T}\underline{w} - Q^{-1T}\underline{r}(\underline{d}^{T}M\underline{e}) \tag{19}$$

Equations (18) & (19) represnt the adaptive identification controller. Matrix M is computed from Eq. (11) and matrices N and Q are chosen by the designer to effect a proper magnitude control signal for the identification dynamics. Note that matrices M, N and Q must be positive definite since they appear in the Liapunov function.

3.5 Nonlinear Mathematical Model

In order to formulate the mathematical model system one must find a relationship among Eqs. (6), (7), (16) & (17). Assuming that the changes in the human operator are much slower than the identification time required for the model's parameters, one may consider matrices A and H as being time-invariant during the identification interval. Therefore, differentiating Eqs. (6) & (7) with respect to time yields

$$\dot{B} = \underline{b}\dot{\underline{u}}^{T} \tag{20}$$

and

$$\dot{C} = \underline{d}\dot{\underline{w}}^{T} \tag{21}$$

since $\underline{b}$ and $\underline{d}$ are constant vectors. Substituting Eqs. (16) & (17) into Eqs. (20) & (21) one obtains

$$\dot{B} = -\tfrac{1}{2}\underline{b}\underline{u}^T\dot{N}N^{-1} - \underline{b}\underline{z}^T N^{-1}(\underline{b}^T\underline{M}\underline{e}) \tag{22}$$

$$\dot{C} = -\tfrac{1}{2}\underline{d}\underline{w}^T\dot{Q}Q^{-1} - \underline{d}\underline{r}^T Q^{-1}(\underline{d}^T\underline{M}\underline{e}) \tag{23}$$

Integration of Eqs. (22) & (23) over the identification time interval yields

$$B = B_o - \int_c^t \left[\tfrac{1}{2}\underline{b}\underline{u}^T\dot{N}N^{-1} + \underline{b}\underline{z}^T N^{-1}(\underline{b}^T\underline{M}\underline{e}) \right] dt \tag{24}$$

$$C = C_o - \int_o^t \left[\tfrac{1}{2}\underline{d}\underline{w}^T\dot{Q}Q^{-1} + \underline{d}\underline{r}^T Q^{-1}(\underline{d}^T\underline{M}\underline{e}) \right] dt \tag{25}$$

where B_o and C_o are the initially assumed matrices for the mathematical model. These matrices are given in Appendix A. The integrals in Eqs. (24) & (25) represent the nonlinear identification dynamics for matrices B and C. Note that these integrals consist of parameter mis-alignments, model-reference input and response as well as the error and elements of the Liapunov function.

To complete the formulation of the mathematical model one substitutes Eqs. (24) & (25) into Eq. (2). This yields

$$\dot{\underline{x}} = \left\{ B_o - \int_o^t \left[\tfrac{1}{2}\underline{b}\underline{u}^T\dot{N}N^{-1} + \underline{b}\underline{z}^T N^{-1}(\underline{b}^T\underline{M}\underline{e}) \right] dt \right\} \underline{x} +$$

$$+ \left\{ C_o - \int_c^t \left[\tfrac{1}{2}\underline{d}\underline{w}^T\dot{Q}Q^{-1} + \underline{d}\underline{r}^T Q^{-1}(\underline{d}^T\underline{M}\underline{e}) \right] dt \right\} \underline{r} \tag{26}$$

Equation (26) represents the human operator's nonlinear mathematical model with its identification dynamics. Note that the identification dynamics depend upon the human operator's response and stimulus.

Since Eqs. (24), (25), (26) and (10) are nonlinear, time varying and interrelated, then the difficulties that arise in their computation may be alleviated by solving these equations iteratively using a digital computer. The digital computer program is easily implemented and can be modified concurrent with experimentation. This permits the identification process to interact with the experimental data in a mutually beneficial way.

The mathematical model is considered identified (representing the human operator) when $\underline{e} = 0$. Due to the semidefinite $\dot{V}$, the model's parameters oscillate about some nominal values. With this modeling technique one may consider the nominal values as being the identified parameters for the human operator. In terms of Eq. (1) this means that one has identified matrices A and H. Experimentation has shown that with the proper choice of N and Q matrices, one achieves a very rapid identification of the model parameters. This modeling technique is illustrated via an example where all the details are shown.

3.6 Linear Mathematical Model

The equations derived in the previous sections may be simplified when one considers that the human operator may be viewed as a linear system. For certain tracking tasks with appropriate conditions this may be the case. Therefore, it is useful and beneficial to investigate the simplifications and the resulting equations leading to a linear

mathematical model.

Let us then presuppose that the human operator (reference system) as shown in Fig. 1. performs in a linear fashion. Since a linear mathematical model of the reference system is desired, one may let matrices M, N and Q in the tentative Liapunov function (Eq. 8) to consist of constant elements. Therefore,

$$\dot{M} = 0 \tag{27}$$

$$\dot{N} = 0 \tag{28}$$

$$\dot{Q} = 0 \tag{29}$$

In view of Eqs. (27), (28) & (29) one obtains from Eq. (10) the time derivative of the Liapunov function as

$$\dot{V} = -\underline{e}^T D\underline{e} + 2\left[\dot{\underline{u}}^T N + \underline{z}^T(\underline{b}^T M\underline{e})\right]\underline{u} + 2\left[\dot{\underline{w}}^T Q + \underline{r}^T(\underline{b}^T M\underline{e})\right]\underline{w} \tag{30}$$

where

$$D = (B^T M + MB) \tag{31}$$

From Eqs. (16) & (17) the simplified controller equations are

$$\dot{\underline{u}}^T = -\underline{z}^T N^{-1}(\underline{b}^T M\underline{e}) \tag{32}$$

$$\dot{\underline{w}}^T = -\underline{r}^T Q^{-1}(\underline{d}^T M\underline{e}) \tag{33}$$

Following the same procedure as in the previous section, matrices B and C are identified by the equations

$$B = B_o - \int_0^t \underline{bz}^T N^{-1}(\underline{b}^T M \underline{e})dt \tag{34}$$

$$C = C_o - \int_0^t \underline{dr}^T Q^{-1}(\underline{d}^T M \underline{e})dt \tag{35}$$

where B_o and C_o are the initially assumed matrices for the mathematical model (see Appendix A) and the integrals represent the linear identification dynamics for matrices B and C. To formulate the linear mathematical model one substitutes Eqs. (34) & (35) into Eq. (2). This gives

$$\dot{\underline{x}} = \left[B_o - \int_0^t \underline{bz}^T N^{-1}(\underline{b}^T M \underline{e})dt \right] \underline{x} +$$

$$+ \left[C_o - \int_0^t \underline{dr}^T Q^{-1}(\underline{d}^T M \underline{e})dt \right] \underline{r} \tag{36}$$

Equation (36) represents a linear mathematical model of the human operator. The integrals in Eq. (36) are the identification dynamics. Although, Eq. (36) may be solved much easier than its nonlinear counterpart, many difficulties are still alleviated when one uses a digital computer. An example illustrating the identification of two parameters for a linear mathematical model is presented in the later part of this report.

4. MODIFIED MODELING TECHNIQUE - CONTROLLABLE FORM

A review of the modeling technique and Eqs. (26) & (36) show that the mathematical model of the human operator is a function of the M matrix in addition of being depended upon other variables. But the M matrix which is computed either from Eq. (11) or Eq. (31) requires the knowledge of the B matrix. Note that the B matrix changes (getting updated) during the identification interval. This in turn, suggests that the M matrix will also change during the identification interval. In order to take into consideration these changes, one must set up a digital computer subroutine which will compute at each iteration a new set of M and B matrices. Since the M matrix appears in the Liapunov function, therefore one must also at each iteration interval monitor V and $\dot{V}$ so that Liapunov's criterion is not violated. This requires another subroutine.

In order to circumvent these additional computations, one may consider Fig. 2. and modify the model-reference error differential equation. From Eq. (3) one obtains

$$\underline{z} = \underline{x} - \underline{e} \tag{37}$$

Substitution of Eq. (37) into Eq. (5) yields a modified model-reference error differential equation

$$\dot{\underline{e}} = A\underline{e} + \underline{bu}^T\underline{x} + \underline{dw}^T\underline{r} \tag{38}$$

where $\underline{bu}^T$ and $\underline{dw}^T$ are as defined by Eqs. (6) & (7). Note the modifications in Eq. (38) when compared with Eq. (5). Equation (38) contains the human operator (reference system) matrix A and the mathematical

model's response $\underline{x}$.

Equation (38), as before, consists of three perturbational vectors, namely $\underline{e}$, $\underline{u}$ and $\underline{w}$. Therefore, one may proceed with an identical development as previously. The Liapunov function is chosen as given by Eq. (8). The time derivative of the Liapunov function, which incorporates the error differential equation becomes

$$\dot{V} = -\underline{e}^T D_2 \underline{e} + 2\left[\dot{\underline{u}}^T N + \tfrac{1}{2}\underline{u}^T \dot{N} + \underline{x}^T(\underline{b}^T M \underline{e})\right]\underline{u} +$$

$$+ 2\left[\dot{\underline{w}}^T Q + \tfrac{1}{2}\underline{w}^T \dot{Q} + \underline{r}^T(\underline{d}^T M \underline{e})\right]\underline{w} \qquad (40)$$

where

$$D_2 = (A^T M + MA + \dot{M}) \qquad (41)$$

Note that the dot denotes the time derivative and superscript T denotes the transpose. The nonlinear identification control laws obtained from Eq. (40) are

$$\dot{\underline{u}}^T = -\tfrac{1}{2}\underline{u}^T \dot{N} N^{-1} - \underline{x}^T N^{-1}(\underline{b}^T M \underline{e}) \qquad (42)$$

$$\dot{\underline{w}}^T = -\tfrac{1}{2}\underline{w}^T \dot{Q} Q^{-1} - \underline{r}^T Q^{-1}(\underline{d}^T M \underline{e}) \qquad (43)$$

The transpose of Eqs. (42) & (43) yields the controller equations

$$\dot{\underline{u}} = -\tfrac{1}{2}N^{-1T}\dot{N}^T \underline{u} - N^{-1T}\underline{x}(\underline{b}^T M \underline{e}) \qquad (44)$$

$$\dot{\underline{w}} = -\tfrac{1}{2}Q^{-1T}\dot{Q}^T \underline{w} - Q^{-1T}\underline{r}(\underline{d}^T M \underline{e}) \qquad (45)$$

Substituting Eqs. (42) & (43) into Eqs. (20) & (21) and integrating the resulting equations over the identification interval, one obtains

$$B = B_o - \int_c^t \left[\tfrac{1}{2}\underline{b}\underline{u}^T \dot{N} N^{-1} + \underline{b}\underline{x}^T N^{-1} (\underline{b}^T M \underline{e}) \right] dt \tag{46}$$

$$C = C_o - \int_c^t \left[\tfrac{1}{2}\underline{d}\underline{w}^T \dot{Q} Q^{-1} + \underline{d}\underline{r}^T Q^{-1} (\underline{d}^T M \underline{e}) \right] dt \tag{47}$$

where B_o and C_o are the initial value matrices. Substitution of Eqs. (46) & (47) into Eq. (2) produces the nonlinear mathematical model of the human operator

$$\dot{\underline{x}} = \left\{ B_o - \int_c^t \left[\tfrac{1}{2}\underline{b}\underline{u}^T \dot{N} N^{-1} + \underline{b}\underline{x}^T N^{-1} (\underline{b}^T M \underline{e}) \right] dt \right\} \underline{x} +$$

$$+ \left\{ C_o - \int_c^t \left[\tfrac{1}{2}\underline{d}\underline{w}^T \dot{Q} Q^{-1} + \underline{d}\underline{r}^T Q^{-1} (\underline{d}^T M \underline{e}) \right] dt \right\} \underline{r} \tag{48}$$

Note that the identification dynamics for this modified mathematical model depend upon the stimulus and the model's response as compared with the previous model which depends upon the stimulus and the human operator's response.

As before, Eqs. (40 - 48) may be simplified if one desires to study the human operator as a linear system. This is possible for certain tracking tasks with certain conditions. It should be noted, however, that

if there are inherent nonlinearities in the human operator that cannot be separated, then one should use the nonlinear mathematical model to represent the human operator. If the nonlinearities can be separated then one may simplify Eqs. (40 - 48).

As shown in section 3.6, (linear case) one may let $\dot{M} = 0$, $\dot{N} = 0$ and $\dot{Q} = 0$. In view of these simplifications Eqs. (40 - 48) become

$$\dot{V} = - \underline{e}^T D_2 \underline{e} + 2\left[\dot{\underline{u}}^T N + \underline{x}^T (\underline{b}^T M \underline{e})\right] \underline{u} + 2\left[\dot{\underline{w}}^T Q + \underline{r}^T (\underline{d}^T M \underline{e})\right] \underline{w} \tag{49}$$

where

$$D_2 = (A^T M + MA) \tag{50}$$

$$\dot{\underline{u}}^T = - \underline{x}^T N^{-1} (\underline{b}^T M \underline{e}) \tag{51}$$

$$\dot{\underline{w}}^T = - \underline{r}^T Q^{-1} (\underline{d}^T M \underline{e}) \tag{52}$$

$$\dot{\underline{u}} = - N^{-1T} \underline{x} (\underline{b}^T M \underline{e}) \tag{53}$$

$$\dot{\underline{w}} = - Q^{-1T} \underline{r} (\underline{d}^T M \underline{e}) \tag{54}$$

$$B = B_o - \int_o^t \underline{b} \underline{x}^T N^{-1} (\underline{b}^T M \underline{e}) dt \tag{55}$$

$$C = C_o - \int_o^t \underline{d} \underline{r}^T Q^{-1} (\underline{d}^T M \underline{e}) dt \tag{56}$$

$$\dot{\underline{x}} = \left\{ B_o - \int_c^t \underline{b}\underline{x}^T N^{-1} (\underline{b}^T \underline{M}\underline{e}) dt \right\} \underline{x} +$$

$$+ \left\{ C_o - \int_o^t \underline{d}\underline{r}^T Q^{-1} (\underline{d}^T \underline{M}\underline{e}) dt \right\} \underline{r} \qquad (57)$$

The problem arising in this modified modeling procedure is that matrix A is unknown initially. Therefore, one cannot compute matrix M from Eq. (41) or Eq. (50) by satisfying the conditions given by Eqs. (12) and (13). Since matrix A represents the reference system which is the actual human operator, then one may assume a priori that matrix A is stable. This will always be the case since the human operator is assumed to be stable when performing a tracking task. According to LaSalle and Lefschetz[18] if A represents a stable system, then there exists a positive definite symmetric M matrix for every positive definite D_2 matrix in Eq. (50). Therefore, in order to generate the identification dynamics, one may choose a set of elements for D_2 and M matrices as long as D_2 and M are positive definite. An alternate way would be to use the chosen initial values of matrix B_o for matrix A and then choose a matrix D_2 and solve for the elements of the M matrix. In this way, one obtains a preliminary set of constants which may be looked upon as weighting factors for the different controller identification loops. In either case this is not a systematic way of computing the elements of the M matrix, but it is more likely a trial and error approach. This is the disadvantage of the modified modeling technique. Work is being continued in this direction to establish a systematic way of computing the M matrix elements

for this modified modeling approach. Experimentation has shown meanwhile that an intelligent choice of D_2 and M matrices leads to very good identification of the human operator's model parameters. Digital computer simulation studies have been performed using this modified modeling approach and the results are included in this report.

A review of the presented modeling technique (controllable form) indicates that the adaptive identification dynamics require the measurement of the entire response vector as well as the entire stimulus vector. This is due to the fact that it is desired to realize the mathematical model based upon a phase variable representation of Eq. (2). If all phase variables of the response and stimulus are not available from measurements then the identification dynamics are inadequate to update the model's parameters. One may generate the non-measurable phase variables using differentiators, then the generated phase variables are either noisy or have discontinuities. This produces oscillations in the identified model parameters and it becomes difficult to determine when the model is identified. Experimental results indicate that the identified model parameters oscillate around some nominal values. Therefore, in this modeling technique one may consider these nominal values as being the identified parameters for the human operator in the reference system.

To overcome this problem a different modeling technique is considered. This modeling technique generates identification dynamics which do not require the measurement of the entire stimulus and response vectors. All one has to measure is the actual stimulus and response. The improved modeling technique is shown in the next section.

5. HUMAN OPERATOR MODELING - OBSERVABLE FORM

5.1 Introduction

As mentioned before, the desired realization of the mathematical model system for the human operator depends upon the choice of the state variables. Let us define, in this section, state variables which differ from the phase variables presented in the previous sections. In order to generate the new set of state variables let the mathematical model be described by the following n^{th} order differential equation

$$d^n x/dt^n + d^{n-1}(h_{n-1}x)/dt^{n-1} + \cdots + d(h_1 x)/dt + h_o x =$$

$$= g_n d^n r/dt^n + d^{n-1}(g_{n-1}r)/dt^{n-1} + \cdots + d(g_1 r)/dt + g_o r \qquad (58)$$

where x denotes the response and r the stimulus. One may rearrange Eq. (58) so that the stimulus and response derivatives of the same order are combined. This yields

$$d^n x/dt^n + d^{n-1}(h_{n-1}x - g_{n-1}r)/dt^{n-1} + \cdots +$$

$$+ d(h_1 x - g_1 r)/dt + h_o x = g_o r \qquad (59)$$

The high order differential equation given by Eq. (59) is equivalent to a system of n first order differential equations. Let the states be defined as

$$
\begin{aligned}
x_1 &= x \\
x_2 &= \dot{x}_1 + (h_{n-1}x - g_{n-1}r) \\
x_3 &= \dot{x}_2 + (h_{n-2}x - g_{n-2}r) \\
&\vdots \\
x_n &= \dot{x}_{n-1} + (h_1 x - g_1 r)
\end{aligned}
\tag{60}
$$

where the dot denotes the time derivative. Rearranging the set of equations given by Eq. (60) one obtains the state equations for the mathematical model

$$
\begin{aligned}
\dot{x}_1 &= -h_{n-1}x + x_2 + g_{n-1}r \\
\dot{x}_2 &= -h_{n-2}x + x_3 + g_{n-2}r \\
\dot{x}_3 &= -h_{n-3}x + x_4 + g_{n-3}r \\
&\vdots \\
\dot{x}_{n-1} &= -h_1 x + x_n + g_1 r \\
\dot{x}_n &= -h_o x + g_o r
\end{aligned}
\tag{61}
$$

where x and r are scalar quantities and can be measured. In matrix notations Eq. (61) has the form

$$\dot{\underline{x}} = H\underline{x} + \underline{g}r \tag{62}$$

where $\dot{\underline{x}}$, $\underline{x}$ and $\underline{g}$ are vectors, r is a scalar and H is a square matrix.

The expanded forms of these vectors and matrix H are given in Appendix B.

As a starting point for this modeling approach, let the human operator be described by

$$\dot{\underline{z}} = A\underline{z} + \underline{b}r \tag{63}$$

where $\dot{\underline{z}}$, $\underline{z}$ and $\underline{b}$ are vectors, r is a scalar and A is a square matrix. Note that Eq. (63) has the same form as Eq. (62). The problem is now to identify a matrix A and a vector $\underline{b}$ such that the response $\underline{z}$ of Eq. (63) matches the experimental output data of an actual human operator when performing a tracking task and is subjected to a known stimulus. In order to proceed with the identification of matrix A and vector $\underline{b}$, one must first formulate the error differential equation for the composite model-reference system as shown in Fig. 2. Then, using Liapunov's criterion, one must obtain the identification dynamics and a controller which will update matrix H and vector $\underline{g}$, so that at the end of the identification interval the response $\underline{x}$ matches the experimental response data of the actual human operator. The mathematical model is considered identified when $H \longrightarrow A$ and $\underline{g} \longrightarrow \underline{b}$. The realization of Eq. (62) then represents the reference system and is the mathematical representation of the actual human operator in the observable form.

5.2 Model-Reference Error Equation

Let the error describing the difference between the actual human operator's response and the tentative model system's response when both are subjected to the same stimulus be defined as

$$\underline{e} = \underline{z} - \underline{x} \tag{64}$$

Differentiating Eq. (64) with respect to time yields

$$\dot{\underline{e}} = \dot{\underline{z}} - \dot{\underline{x}} \tag{65}$$

Substituting Eqs. (62) & (63) into Eq. (65) gives

$$\dot{\underline{e}} = A\underline{z} + \underline{b}r - H\underline{x} - \underline{g}r \tag{66}$$

The above error differential equation may be rearranged in terms of parameter misalignments by letting $\underline{z} = \underline{e} + \underline{x}$. The resulting equation assumes the form

$$\dot{\underline{e}} = A\underline{e} + (A - H)\underline{x} + (\underline{b} - \underline{g})r \tag{67}$$

Let the parameter misalignments be defined as

$$(A - H) = \underline{u}\underline{c}^T \tag{68}$$

and

$$(\underline{b} - \underline{g}) = \underline{w} \tag{69}$$

where $\underline{u}$ and $\underline{w}$ are column vectors and $\underline{c}^T$ is a constant row vector. These vectors are shown in detailed form in Appendix B.

Substitution of Eqs. (68) and (69) into Eq. (67) yields the error diffential equation

$$\dot{\underline{e}} = A\underline{e} + \underline{u}(\underline{c}^T\underline{x}) + \underline{w}r \tag{70}$$

since

$$\underline{c}^T\underline{x} = \left| 1,0, \ldots, 0 \right| \cdot \begin{vmatrix} x_1 \\ x_2 \\ \cdot \\ \cdot \\ \cdot \\ x_n \end{vmatrix} = x_1 = x$$

then Eq. (70) may be written as

$$\dot{\underline{e}} = A\underline{e} + \underline{u}x + \underline{w}r \tag{70a}$$

where x and r are scalars and denote the response and stimulus respectively. Note that the error differential equation contains the model's response without its derivatives and the model-reference system stimulus without its derivatives. This is a very desirable result, since both of these quantities, x and r, can be measured.

Equation (70) contains three perturbational quantities, namely $\underline{e}$, $\underline{u}$ and $\underline{w}$. These quantities, as stated before, denote the model-reference system error and the parameter misalignments respectively.

5.3 Formulation of a Liapunov Function

An appropriate Liapunov function for Eq. (70) should be positive definite in the model-reference system error as well as in parameter misalignments. Therefore, one may choose again a candidate Liapunov function of the form

$$V = \underline{e}^T M\underline{e} + \underline{u}^T N\underline{u} + \underline{w}^T Q\underline{w} \tag{71}$$

where matrices M, N and Q are symmetric positive definite matrices whose elements may be constants, time varying and/or functions of the state variables. Differentiating Eq. (71) with respect to time and then substituting Eq. (70) and its transpose given by

$$\dot{\underline{e}}^T = \underline{e}^T A^T + \underline{u}^T x + \underline{w}^T r \tag{72}$$

one obtains the time derivative of the Liapunov function

$$\dot{V} = -\underline{e}^T D_3 \underline{e} + 2\underline{u}^T(N\dot{\underline{u}} + M\underline{e}x + \dot{N}\underline{u}) + 2\underline{w}^T(Q\dot{\underline{w}} + M\underline{e}r + \dot{Q}\underline{w}) \tag{73}$$

where

$$D_3 = (A^T M + MA + \dot{M}) \tag{74}$$

To satisfy Liapunov's criterion $V > 0$ and $\dot{V} \leq 0$ one may solve Eq. (74) in the same manner as described in the previous modeling technique and let

$$(N\dot{\underline{u}} + M\underline{e}x + \dot{N}\underline{u}) \overset{\leq}{=} 0 \tag{75}$$

$$(Q\dot{\underline{w}} + M\underline{e}r + \dot{Q}\underline{w}) \overset{\leq}{=} 0 \tag{76}$$

Equations (75) and (76) constitute the basic relationships from which one realizes the adaptive controller and the identification dynamics. It should be noted again that the resulting $\dot{V}$ may be negative semidefinite or negative definite depending on the condition given by Eqs. (75) and (76).

5.4 Formulation of Controller and Mathematical Model (Nonlinear Case)

Rearranging Eqs. (75) and (76) one obtains

$$\dot{\underline{u}} = -N^{-1}M\underline{e}x - N^{-1}\dot{N}\underline{u} \tag{77}$$

$$\dot{\underline{w}} = -Q^{-1}M\underline{e}r - Q^{-1}\dot{Q}\underline{w} \tag{78}$$

Equations (77) & (78) represent the identification dynamics and the realization of these equations produces the adaptive controller. Matrices M, N and Q are determined in the same manner as explained in the previous sections. Note that r and x are scalar quantities here and represent the

measurable stimulus-response data.

In order to continue with the formulation of the mathematical model system, one must establish a relationship among Eqs. (68), (69), (77) and (78). As before, one may assume that the changes in the human operator during his performance are much slower than the identification time required for the model's parameters. This restriction permits one to consider matrix A and vector $\underline{b}$ as being time-invariant during the identification interval. Therefore, differentiating Eqs. (68) & (69) with respect to time yields

$$\dot{H} = -\underline{\dot{u}}\underline{c}^T \tag{79}$$

and

$$\dot{\underline{g}} = -\underline{\dot{w}} \tag{80}$$

Substituting Eqs. (77) and (78) into Eqs. (79) and (80) respectively, one obtains

$$\dot{H} = N^{-1}\underline{M}\underline{e}\underline{x}\underline{c}^T + N^{-1}\dot{N}\underline{u}\underline{c}^T \tag{81}$$

$$\dot{\underline{g}} = Q^{-1}\underline{M}\underline{e}\underline{r} + Q^{-1}\dot{Q}\underline{w} \tag{82}$$

Integration of Eqs. (81) and (82) over the identification interval yields

$$H = H_o + \int_o^t (N^{-1}\underline{M}\underline{e}\underline{x}\underline{c}^T + N^{-1}\dot{N}\underline{u}\underline{c}^T)dt \tag{83}$$

$$\underline{g} = \underline{g}_o + \int_c^t (Q^{-1}\underline{M}\underline{e}\underline{r} + Q^{-1}\dot{Q}\underline{w})dt \tag{84}$$

where H_o and $\underline{g}_o$ are the initially assumed values for matrix H and vector $\underline{g}$

respectively. Matrix H_o and vector g_o are given in Appendix B. The integrals in Eqs. (83) and (84) constitute the identification dynamics and may be considered of the memory or "learning" type.

To complete the formulation of the mathematical model one substitutes Eqs. (83) and (84) into Eqs. (62). The resulting equation is then the mathematical model which at the end of the identification interval represents the actual human operator. The mathematical model is given by

$$\dot{\underline{x}} = \left\{ H_o + \int_0^t (N^{-1}\underline{M}_e \underline{x}_c^T + N^{-1}\dot{N}\underline{u}_c^T)dt \right\} \underline{x} +$$

$$+ \left\{ g_o + \int_0^t (Q^{-1}\underline{M}_e r + Q^{-1}\dot{Q}\underline{w})dt \right\} r \qquad (85)$$

Since Eqs. (83), (84), (85) and (74) are nonlinear, time varying and interrelated, then one must utilize a digital computer and solve these equations iteratively.

The mathematical model may be considered to represent the actual human operator when $e = 0$. Digital computer simulation has shown that with proper choice of N,Q and M matrices one obtains a rapid identification of parameters for the mathematical model. This is illustrated via an example later in the report.

It is desirable for the identification dynamics to possess memory ("learning") capabilities so that the mathematical model's initial parameter values are permanently updated to eventually eliminate the need of the error information being supplied by the model-reference system configuration.

The interval of time required for the model to update or "learn" a set of parameter values which produce a model response that is equivalent to the response of the human operator being modeled could be referred to as a "learning" period. This "learning" period will vary for different systems and will depend upon the characteristics of the stimulus signal.

One possible means for determining when a set of model parameters have been identified is by examination of the model parameter waveforms throughout the "learning" interval. During the initial segment of a "learning" interval, the "learned" parameter waveforms usually fluctuate over a wide range of values as the model tries to conform to the reference system. In the later portion of the "learning" interval, the fluctuations die down and the model parameters tend toward their desired levels. Therefore, once the fluctuations have ceased, it can be assumed that a set of model parameter values have been established. If a change occurs in the human operator's tracking task, the model parameter waveforms will again begin to fluctuate and a new "learning" period is initiated, until the fluctuations cease and the model establishes another set of parameter values. This adaptive property is inherent in the integrals given by Eq. (83) and (84) and therefore, one may consider these integrals as being of the memory or "learning" type. Note that the mathematical model of the human operator contains these integrals. Hence, the model has also this adaptive "learning" property.

The identification of vector g in Eq. (85) may be simplified by utilizing the measured human operator's response. Consider Eq. (63) again

$$\dot{\underline{z}} = A\underline{z} + \underline{b}r$$

At t = 0, let $\underline{z}(0) = 0$ and r = 1. From Eq. (63) one obtains

$$\dot{\underline{z}}(0) = \underline{b} \tag{86}$$

or

$$\underline{z}(\Delta t)/\Delta t = \underline{b} \tag{87}$$

Since one desires at the end of the identification interval that vector $\underline{g}$ approach vector $\underline{b}$, then one may set in the computations

$$\underline{z}(\Delta t)/\Delta t = \underline{g} \tag{88}$$

Note that vector $\underline{g}$ may be determined by utilizing the initial conditions of the model-reference system. Equation (88) suggests that vector $\underline{g}$ may be identified during the first iteration interval using the experimental response data of the human operator. Note also that this data has been recorded on magnetic tape and the reel of tape serves as the human operator.

In view of Eq. (88) one may modify Eq. (85) as

$$\dot{\underline{x}} = \left[H_o + \int_0^t (N^{-1} M \underline{x} \underline{c}^T + N^{-1} N \underline{u} \underline{c}^T) dt \right] \underline{x} + \left[\underline{g}_o + \underline{z}(\Delta t)/\Delta t \right] r \tag{89}$$

Equation (89) represents the simplified mathematical model of the human operator when performing a tracking task. Note that the identification time has been reduced appreciably, since after the first iteration one has to identify only the H matrix.

5.5 Linear Mathematical Model

Under certain conditions and for specific tasks the human operator in a closed loop control operation may operate as a linear system. In this

case the human operator may be described by a linear mathematical model. In order to formulate a linear model, one has to simplify the equations presented in section 5.4.

Since a linear mathematical model is desired, then in accordance with Liapunov's stability theory, M, N and Q matrices appearing in the Liapunov function may consist of constant elements. Hence, $\dot{M} = 0$, $\dot{N} = 0$ and $\dot{Q} = 0$. In view of these simplifications, the time derivative of the Liapunov function becomes

$$\dot{V} = - \underline{e}^T D_4 \underline{e} + 2\underline{u}^T(N\dot{\underline{u}} + M\underline{e}x) + 2\underline{w}^T(Q\dot{\underline{w}} + M\underline{e}r) \tag{90}$$

where

$$D_4 = (A^T M + MA) \tag{91}$$

Liapunov's criterion for stability calls for $V > 0$ and $\dot{V} \leq 0$. One way to satisfy this criterion is to impose the following conditions: $M > 0$, $N > 0$, $Q > 0$, $D_4 > 0$ and let

$$(N\dot{\underline{u}} + M\underline{e}x) = 0 \tag{92}$$

$$(Q\dot{\underline{w}} + M\underline{e}r) = 0 \tag{93}$$

From Eqs. (92) and (93) one obtains the identification dynamics for the linear mathematical model of the human operator. Rearranging Eqs. (92) and (93) yields

$$\dot{\underline{u}} = - N^{-1} M\underline{e}x \tag{94}$$

$$\dot{\underline{w}} = - Q^{-1} M\underline{e}r \tag{95}$$

Equations (94) and (95) are the basic equations for the realization of the linear adaptive controller. Substituting Eqs. (94) and (95) into Eqs. (79) and (80) respectively, one obtains

$$\dot{H} = N^{-1} M \underline{e} \underline{x}_c^T \tag{96}$$

$$\dot{\underline{g}} = Q^{-1} M \underline{e} r \tag{97}$$

Integrating Eqs. (96) and (97) over the identification interval gives

$$H = H_o + \int_c^t (N^{-1} M \underline{e} \underline{x}_c^T) dt \tag{98}$$

$$\underline{g} = \underline{g}_o + \int_0^t (Q^{-1} M \underline{e} r) dt \tag{99}$$

where H_o and $\underline{g}_o$ are the initial values for matrix H and vector $\underline{g}$ respectively. Finally, substituting Eqs. (98) and (99) into Eq. (62) yields

$$\dot{\underline{x}} = \left[H_o + \int_o^t (N^{-1} M \underline{e} \underline{x}_c^T) dt \right] \underline{x} + \left[\underline{g}_o + \int_o^t (Q^{-1} M \underline{e} r) dt \right] r \tag{100}$$

Equation (100) represents the linear mathematical model of the human operator. The identification of vector $\underline{g}$ may be simplified by utilizing Eq. (88). Hence, the linear mathematical model has the form

$$\dot{\underline{x}} = \left[H_o + \int_o^t (N^{-1} M \underline{e} \underline{x}_c^T) dt \right] \underline{x} + \left[\underline{g}_o + \underline{z}(\Delta t)/\Delta t \right] r \tag{101}$$

The realization of this mathematical model is illustrated in example 2. which illustrates the identification of four parameters.

In order to illustrate both identification techniques two "artificial" examples are considered. The reason for presenting these "artificial" examples is to show the usefulness of the identification methods and the information one must know a priori about the reference system so that the resulting model is a true representation of the human operator when performing a particular task. By an "artificial" example is meant that the reference system does not represent a true human operator performing a prescribed task, but instead the reference system represents a dynamic differential equation with known coefficients. This differential equation is then subjected to a known stimulus and the generated response with the stimulus are recorded on tape. Only the stimulus and response data are utilized in the identification process.

The purpose of illustrating the identification techniques via these examples is twofold. First, it gives the designer a means of verifying the validity of the controller or control laws. Second, one has a check on the identified mathematical model parameters. In addition, one obtains an insight and experience in choosing the M, N and Q matrices in order to shorten or lenghten the identification time. Once this knowledge is gained, one may undertake the modeling of the actual human operator data provided it is recorded on the tape in the required form.

The first example illustrates the identification of two parameters for a second order mathematical model expressed in the controllable form. The second example shows the identification of four parameters for a second order mathematical model expressed in the observable form.

6. EXAMPLES

6.1 Example 1. Identification of Two Parameters

Consider Fig. 1. This example illustrates the identification of two parameters for a second order mathematical model. The desired realization of the mathematical model is a state determined controllable form. Therefore, the choice of the state variables is in accordance with the desired realization.

Let the response of the reference system, denoted by z, be generated by the differential equation

$$\ddot{z} + 22\dot{z} + 121z = 102\dot{r} + 187r \tag{E1}$$

where $r = -y$ and $z = \ddot{y}$ as shown in Fig. 1. The initial stimulus is applied to the last stage of the plant. The information recorded on magnetic tape consists of the initial stimulus, the reference system's response and plant's response. Note that the plant's response is fedback to the input of the reference system. If one were to replace the reference system with an actual human operator whose task would be to control the plant, then the fedback plant's response would indicate to the human operator how to move the stick or similar output device in order to force the plant to conform to a desired performance.

A tentative mathematical model is chosen for the reference system. The model has the form

$$\ddot{x} + b_2\dot{x} + b_1x = 102\dot{r} + 187r \tag{E2}$$

The problem at hand is to identify b_2 and b_1. At this point one assumes that b_2 and b_1 are completely unknown, except that one may assign initial

values to b_2 and b_1. The restriction on the initial values is that they must lie within the stability region of the tentative mathematical model as determined by a Liapunov function generated for this model system.

The next step in the modeling process is to realize a controller or control laws which update the initially chosen values of b_2 and b_1 so that the final mathematical model represents the reference system. In order to accomplish this task, one makes use of the derived equations. Using a phase variable representation of Eq. (E2), the B-matrix has the form

$$B = \begin{vmatrix} 0 & 1 \\ -b_1 & -b_2 \end{vmatrix} \tag{E3}$$

Therefore, in view of Eq. (20)

$$\dot{B} = \begin{vmatrix} 0 & 0 \\ -\dot{b}_1 & -\dot{b}_2 \end{vmatrix} = \begin{vmatrix} 0 \\ 1 \end{vmatrix} \cdot \left| -\dot{b}_1, -\dot{b}_2 \right| = \underline{b}\dot{\underline{u}}^T \tag{E4}$$

where

$$\underline{b} = \begin{vmatrix} 0 \\ 1 \end{vmatrix} \tag{E5}$$

and

$$\dot{\underline{u}} = \begin{vmatrix} \dot{u}_1 \\ \dot{u}_2 \end{vmatrix} = \begin{vmatrix} -\dot{b}_1 \\ -\dot{b}_2 \end{vmatrix} \tag{E6}$$

Note that the dot denotes the time derivative and superscript T denotes the transpose.

Since a linear model system is considered, then using Eqs. (32) and

(E6) yields, after some algebraic manipulations, the following identification dynamics

$$\dot{b}_1 = (1/n_{11}) \cdot z \cdot (m_{12}e + m_{22}\dot{e}) \tag{E7}$$

$$\dot{b}_2 = (1/n_{22}) \cdot \dot{z} \cdot (m_{12}e + m_{22}\dot{e}) \tag{E8}$$

Integration of Eqs. (E7) and (E8) gives

$$b_1 = b_{10} + \int_0^t (1/n_{11}) \cdot z \cdot (m_{12}e + m_{22}\dot{e})dt \tag{E9}$$

$$b_2 = b_{20} + \int_0^t (1/n_{22}) \cdot \dot{z} \cdot (m_{12}e + m_{22}\dot{e})dt \tag{E10}$$

where b_{10} and b_{20} are the initially assumed values for b_1 and b_2 respectively. The variables z, $\dot{z}$, e and $\dot{e}$ are measured quantities. Note that z and $\dot{z}$ are recorded on the tape. Elements m_{12}, m_{22}, n_{11} and n_{22} are obtained from the Liapunov function. The elements m_{12} and m_{22} are computed from Eq. (31) or Eq. (50). Elements n_{11} and n_{22} are free design parameters and must satisfy the conditions $n_{11} > 0$, $n_{22} > 0$. Using Eqs. (31) and (E3) with a diagonal D-matrix of the form

$$D = \begin{vmatrix} -d_{11} & 0 \\ 0 & -d_{22} \end{vmatrix} \tag{E11}$$

and a symmetric M-matrix of the form

$$K = \begin{vmatrix} m_{11} & m_{12} \\ m_{12} & m_{22} \end{vmatrix} \tag{E12}$$

one obtains

$$m_{12} = d_{11}/2b_1 \tag{E13}$$

$$m_{22} = (d_{22} + d_{11}/b_1)/(1/2b_2) \tag{E14}$$

and

$$m_{11} = (b_2^2 d_{11} + b_1^2 d_{22} + b_1 d_{11})/(2b_1 b_2) \tag{E15}$$

Without loss of insight into the modeling procedure one may let $d_{11} = 1$ and $d_{22} = 1$. Equations (E13 to E15) reduce to

$$m_{12} = 1/2b_1 \tag{E16}$$

$$m_{22} = (1 + 1/b_1)/(1/2b_2) \tag{E17}$$

and

$$m_{11} = (b_2^2 + b_1^2 + b_1)/(2b_1 b_2) \tag{E18}$$

Note that if one uses Eq. (31) the elements m_{11}, m_{12} and m_{22} are dependant upon the b_i's. Therefore, during the identification process, one must compute new sets of m_{ij}'s at each iteration step. Since the m_{ij}'s appear in the Liapunov function, then one must also compute V and $\dot{V}$ at each iteration step using Eqs. (8) and (30) and check if Liapunov's criterion is satisfied at each iteration.

Substitution of Eqs. (E9) and (E10) into Eq. (E2) yields the mathematical model for the tape recorded data. The model is described by

$$\ddot{x} + \left[b_{20} + \int_0^t (1/n_{22})\cdot\dot{z}\cdot(m_{12}e + m_{22}\dot{e})dt\right]\dot{x} +$$

$$+\left[b_{10} + \int_c^t (1/n_{11})\cdot z\cdot(m_{12}e + m_{22}\dot{e})dt\right]x = 102\dot{r} + 187r \qquad (E19)$$

where the m_{ij}'s are given by Eqs. (E16 - E18) and the n_{ii}'s are from the diagonal N-matrix used in the formulation of the Liapunov function.

As mentioned before, one may also use Eq. (50) to find a set of m_{ij}'s needed for the controller identification dynamics. Equation (50) contains the reference system matrix A which is unknown. No information is recorded on the tape. In this case, the generation of the m_{ij}'s becomes a trial and error approach. The m_{ij}'s are then chosen according to the theorem given by LaSalle and Lefschetz[18]. This theorem states that if A represents a stable system, then there exists a positive definite symmetric M-matrix for every negative definite symmetric D_2 matrix. (See Eq. (50)).

Using Eqs. (53), (E6) and (A-17) one obtains after some algebraic manipulations the identification dynamics given by

$$\dot{b}_1 = (SB)\cdot(n_{22}x - n_{12}\dot{x}) \qquad (E20)$$

$$\dot{b}_2 = (SB)\cdot(n_{11}\dot{x} - n_{12}x) \qquad (E21)$$

where

$$(SB) = (m_{12}e + m_{22}\dot{e})/(n_{11}\cdot n_{22} - n_{12}^2)$$

Integration of Eqs. (E20) and (E21) gives

$$b_1 = b_{10} + \int_c^t (SB)\cdot(n_{22}x - n_{12}\dot{x})dt \qquad (E22)$$

$$b_2 = b_{20} + \int_o^t (SB)\cdot(n_{11}\dot{x} - n_{12}x)dt \qquad (E23).$$

where b_{10} and b_{20} are the initial values of b_1 and b_2 respectively. Note that a non-diagonal N-matrix was used in the above equations. The m_{ij}'s and n_{ij}'s are obtained from the Liapunov function.

Substitution of Eqs. (E22) and (E23) into Eq. (E2) yields the mathematical model for the tape recorded data. The model is described by

$$\ddot{x} + \left[b_{20} + \int_o^t (SB)\cdot(n_{11}\dot{x} - n_{12}x)dt\right]\dot{x} +$$

$$+\left[b_{10} + \int_o^t (SB)\cdot(n_{22}x - n_{12}\dot{x})dt\right]x = 102\dot{r} + 187r \qquad (E24)$$

Following is a list of numerical values used in the digital computer program:

N-matrix elements

$m_{11} = 100$ $\quad m_{12} = 27$ $\quad m_{22} = 27$

N-matrix elements

$n_{11} = 1$ $\quad n_{12} = .9$ $\quad n_{22} = 1$

Q-matrix elements

$q_{11} = 1$ $\quad q_{12} = .95$ $\quad q_{22} = 1$

Initial Parameters of Model

$b_{20} = 50$ $\quad b_{10} = 50$

Iteration Interval

$\Delta t = 0.0001$ sec.

The digital computer results are shown in section 12.

6.2 Example 2. Identification of Four Parameters

Consider Fig. 2. This example illustrates the identification of four parameters for a second order mathematical model. The desired realization of the model is a state determined observable form. Therefore, one chooses the states for the model in accordance with the desired realization.

Let the response of the reference system, denoted by z, be generated by a differential equation

$$d^2z/dt^2 + 22dz/dt + 121z = 102dr/dt + 187r \qquad (E25)$$

where $r = -y$ and $z = d^2y/dt^2$ as shown in Fig. 2. The initial stimulus is applied to the plant and the plant's response is fedback to the input of the reference system. Fig. 2. may be considered as a representation of a tracking task, in which a human operator observes on a visual display the plant's response y and adjusts a manipulator, joystick, handwheel or similar output device in such manner that the plant's response conforms to a desired performance. The information recorded on magnetic tape consist of the initial stimulus, the reference system's output and the plant's response. Note that the reference system's output, denoted by z, represents the adjustment which the human operator imparts on the plant by manipulating the stick.

In order to describe the recorded data via a mathematical relationship, one may choose first a tentative mathematical model. Let the tentative mathematical model for the recorded data be

$$d^2x/dt^2 + h_1dx/dt + h_0x = g_1dr/dt + g_0r \qquad (E26)$$

where h_1, h_o, g_1 and g_o are to be identified from the recorded tape data. Note that the problem at hand is the identification of four parameters based on experimental recorded data. Rearranging Eq. (E26) yields

$$d^2x/dt^2 + d(h_1x - g_1r)/dt + h_ox = g_or \tag{E27}$$

Defining the state variables as

$$\begin{aligned} x_1 &= x \\ x_2 &= \dot{x}_1 + (h_1x_1 - g_1r) \end{aligned} \tag{E28}$$

the state equations for the tentative mathematical model are

$$\begin{aligned} \dot{x}_1 &= -h_1x_1 + x_2 + g_1r \\ \dot{x}_2 &= -h_ox_1 + g_or \end{aligned} \tag{E29}$$

The H-matrix resulting from this choice of state variables is

$$H = \begin{vmatrix} -h_1 & 1 \\ -h_o & 0 \end{vmatrix} \tag{E30}$$

and the g-vector is given by

$$g = \begin{vmatrix} g_1 \\ g_o \end{vmatrix} \tag{E31}$$

Note that h_1, h_o, g_1 and g_o are unknown quantities. One may assume initial values for h_1, h_o, g_1 and g_o with the restriction that the assumed initial values lie within the stability region of the tentative mathematical model.

This stability region may be determined by a Liapunov function formulated for the model system.

The next step in the modeling process is to find the control laws which update the initially chosen values of h_1, h_o, g_1 and g_o, and permit the realization of the adaptive identification controller.

Using the equations derived in section 5. one obtains

$$\dot{H} = \begin{vmatrix} -\dot{h}_1 & 0 \\ -\dot{h}_o & 0 \end{vmatrix} = \begin{vmatrix} -\dot{u}_1 \\ -\dot{u}_o \end{vmatrix} \begin{vmatrix} 0 & 1 \end{vmatrix} = -\dot{\underline{u}}\underline{c}^T \tag{E32}$$

where

$$-\dot{\underline{u}} = \begin{vmatrix} -\dot{u}_1 \\ -\dot{u}_o \end{vmatrix} = \begin{vmatrix} -\dot{h}_1 \\ -\dot{h}_o \end{vmatrix} \tag{E33}$$

and

$$\underline{c} = \begin{vmatrix} 0 \\ 1 \end{vmatrix} \tag{E34}$$

Note that the dot denotes the time derivative and superscript T denotes the transpose.

Since a linear mathematical model is being considered, then using Eqs. (96) and (97) one obtains, after some algebraic manipulations, the identification dynamics for the model parameters.

$$\dot{h}_1 = (x/n_{11}) \cdot (m_{11}e + m_{12}\dot{e}) \tag{E35}$$

$$\dot{h}_o = (x/n_{22}) \cdot (m_{12}e + m_{22}\dot{e}) \tag{E36}$$

$$\dot{g}_1 = (r/q_{11}) \cdot (m_{11}e + m_{12}\dot{e}) \tag{E37}$$

$$\dot{g}_o = (r/q_{22}) \cdot (m_{12}e + m_{22}\dot{e}) \tag{E38}$$

Note that matrices N and Q are assumed to be diagonal for simplicity. Integration of Eqs. (E35 - E38) yields the model parameters

$$h_1 = h_{10} + \int_0^t (x/n_{11}) \cdot (m_{11}e + m_{12}\dot{e})dt \tag{E39}$$

$$h_o = h_{oo} + \int_0^t (x/n_{22}) \cdot (m_{12}e + m_{22}\dot{e})dt \tag{E40}$$

$$g_1 = g_{10} + \int_0^t (r/q_{11}) \cdot (m_{11}e + m_{12}\dot{e})dt \tag{E41}$$

$$g_o = g_{oo} + \int_0^t (r/q_{22}) \cdot (m_{12}e + m_{22}\dot{e})dt \tag{E42}$$

where h_{10}, h_{oo}, g_{10} and g_{oo} are the initial assumed values for the model's parameters. The variables r, x, e and $\dot{e}$ are measured quantities and represent the input, model's output, model-reference error and its time derivative respectively. Elements m_{11}, m_{12}, m_{22}, n_{11}, n_{22}, q_{11} and q_{22} are obtained from the Liapunov function. Elements n_{ii} and q_{ii} are free design parameters and must satisfy the condition $n_{ii} > 0$ and $q_{ii} > 0$. These elements arise from the N and Q matrices which are chosen for this example to be diagonal matrices. The m_{ij}'s are chosen in accordance with the previous stated theorem[18].

Substitution of Eqs. (E39 - E42) into Eq. (E26) yields the

mathematical model

$$\ddot{x} + \left[h_{10} + \int_c^t (x/n_{11}) \cdot (m_{11}e + m_{12}\dot{e})dt \right] \dot{x} +$$

$$+ \left[h_{oo} + \int_c^t (x/n_{22}) \cdot (m_{12}e + m_{22}\dot{e})dt \right] x =$$

$$= \left[g_{10} + \int_c^t (r/q_{11}) \cdot (m_{11}e + m_{12}\dot{e})dt \right] \dot{r} +$$

$$+ \left[g_{oo} + \int_o^t (r/q_{22}) \cdot (m_{12}e + m_{22}\dot{e})dt \right] r \qquad (E43)$$

Equation (E43) may be simplified if one assumes that the reference system and the mathematical model are at rest at t = 0. Let r = 1, $x_1(0) = 0$ and $x_2(0) = 0$ at t = 0. Then Eq. (E29) gives

$$\dot{x}_1 = g_1 \qquad (E44)$$

$$\dot{x}_2 = g_o \qquad (E45)$$

or

$$x_1(\Delta t)/\Delta t = g_1 \qquad (E46)$$

$$x_2(\Delta t)/\Delta t = g_o \qquad (E47)$$

Since one desires $b_1 = g_1$ and $b_o = g_o$ at the end of the identification interval, then, using the recorded tape data, the b's may be computed at

the first iteration by

$$z_1(\Delta t)/\Delta t = b_1 = g_1 \tag{348}$$

$$z_2(\Delta t)/\Delta t = b_o = g_o \tag{349}$$

Note that vector g can be determined from the initial conditions. Thus, at the first iteration interval one determines vector g. The remaining identification time is then utilized to identify the elements of the H-matrix. This simplification reduces the time for identifying the model's parameters.

The simplified mathematical model has now the form given by

$$\ddot{x} + \left[h_{10} + \int_o^t (x/n_{11})\cdot(m_{11}e + m_{12}\dot{e})dt \right]\dot{x} +$$

$$+\left[h_{oo} + \int_o^t (x/n_{22})\cdot(m_{12}e + m_{22}\dot{e})dt \right] x =$$

$$=\left[g_{10} + z_1(\Delta t)/\Delta t \right]\dot{r} + \left[g_{oo} + z_2(\Delta t)/\Delta t \right] r \tag{350}$$

where z_1 and z_2 are defined in the same manner as x_1 and x_2.

Following is a list of numerical values used in the digital computer program:

M-matrix elements

$m_{11} = 700$ $\quad m_{12} = 100$ $\quad m_{22} = 30$

N-matrix elements

$n_{11} = 0.5 \qquad n_{12} = 0 \qquad n_{22} = 0.05$

Q-matrix elements

$q_{11} = 1 \qquad q_{12} = 0 \qquad q_{22} = 1$

Initial parameters of Model

$h_{10} = 2 \qquad h_{oo} = 200 \qquad g_{10} = 0 \qquad g_{oo} = 0$

Iteration interval

$t = 0.0001$ sec.

The program and computer results are shown in section 12.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

Two adaptive modeling techniques to identify and control a human operator's mathematical model has been presented. The modeling techniques offer a theoretically consistent approach for identifying a model's parameters from experimental data. A very useful feature of this study is the development of a digital computer program which is easily implemented and modified concurrent with experimentation. In this way, the modeling process interacts with the experimentation process in a mutually beneficial way. This is shown via the logic flow diagrams in Figs. 3, 4, 5 and 6. Note also that it is the systematic and logical use of the digital computer that permits one to effectively apply the class of Liapunov functions to the modeling of a human operator when performing a tracking task.

One of the objectives of both modeling techniques has been the synthesis of a controller or control laws that provide the identification dynamics for the model's parameters. An important feature of these identification dynamics is their "learning" capability. This "memory" or "learning" capability provides a means for determining when a set of model parameters has been identified. All one has to do is to examine the model parameters throughout the "learning" interval. As it can be observed from the digital computer printouts, during the initial segment of a "learning" interval, the model parameters usually fluctuate over a wide range of values. In the later portion of the "learning" interval, as the parameters approach the correct values, the fluctuations in the

parameters diminish and the model parameters tend toward the correct values. Therefore, once the fluctuations have ceased, one may assume that a set of model parameters has been identified for the human operator performing a given tracking task.

The "memory" or "learning" capability of the identification dynamics has another important feature. It permits one to establish a correspondence between reference system's disorders and parameter value changes in the mathematical model. This may be observed from the following experiment. If a change occurs in the human operator's tracking task, the model parameters begin to fluctuate again and a new "learning" period is initiated, until the fluctuations cease and a new set of parameter values has been identified for the mathematical model which represents the human operator for a changed condition. This adaptive property is one of the main advantages of both modeling techniques.

Perusal of the modeling techniques indicate that the identification dynamics developed for the mathematical model in the controllable form require the measurement of the entire response vector as well as the stimulus vector. This is due to the fact that the mathematical model has been synthesized based upon a phase variable representation of Eq. (2). If some of the phase variables of the stimulus and response are not measurable, then the identification laws are inadequate to update the model's parameters. To alleviate this situation, one may generate the additional required phase variables by successively differentiating the last measured phase variable. The resulting phase variables are then noisy and may contain discontinuities. This produces oscillations in the model parameters and it becomes difficult to determine the identified set of model parametes.

Since these oscillations are steady and oscillate about some nominal values, then one may consider these nominal values as the set of identified parameters for the mathematical model.

To overcome this disadvantage, the second modeling technique which realizes a mathematical model in the observable form has been formulated. A review of this technique indicates that one does not have to measure the entrie response and stimulus vector in order to generate the identification dynamics. It is sufficient to measure only the scalar response and stimulus values as it is indicated by Eqs. (83) and (84). In addition to this improvement, the identification dynamics of this second modeling technique have also the "learning" capability. Therefore, one may consider the identification technique leading to the mathematical model of the observable form as being superior to the identification technique which produces a mathematical model of the controllable form.

The identification dynamics have been derived from a class of Liapunov functions which possess variable characteristics. An important feature about Liapunov's Direct Method is that Liapunov functions are not unique. This accounts for the fact that matrices M, N and Q can be arbitrarily chosen for the identification dynamics. The condition these matrices must satisfy is that $M > 0$, $N > 0$ and $Q > 0$. Experimental observations have shown that matrices M, N and Q affect the rate of model parameter convergence to their correct values.

A review of the identification dynamics equations show that the elements of M, N and Q matrices serve as weighting factors on the model-

reference system error as well as on the response and stimulus variables. Several sets of values for the elements of M, N and Q matrices have been considered. Two of the better sets are shown in the computer printouts in section 12.

The digital computer results given in section 12 are self-explanatory.

7.2 Recommendations

It should be emphasized that the adaptive controller is intended mainly to aid in the identification of the mathematical model's parameters. In general, analysis of the results obtained by using the adaptive controller does not necessarily dictate that the actual human operator under study must be modeled in the proposed manner. Instead, analysis of the results suggest certain modifications which should be considered in future studies. One of this considerations is a better and clearer delineation of the experimental data. Note that the recorded experimental data needed to formulate a mathematical model of the controllable form is different from the recorded experimental data needed to generate a mathematical model of the observable form. Therefore, one of the recommendations of this study is to first decide on the desired model structure and then perform the experimentation with the human operator and record the data needed for identifying the model's parameters. Should the experimental data be difficult to obtain, then one can modify easily the model structure to accommodate the experiment.

The following areas of research are logical extensions of this study:

1. Develop a design criterion that would permit the mathematical model parameters to become identified in the shortest time.

2. Investigate new forms of Liapunov functions from which different identification dynamics may be obtained.

3. Study the usefulness of the presented modeling techniques to the development of diagnostic techniques. This recommendation may be useful for investigating abnormalities in a human operator's performance with a particular plant. It may also be useful for investigating human operator performance with different plants.

8. REFERENCES

1. Dutton, J. M. and Starbuck, W. H., "Computer Simulation Models of Human Behavior: A History of an Intellectual Technology", IEEE Trans. Systems, Man and Cybernetics, Vol. SMC-1, pp. 128-171, April, 1971.

2. Saridis, G. N. and Lobbia, R. N., "Parameter Identification and Control of Linear Discrete-Time Systems", IEEE Trans. Automatic Control, Vol. AC-17, pp. 52-60, February 1972.

3. Mekel, R. and Peruo, P., "Design of Controllers for a Class of Nonlinear Control Systems", IEEE Trans. Automatic Control, Vol. AC-17, pp. 206-213, April 1972.

4. Adams, J. J. and Bergeron, H. P., "A Synthesis of Human Response in Closed-Loop Tracking Tasks", NASA Technical Note D-4842, October 1968.

5. Whitaker, H. P., Yarmon, J, and Kezer, A., "Design of Model-Reference Adaptive Control Systems for Aircraft", MIT Instrumentation Lab. Report R-164, September 1958.

6. Osborn, P. V., Whitaker, H. P. and Kezer, A. "New Developments in the Design of Adaptive Control Systems", Institute of Aeronautical Sciences, Paper 61-39, January 1961.

7. Adams, J. J. and Bergeron, H. P., "Measured Variation in the Transfer Function of a Human Pilot in Single-Axis Tasks", NASA TN D-1952, 1963.

8. Parks, P. C., "Lyapunov Redesign of Model-Reference Adaptive Control Systems", IEEE Trans. Automatic Control, Vol. AC-11, pp. 362-367, July 1966.

9. Margolis, M., "On the Theory of Process Adaptive Control Systems, The Learning Model Approach", Doctoral Dissertations Department of Engineering, University of California, Los Angeles, 1959.

10. Bergeron, H. P., Kincaid, J. K. and Adams, J. J. "Measured Human Transfer Functions in Simulated Single-Degree-of-Freedom Nonlinear Control Systems", NASA TN D-2569, 1965.

11. Staffeson, F. L., "Determining Parameters Corrections According to System Performance: A Method and its Application to Real-Time Missile Testing", Army Missile Test Center, White Sands Missile Range, Lab. Res. Rpt. 20, July 1960.

12. Adams, J. J. and Bergeron, H. P., "Measurements of Human Transfer-Function With Various Model Forms", NASA TN D-2394, 1964.

13. Bekey, G. A., "Description of The Human Operator in Control Systems" Modern Control Systems Theory, Chapter 12, McGraw-Hill Book Co, Inc. 1965.

14. Phatak, A. V. and Bekey, G. A., "Decision Processes in the Adaptive Behavior of Human Controllers", IEEE Trans. on System Science and Cybernetics, October 1969.

15. Elkind, J. I. and Green, D. M., "Measurement of Time Varying and Non-Linear Dynamic Characteristics of Human Pilots", ASD Technical Report 61-225, December 1961.

16. Kalman, R. E. and Bertram, J. E., "Control System Analysis and Design via the Second Method of Lyapunov, Trans. of ASME, June 1960.

17. Bekey, G. A. and Neal, C. B., "Identification of Sampling Intervals in Sampled-Data Models of Human Operators", IEEE Trans. on Man-Machine Systems, December 1968.

18. LaSalle, J. and Lefschetz, S., "Stability by Lyapunov's Direct Method With Applications", Academic Press, Inc., 1961.

19. Rang, E. R., "Adaptive Controllers Derived by Stability Considerations" Minneapolis Honeywell Regulator Co., Memorandum MR 7905, May 9, 1962.

20. Phatak, A. V. and Bekey, G. E., "Model of the Adaptive Behavior of The Human Behavior Change in Control Situation" IEEE Trans. on Man-Machine Systems, Dec. 1968.

21. Grayson, L. P., "The Status of Synthesis Using Liapunov's Method", Automatica, Vol. 3, pp. 91-121, Pergamon Press, 1965. Printed in Great Britain.

22. Grayson, L. P., "The Design of Non-Linear and Adaptive Controllers Via Liapunov's Second Method", Microwave Research Institute, Polytechnic Institute of Brooklyn, Research Report No. PIBMRI-937-61 July 1961.

23. Bekey, G. A., Meissinger, H. F. and Rose, R. E., "A Study of Model Matching Techniques for The Determination of Parameters in Human Model", Langley Research Center, May 1964.

24. Philipson, P. H., "Concerning Liapunov Redesign of Model-Reference Adaptive Control Systems", IEEE Trans. Automatic Control, Vol. AC-12 p. 625, October 1967.

25. Philipson, P. H., "Design Methods for Model-Reference Adaptive Systems", Proc. Inst. Mechanical Engineers, Part I, Vol. 183, 1968/1969.

26. Winsor, C. A. and Roy, R. J., "Design of Model Reference Adaptive Control Systems by Lyapunov's Second Method", IEEE Trans. Automatic Control, Vol. AC-13, p. 204, April 1968.

27. Gilbert, J. W., Monopoli, R. V. and Price, C. F., "Improved Convergence and Increased Flexibility in the Design of Model-Reference Adaptive Control System", Proc. 1970 Symp. Adaptive Processes Decision and Control, 1970.

28. Shahein, H. I. H, Ghonainy, M. A. R. and Shen, D. W. C., "Accelerated Model Reference Adaptation Via Liapunov and Steepest Descent Design Techniques", IEEE Trans. Automatic Control, Vol. AC-17, P. 125, February 1972.

29. Mekel, R., "Synthesis of Corrective Dynamics for Human Operator Models in Closed-Loop Control System", NASA, LWP-816, October 1969.

30. Mekel, R., "An Adaptive Modeling Technique Using a Class of Liapunov Functions", Proc. of the 1972 International Conference on Cybernetics and Society, October 9-12, 1972, Washington, D. C.

31. Lindorff, D. P. and Carroll, R. L., "Survey of Adaptive Control Using Liapunov Design", Proc. of the 1972 International Conference on Cybernetics and Society, October 9-12, 1972, Washington, D. C.

32. Mekel, R., "Adaptive Identification of Parameters In Models of Physiological Systems", Proc. 8th Annual Conference on Manual Control, Ann Arbor, Michigan, May 17-19, 1972.

9. APPENDIX A

This appendix gives the detailed forms of matrices and vectors used to derive the mathematical model in the controllable form.

$$A = \begin{vmatrix} 0 & 1 & 0 & \cdots & 0 \\ 0 & 0 & 1 & \cdots & 0 \\ \cdot & \cdot & \cdot & & \cdot \\ \cdot & \cdot & \cdot & & \cdot \\ \cdot & \cdot & \cdot & & \cdot \\ -a_1 & -a_2 & -a_3 & \cdots & -a_n \end{vmatrix} \qquad \text{(A-1)}$$

$$B = \begin{vmatrix} 0 & 1 & 0 & \cdots & 0 \\ 0 & 0 & 1 & \cdots & 0 \\ \cdot & \cdot & \cdot & & \cdot \\ \cdot & \cdot & \cdot & & \cdot \\ \cdot & \cdot & \cdot & & \cdot \\ -b_1 & -b_2 & -b_3 & \cdots & -b_n \end{vmatrix} \qquad \text{(A-2)}$$

$$H = \begin{vmatrix} 0 & 0 & 0 & \cdots & 0 \\ 0 & 0 & 0 & \cdots & 0 \\ \cdot & \cdot & \cdot & & \cdot \\ \cdot & \cdot & \cdot & & \cdot \\ \cdot & \cdot & \cdot & & \cdot \\ h_1 & h_2 & h_3 & \cdots & h_n \end{vmatrix} \qquad \text{(A-3)}$$

$$C = \begin{vmatrix} 0 & 0 & 0 & \cdots & 0 \\ 0 & 0 & 0 & \cdots & 0 \\ \cdot & \cdot & \cdot & & \cdot \\ \cdot & \cdot & \cdot & & \cdot \\ \cdot & \cdot & \cdot & & \cdot \\ c_1 & c_2 & c_3 & \cdots & c_n \end{vmatrix} \qquad \text{(A-4)}$$

$$\dot{\underline{z}} = \begin{vmatrix} \dot{z}_1 \\ \dot{z}_2 \\ \dot{z}_3 \\ \cdot \\ \cdot \\ \cdot \\ \dot{z}_n \end{vmatrix} \quad \text{(A-5)} \qquad \underline{z} = \begin{vmatrix} z_1 \\ z_2 \\ z_3 \\ \cdot \\ \cdot \\ \cdot \\ z_n \end{vmatrix} \qquad \text{(A-6)}$$

$$\dot{\underline{x}} = \begin{vmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \\ \cdot \\ \cdot \\ \cdot \\ \dot{x}_n \end{vmatrix} \quad \text{(A-7)} \qquad x = \begin{vmatrix} x_1 \\ x_2 \\ x_3 \\ \cdot \\ \cdot \\ \cdot \\ x_n \end{vmatrix} \qquad \text{(A-8)}$$

where $z = z_1$ and $x = x_1$

$\dot{z}_1 = z_2$ $\dot{x}_1 = x_2$

$\dot{z}_2 = z_3$ $\dot{x}_2 = x_3$

etc. etc.

$$\dot{\underline{e}} = \begin{vmatrix} \dot{e}_1 \\ \dot{e}_2 \\ \dot{e}_3 \\ \cdot \\ \cdot \\ \cdot \\ \dot{e}_n \end{vmatrix} \quad \text{(A-9)} \qquad e = \begin{vmatrix} e_1 \\ e_2 \\ e_3 \\ \cdot \\ \cdot \\ \cdot \\ e_n \end{vmatrix} = \begin{vmatrix} x_1 - z_1 \\ x_2 - z_2 \\ x_3 - z_3 \\ \cdot \\ \cdot \\ \cdot \\ x_n - z_n \end{vmatrix} \quad \text{(A-10)}$$

where $e = e_1$

$\dot{e}_1 = e_2$

$\dot{e}_2 = e_3$

etc.

$$\underline{b} = \begin{vmatrix} 0 \\ 0 \\ 0 \\ \cdot \\ \cdot \\ \cdot \\ 1 \end{vmatrix} \quad \text{(A-11)} \qquad \underline{d} = \begin{vmatrix} 0 \\ 0 \\ 0 \\ \cdot \\ \cdot \\ \cdot \\ 1 \end{vmatrix} \quad \text{(A-12)} \qquad \underline{r} = \begin{vmatrix} r_1 \\ r_2 \\ r_3 \\ \cdot \\ \cdot \\ \cdot \\ r_n \end{vmatrix} \quad \text{(A-13)}$$

where $r = r_1$

$\dot{r}_1 = r_2$

$\dot{r}_2 = r_3$

etc.

$$\underline{u} = \begin{vmatrix} u_1 \\ u_2 \\ u_3 \\ \cdot \\ \cdot \\ \cdot \\ u_n \end{vmatrix} = \begin{vmatrix} a_1 - b_1 \\ a_2 - b_2 \\ a_3 - b_3 \\ \cdot \\ \cdot \\ \cdot \\ a_n - b_n \end{vmatrix} \qquad \text{(A-14)}$$

$$\underline{w} = \begin{vmatrix} w_1 \\ w_2 \\ w_3 \\ \cdot \\ \cdot \\ \cdot \\ w_n \end{vmatrix} = \begin{vmatrix} c_1 - h_1 \\ c_2 - h_2 \\ c_3 - h_3 \\ \cdot \\ \cdot \\ \cdot \\ c_n - h_n \end{vmatrix} \qquad \text{(A-15)}$$

$$M = \begin{vmatrix} m_{11} & m_{12} & m_{13} & \cdots & m_{1n} \\ m_{12} & m_{22} & m_{23} & \cdots & m_{2n} \\ \cdot & \cdot & \cdot & & \cdot \\ \cdot & \cdot & \cdot & & \cdot \\ \cdot & \cdot & \cdot & & \cdot \\ m_{1n} & m_{2n} & m_{3n} & \cdots & m_{nn} \end{vmatrix} \qquad \text{(A-16)}$$

$$N = \begin{vmatrix} n_{11} & n_{12} & n_{13} & \cdots & n_{1n} \\ n_{12} & n_{22} & n_{23} & \cdots & n_{2n} \\ \cdot & \cdot & \cdot & & \cdot \\ \cdot & \cdot & \cdot & & \cdot \\ \cdot & \cdot & \cdot & & \cdot \\ n_{1n} & n_{2n} & n_{3n} & \cdots & n_{nn} \end{vmatrix} \qquad \text{(A-17)}$$

$$Q = \begin{vmatrix} q_{11} & q_{12} & q_{13} & \cdot & \cdot & \cdot & q_{1n} \\ q_{12} & q_{22} & q_{23} & \cdot & \cdot & \cdot & q_{2n} \\ \cdot & \cdot & \cdot & & & & \cdot \\ \cdot & \cdot & \cdot & & & & \cdot \\ \cdot & \cdot & \cdot & & & & \cdot \\ q_{1n} & q_{2n} & q_{3n} & \cdot & \cdot & \cdot & q_{nn} \end{vmatrix} \qquad \text{(A-18)}$$

$$\underline{\dot{u}} = \begin{vmatrix} \dot{u}_1 \\ \dot{u}_2 \\ \dot{u}_3 \\ \cdot \\ \cdot \\ \cdot \\ \dot{u}_n \end{vmatrix} = \begin{vmatrix} -\dot{b}_1 \\ -\dot{b}_2 \\ -\dot{b}_3 \\ \cdot \\ \cdot \\ \cdot \\ -\dot{b}_n \end{vmatrix} \qquad \text{(A-19)} \qquad \underline{\dot{w}} = \begin{vmatrix} \dot{w}_1 \\ \dot{w}_2 \\ \dot{w}_3 \\ \cdot \\ \cdot \\ \cdot \\ \dot{w}_n \end{vmatrix} = \begin{vmatrix} \dot{c}_1 \\ \dot{c}_2 \\ \dot{c}_3 \\ \cdot \\ \cdot \\ \cdot \\ \dot{c}_n \end{vmatrix} \qquad \text{(A-20)}$$

$$B_o = \begin{vmatrix} 0 & 1 & 0 & \cdot & \cdot & \cdot & 0 \\ 0 & 0 & 1 & \cdot & \cdot & \cdot & 0 \\ \cdot & \cdot & \cdot & & & & \cdot \\ \cdot & \cdot & \cdot & & & & \cdot \\ \cdot & \cdot & \cdot & & & & \cdot \\ -b_{10} & -b_{20} & -b_{30} & \cdot & \cdot & \cdot & -b_{no} \end{vmatrix} \qquad \text{(A-21)}$$

$$C_o = \begin{vmatrix} 0 & 0 & 0 & \cdot & \cdot & \cdot & 0 \\ 0 & 0 & 0 & \cdot & \cdot & \cdot & 0 \\ \cdot & \cdot & \cdot & & & & \cdot \\ \cdot & \cdot & \cdot & & & & \cdot \\ \cdot & \cdot & \cdot & & & & \cdot \\ c_{10} & c_{20} & c_{30} & \cdot & \cdot & \cdot & c_{no} \end{vmatrix} \qquad \text{(A-22)}$$

$$D_1 = \begin{vmatrix} d_{11} & d_{12} & d_{13} & \cdot & \cdot & \cdot & d_{1n} \\ d_{21} & d_{22} & d_{23} & \cdot & \cdot & \cdot & d_{2n} \\ \cdot & \cdot & \cdot & & & & \cdot \\ \cdot & \cdot & \cdot & & & & \cdot \\ \cdot & \cdot & \cdot & & & & \cdot \\ d_{n1} & d_{n2} & d_{n3} & \cdot & \cdot & \cdot & d_{nn} \end{vmatrix} \qquad \text{(A-23)}$$

$$D_2 = \begin{vmatrix} d_{11} & d_{12} & d_{13} & \cdot & \cdot & \cdot & d_{1n} \\ d_{12} & d_{22} & d_{23} & \cdot & \cdot & \cdot & d_{2n} \\ \cdot & \cdot & \cdot & & & & \cdot \\ \cdot & \cdot & \cdot & & & & \cdot \\ \cdot & \cdot & \cdot & & & & \cdot \\ d_{1n} & d_{2n} & d_{3n} & \cdot & \cdot & \cdot & d_{nn} \end{vmatrix} \qquad \text{(A-24)}$$

or

$$D_2 = \begin{vmatrix} d_{11} & 0 & 0 & \cdot & \cdot & \cdot & 0 \\ 0 & d_{22} & 0 & \cdot & \cdot & \cdot & 0 \\ \cdot & \cdot & \cdot & & & & \cdot \\ \cdot & \cdot & \cdot & & & & \cdot \\ \cdot & \cdot & \cdot & & & & \cdot \\ 0 & 0 & 0 & \cdot & \cdot & \cdot & d_{nn} \end{vmatrix} \qquad \text{(A-25)}$$

Additional Information

$z = z(t)$ represents the reference system's scalar response (measurable). It is the stick output.

$x = x(t)$ represents the mathematical model system's scalar response (measurable).

$e = e(t)$ represents the model-reference composite system's scalar error (measurable).

$y = y(t)$ represents the plant's scalar response (measurable)

$\underline{u} = \underline{u}(t)$ and $\underline{w} = \underline{w}(t)$ represent the parameter misalignment vectors.

$r = r(t)$ represents the scalar stimulus.

$\dot{M} = dM/dt$

$\dot{N} = dN/dt$

$\dot{Q} = dQ/dt$

$\dot{\underline{u}} = d\underline{u}/dt$

$\dot{\underline{w}} = d\underline{w}/dt$

10. APPENDIX B

This appendix gives the detailed forms of matrices and vectors used to derive the mathematical model in the observable form.

$$A = \begin{vmatrix} -a_{n-1} & 1 & 0 & \cdots & 0 \\ -a_{n-2} & 0 & 1 & \cdots & 0 \\ \vdots & \vdots & \vdots & & \vdots \\ -a_1 & 0 & 0 & \cdots & 1 \\ -a_o & 0 & 0 & \cdots & 0 \end{vmatrix} \qquad \text{(B-1)}$$

$$H = \begin{vmatrix} -h_{n-1} & 1 & 0 & \cdots & 0 \\ -h_{n-2} & 0 & 1 & \cdots & 0 \\ \vdots & \vdots & \vdots & & \vdots \\ -h_1 & 0 & 0 & \cdots & 1 \\ -h_o & 0 & 0 & \cdots & 0 \end{vmatrix} \qquad \text{(B-2)}$$

$$\underline{b} = \begin{vmatrix} b_{n-1} \\ b_{n-2} \\ \vdots \\ b_1 \\ b_o \end{vmatrix} \qquad \text{(B-3)} \qquad \underline{g} = \begin{vmatrix} g_{n-1} \\ g_{n-2} \\ \vdots \\ g_1 \\ g_o \end{vmatrix} \qquad \text{(B-4)}$$

$$\dot{\underline{z}} = \begin{vmatrix} \dot{z}_1 \\ \dot{z}_2 \\ \cdot \\ \cdot \\ \cdot \\ \dot{z}_{n-1} \\ \dot{z}_n \end{vmatrix} \quad (B\text{-}5) \qquad \underline{z} = \begin{vmatrix} z_1 \\ z_2 \\ \cdot \\ \cdot \\ \cdot \\ z_{n-1} \\ z_n \end{vmatrix} \quad (B\text{-}6)$$

$$\dot{\underline{x}} = \begin{vmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \cdot \\ \cdot \\ \cdot \\ \dot{x}_{n-1} \\ \dot{x}_n \end{vmatrix} \quad (B\text{-}7) \qquad \underline{x} = \begin{vmatrix} x_1 \\ x_2 \\ \cdot \\ \cdot \\ \cdot \\ x_{n-1} \\ x_n \end{vmatrix} \quad (B\text{-}8)$$

$$\dot{\underline{e}} = \begin{vmatrix} \dot{e}_1 \\ \dot{e}_2 \\ \cdot \\ \cdot \\ \cdot \\ \dot{e}_{n-1} \\ \dot{e}_n \end{vmatrix} \quad (B\text{-}9) \qquad \underline{e} = \begin{vmatrix} e_1 \\ e_2 \\ \cdot \\ \cdot \\ \cdot \\ e_{n-1} \\ e_n \end{vmatrix} \quad (B\text{-}10)$$

where $\underline{x}$ and $\dot{\underline{x}}$ are given by Eqs. (60) and (61) respectively. Vectors $\underline{z}$, $\dot{\underline{z}}$, $\underline{e}$ and $\dot{\underline{e}}$ are obtained in the same manner.

$$\underline{e}^T = \begin{vmatrix} 1 & 0 & \cdot & \cdot & \cdot & 0 & 0 \end{vmatrix} \tag{B-11}$$

$$\underline{u} = \begin{vmatrix} u_{n-1} \\ u_{n-2} \\ \cdot \\ \cdot \\ \cdot \\ u_1 \\ u_o \end{vmatrix} = \begin{vmatrix} -a_{n-1} + h_{n-1} \\ -a_{n-2} + h_{n-2} \\ \cdot \\ \cdot \\ \cdot \\ -a_1 + h_1 \\ -a_o + h_o \end{vmatrix} \tag{B-12}$$

$$\underline{w} = \begin{vmatrix} w_{n-1} \\ w_{n-2} \\ \cdot \\ \cdot \\ \cdot \\ w_1 \\ w_o \end{vmatrix} = \begin{vmatrix} b_{n-1} - g_{n-1} \\ b_{n-2} - g_{n-2} \\ \cdot \\ \cdot \\ \cdot \\ b_1 - g_1 \\ b_o - g_o \end{vmatrix} \tag{B-13}$$

$$M = \begin{vmatrix} m_{11} & m_{12} & m_{13} & \cdot & \cdot & \cdot & m_{1n} \\ m_{12} & m_{22} & m_{23} & \cdot & \cdot & \cdot & m_{2n} \\ \cdot & \cdot & \cdot & & & & \cdot \\ \cdot & \cdot & \cdot & & & & \cdot \\ \cdot & \cdot & \cdot & & & & \cdot \\ m_{1n} & m_{2n} & m_{3n} & \cdot & \cdot & \cdot & m_{nn} \end{vmatrix} \tag{B-14}$$

$$N = \begin{vmatrix} n_{11} & 0 & 0 & \cdots & 0 \\ 0 & n_{22} & 0 & \cdots & 0 \\ \cdot & \cdot & \cdot & & \cdot \\ \cdot & \cdot & \cdot & & \cdot \\ \cdot & \cdot & \cdot & & \cdot \\ 0 & 0 & 0 & \cdots & n_{nn} \end{vmatrix} \qquad \text{(B-15)}$$

$$Q = \begin{vmatrix} q_{11} & 0 & 0 & \cdots & 0 \\ 0 & q_{22} & 0 & \cdots & 0 \\ \cdot & \cdot & \cdot & & \cdot \\ \cdot & \cdot & \cdot & & \cdot \\ \cdot & \cdot & \cdot & & \cdot \\ 0 & 0 & 0 & \cdots & q_{nn} \end{vmatrix} \qquad \text{(B-16)}$$

$$\underline{\dot{u}} = \begin{vmatrix} \dot{u}_{n-1} \\ \dot{u}_{n-2} \\ \cdot \\ \cdot \\ \cdot \\ \dot{u}_1 \\ \dot{u}_o \end{vmatrix} = \begin{vmatrix} \dot{h}_{n-1} \\ \dot{h}_{n-2} \\ \cdot \\ \cdot \\ \cdot \\ \dot{h}_1 \\ \dot{h}_o \end{vmatrix} \qquad \text{(B-17)}$$

$$\underline{\dot{w}} = \begin{vmatrix} \dot{w}_{n-1} \\ \dot{w}_{n-2} \\ \cdot \\ \cdot \\ \cdot \\ \dot{w}_1 \\ \dot{w}_o \end{vmatrix} = \begin{vmatrix} -\dot{g}_{n-1} \\ -\dot{g}_{n-2} \\ \cdot \\ \cdot \\ \cdot \\ -\dot{g}_1 \\ -\dot{g}_o \end{vmatrix} \qquad \text{(B-18)}$$

$$H_o = \begin{vmatrix} -h_{(n-1)o} & 1 & 0 & \cdots & 0 \\ -h_{(n-2)o} & 0 & 1 & \cdots & 0 \\ \vdots & \vdots & \vdots & & \vdots \\ -h_{10} & 0 & 0 & \cdots & 0 \\ -h_{oo} & 0 & 0 & \cdots & 0 \end{vmatrix} \qquad \text{(B-19)}$$

$$g_o = \begin{vmatrix} g_{(n-1)o} \\ g_{(n-2)o} \\ \vdots \\ g_{10} \\ g_{oo} \end{vmatrix} \qquad \text{(B-20)}$$

$$D_3 = \begin{vmatrix} d_{11} & d_{12} & d_{13} & \cdots & d_{1n} \\ d_{21} & d_{22} & d_{23} & \cdots & d_{2n} \\ \vdots & \vdots & \vdots & & \vdots \\ d_{n1} & d_{n2} & d_{n3} & \cdots & d_{nn} \end{vmatrix} \qquad \text{(B-21)}$$

$$D_4 = \begin{vmatrix} d_{11} & d_{12} & d_{13} & \cdot & \cdot & \cdot & d_{1n} \\ d_{12} & d_{22} & d_{23} & \cdot & \cdot & \cdot & d_{2n} \\ \cdot & \cdot & \cdot & & & & \cdot \\ \cdot & \cdot & \cdot & & & & \cdot \\ \cdot & \cdot & \cdot & & & & \cdot \\ d_{1n} & d_{2n} & d_{3n} & \cdot & \cdot & \cdot & d_{nn} \end{vmatrix} \qquad \text{(B-22)}$$

or

$$D_4 = \begin{vmatrix} d_{11} & 0 & 0 & \cdot & \cdot & \cdot & 0 \\ 0 & d_{22} & 0 & \cdot & \cdot & \cdot & 0 \\ \cdot & \cdot & \cdot & & & & \cdot \\ \cdot & \cdot & \cdot & & & & \cdot \\ \cdot & \cdot & \cdot & & & & \cdot \\ 0 & 0 & 0 & \cdot & \cdot & \cdot & d_{nn} \end{vmatrix} \qquad \text{(B-23)}$$

Additional Information

$z = z(t)$ represents the reference system's scalar response (measurable). It is the stick output.

$x = x(t)$ represents the mathematical model system's scalar response (measurable).

$e = e(t)$ represents the model-reference composite system's scalar error (measurable).

$y = y(t)$ represents the plant's scalar response (measurable).

$\underline{u} = \underline{u}(t)$ and $\underline{w} = \underline{w}(t)$ represent the parameter misalignment vectors.

$r = r(t)$ represents the scalar stimulus.

$\dot{M} = dM/dt$

$\dot{N} = dN/dt$

$\dot{Q} = dQ/dt$

$\dot{\underline{u}} = d\underline{u}/dt$

$\dot{\underline{w}} = d\underline{w}/dt$

11. FIGURES

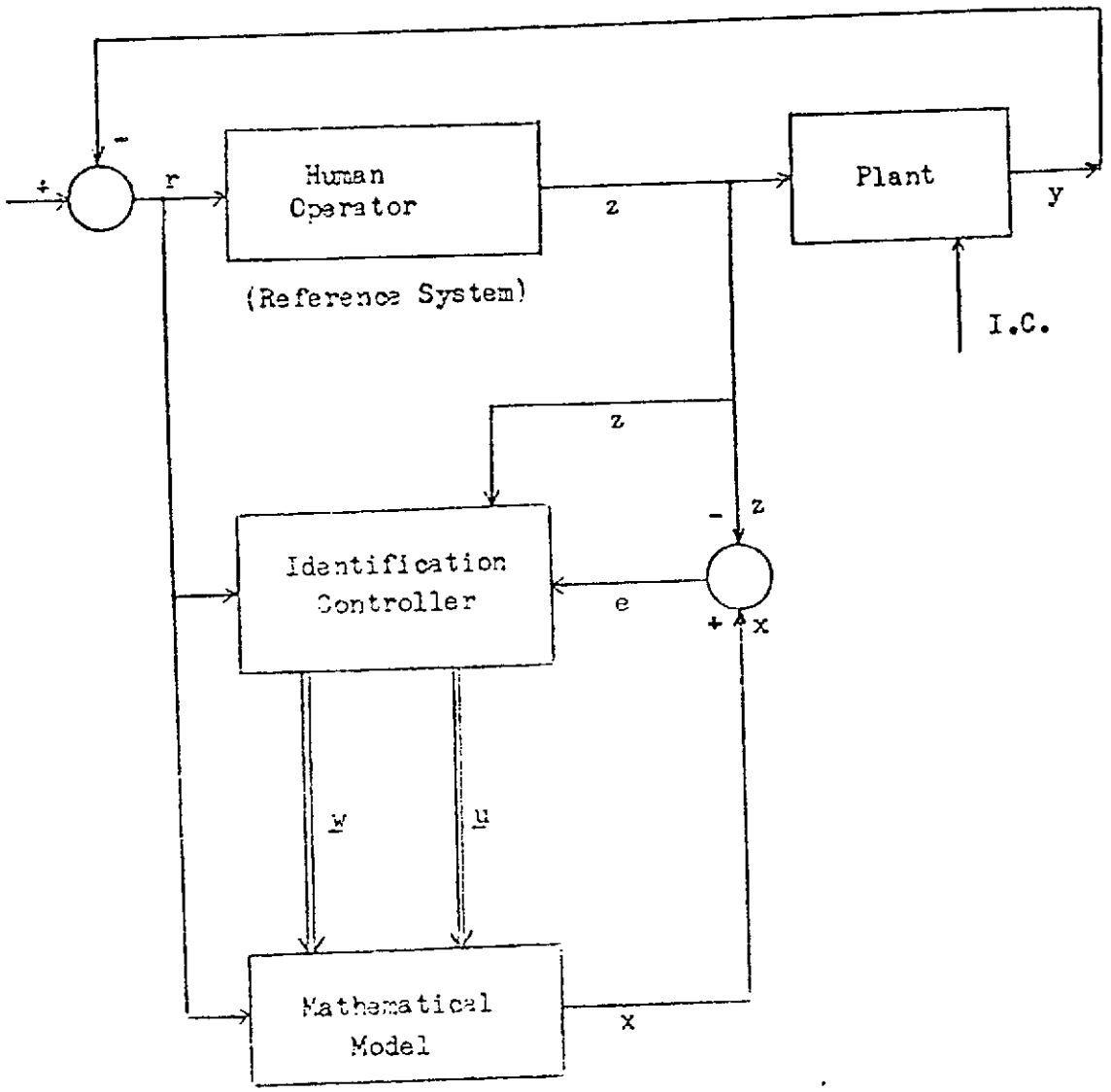

FIG. 1. Model - Reference System Configuration with Human Operator's Response Applied to Controller and $e = x - z$

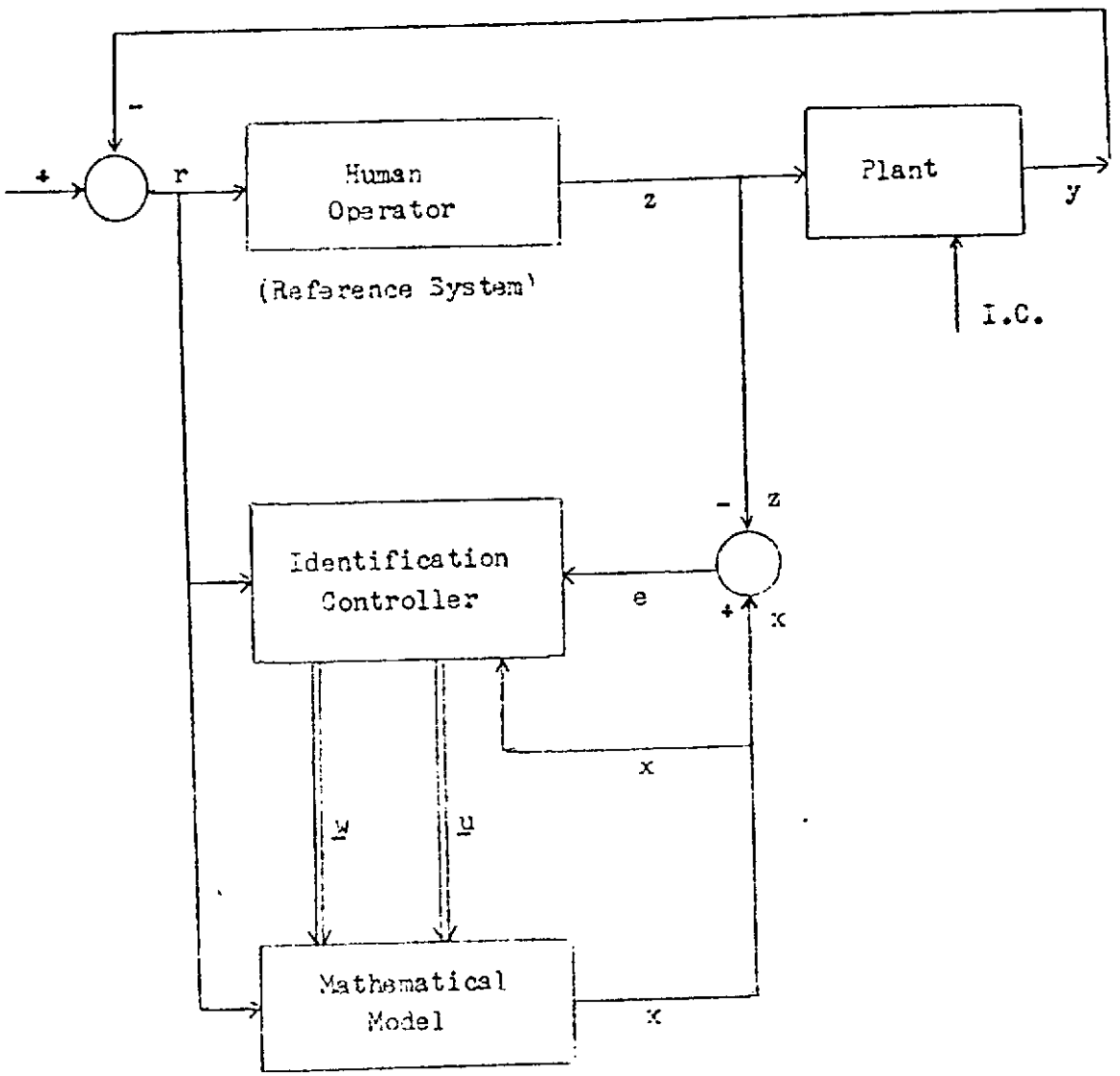

FIG. 2. Model - Reference System Configuration with Mathematical Model's Response Applied to Controller and e = x - z

Note: To realize the mathematical model in the observable form define e = z - x

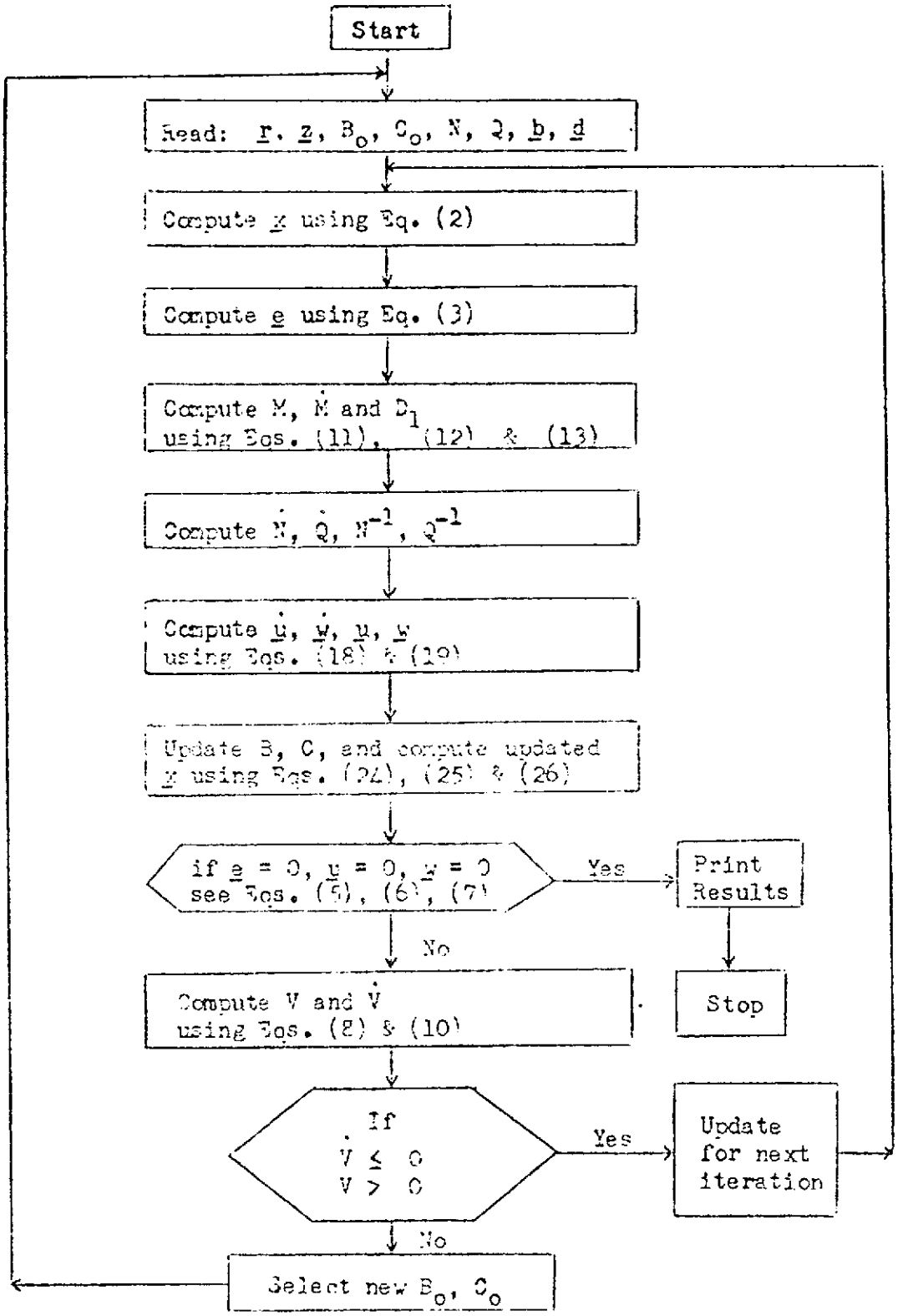

FIG. 3. Logic Flow Diagram - Nonlinear Model in Controllable Form

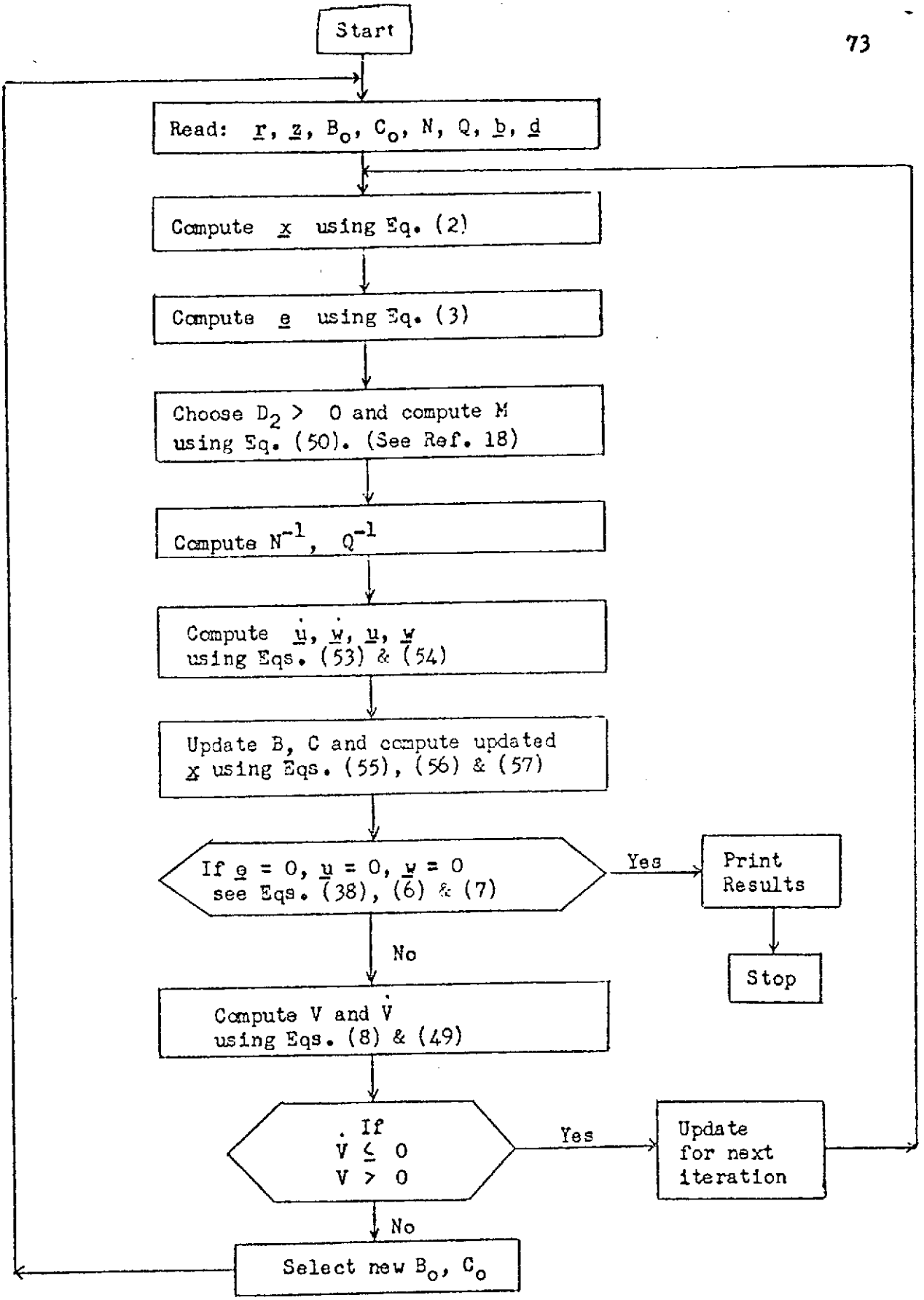

FIG. 4. Logic Flow Diagram - Linear Model in Controllable Form

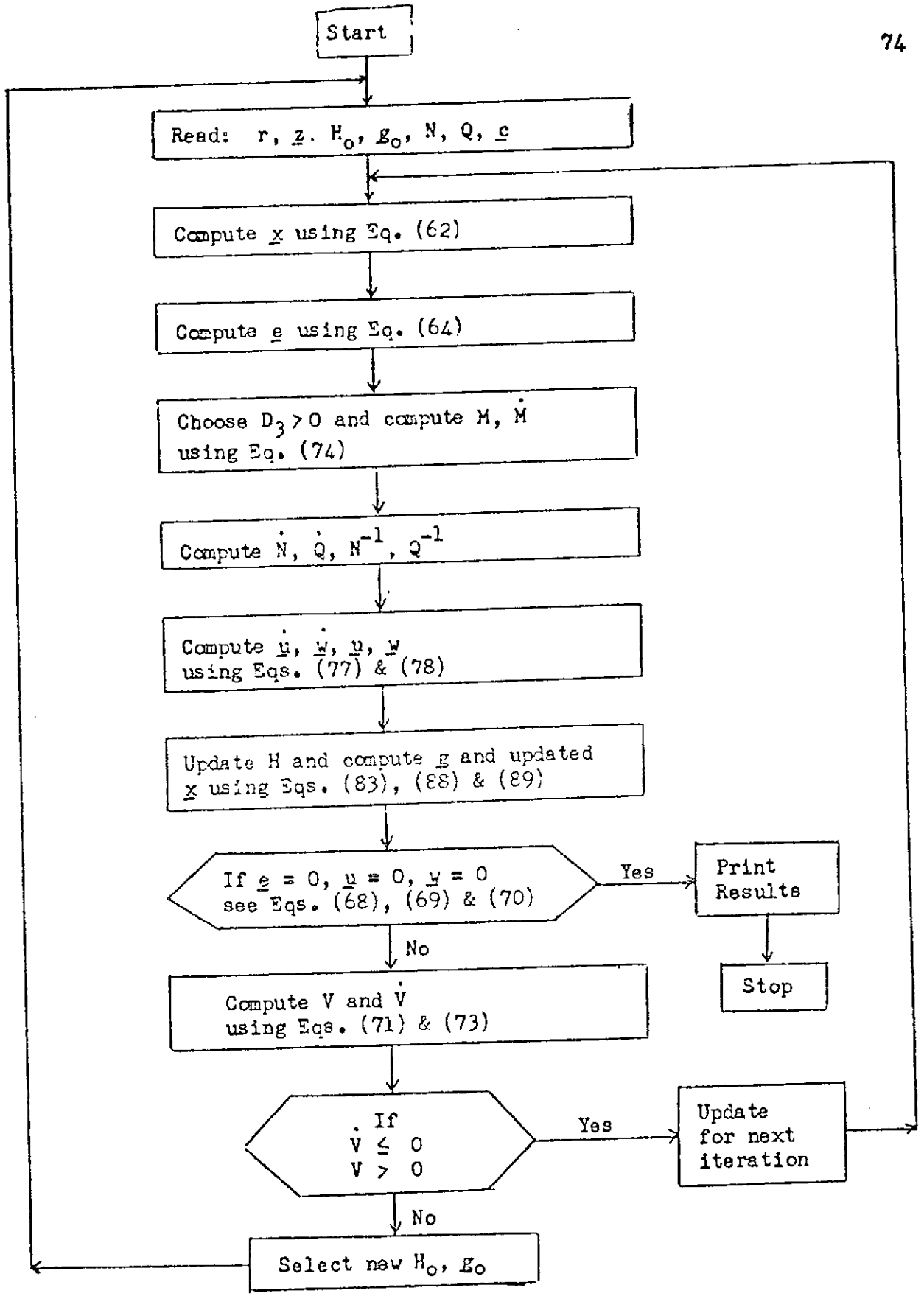

FIG. 5. Logic Flow Diagram - Nonlinear Model in Observable Form

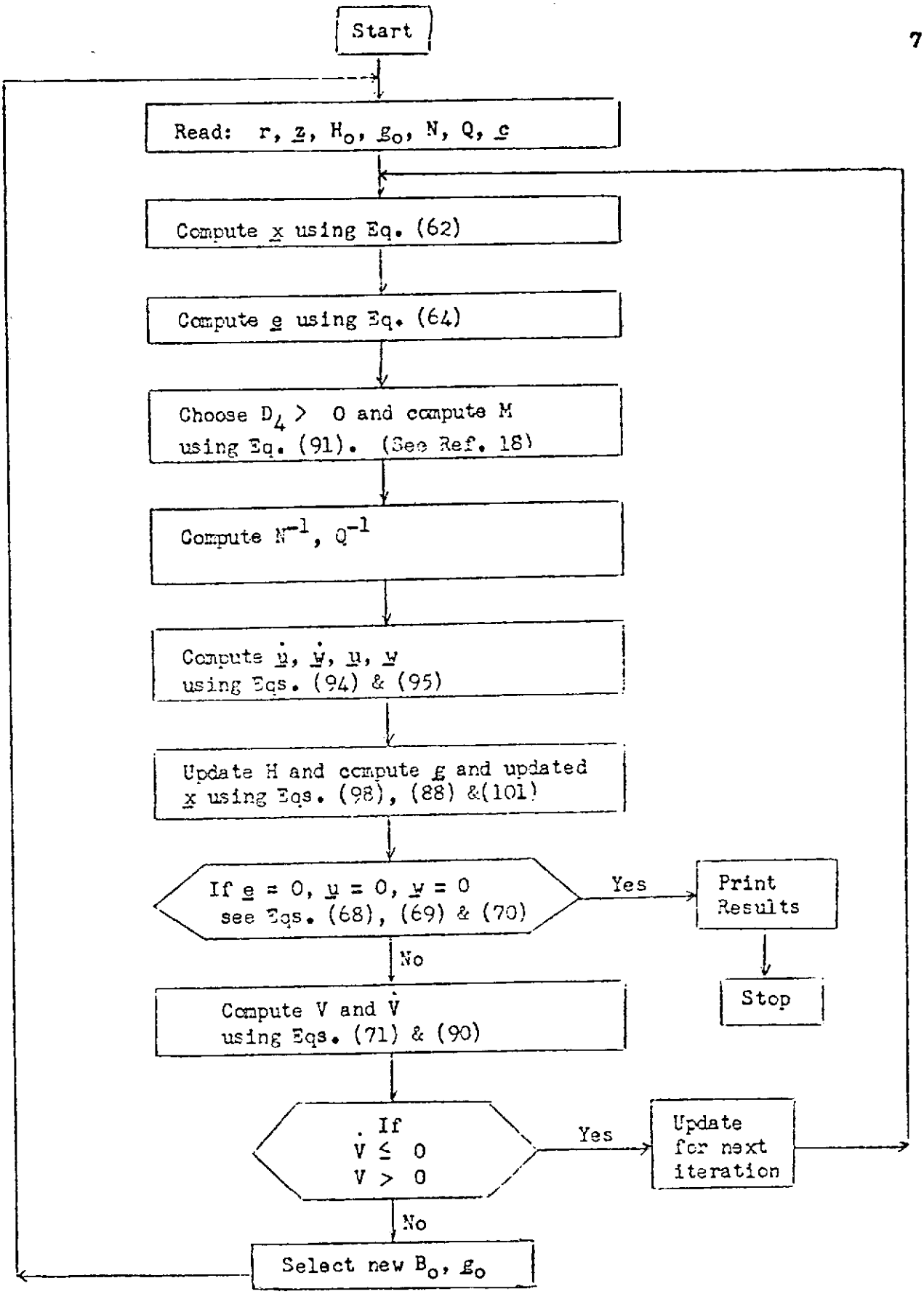

FIG. 6. Logic Flow Diagram - Linear Model in Observable Form

12. DIGITAL COMPUTER RESULTS

```
FORTRAN IV G LEVEL 20    MAIN    DATE = 72313    13/49/02    PAGE 0001

0001          REAL  IN1,IN2
0002          DATA Z1,Z2,Y1,Y2/0.,0.,0.,0./
0003          DATA R1,R2/0.,0./
0004          REWIND 9
0005          READ(5,1000)A1,A2,H1,H2
0006          WRITE(6,1000)A1,A2,H1,H2
0007     1000 FORMAT(4G10.3)
0008          DT=1.E-4
0009          C=3.0
              C              ------    INPUT SIGNAL    ----------
0010          IN1=1.0
0011          DO 100 J=1,200000
0012          R10=R1
0013          R1=IN1-Y1
0014          R2=(R1-R10)/DT
              C ---------------------- REFERENCE SYSTEM OUTPUT ----------------------------
0015          Z20=-A1*Z1-A2*Z2+H1*R1+H2*R2
0016          Z2=Z2+DT*Z20
0017          Z1=Z1+DT*Z2
              C                ----    OUTPUT LIMITER AND DOUBLE INTEGRATOR --------
0018          IF(ABS(Z1).LT.1..OR.ABS(Z1).GT..01)GO TO 2500
0019          IF(ABS(Z1).GT.1.) ZL=SIGN(1.,Z1)
0020          IF(ABS(Z1).LT..01) ZL=0.0
0021          GO TO 2501
0022     2500 ZL=Z1
0023     2501 Y2=Y2+(C*ZL)*DT
0024          Y1=Y1+(C*Y2)*DT
0025        2 FORMAT(I6,6E15.7)
0026          WRITE(9,2)J,R1,R2,Z1,Z2,Y1,Y2
0027          IF(MOD(J,2000).EQ.0)WRITE(6,2)J,R1,R2,Z1,Z2,Y1,Y2
0028      100 CONTINUE
0029          END FILE 9
0030          REWIND 9
0031          STOP
0032          END
```

```
0001          IMPLICIT REAL(M,N)
0002          INTEGER MOD
0003          DIMENSION JOT(320)
0004          DATA X1,X2,Z1,Z2/0.,0.,0.,0./
0005          DATA R1,R2/0.,0./
0006          DATA Y1,Y2/0.,0./
0007          REWIND 15
C                    -------  INPUT OF REFERENCE, MODEL AND MATRIX  PARAMETERS  --------
0008          READ(5,1000)B1,B2,C1,C2
0009          READ(5,1001)M11,M22,M12
0010          READ(5,1000)N11,N22,Q11,Q22
0011          READ(5,1002)DT
0012          READ(5,26)JOT
C  SIXTEEN CARDS FOR COMMENT MUST BE PLACED AT DATA'S END PLUS 2 BLANKS
0013          N12=SQRT(.8*N11*N22)
0014          Q12=SQRT(.9*Q11*Q22)
C
C ------------------------ CHECK OF COMPUTER READING ------------------------
0015          WRITE(6,20)B1,B2,C1,C2
0016          WRITE(6,23)DT
0017          WRITE(6,25)M11,M22,M12
0018          WRITE(6,21)N11,N22,N12,Q11,Q22,Q12
0019          WRITE(6,26)JOT
0020          WRITE(6,22)
0021          T=0.
0022          DO 100 J=1,100000
C
C ------------------  PRINT OUT  ---------------------
0023          IF(.NOT.(J.EQ.1.OR.MOD(J,200).EQ.0))GO TO 50
0024          IF(MOD(J,11200).EQ.0)WRITE(6,22)
0025          WRITE(6,30)J,T,B1,B2,X1,Z1,X2,Z2,Y1,Y2
0026       30 FORMAT(I2,I5,9(2X,1PE10.3))
0027       22 FORMAT('1CYCLE',T11,'TIME',T25,'B1',T37,'B2',T49,'X1',T61,'Z1',T73
          1,'X2',T85,'Z2',T97,'Y1',T109,'Y2'//)
0028          50 CONTINUE
C
0029          T=T+DT
C
C ------------------  READING THE DATA TAPE  ---------------------
0030          READ(15,2)J,R1,R2,Z1,Z2,Y1,Y2
0031        2 FORMAT(I6,6E15.7)
C
C                -----   MODEL SYSTEM STATE EQUATIONS   ----------
C
0032          X2D=-B1*X1-B2*X2+C1*R1+C2*R2
0033          X2=X2+DT*X2D
0034          X1=X1+DT*X2
C
C ------------------  ADJUSTMENT CALCULATIONS  ---------------------
C
0035          E1=X1-Z1
0036          E2=X2-Z2
0037          S0=(M12*E1+M22*E2)/(N11*N22-N12**2)
0038          A2D=S0*(N22*X1-N12*X2)
0039          B2D=S0*(N11*X2-N12*X1)
0040          B1=B1+DT*B1D
0041          B2=B2+DT*B2D
```

```
0043          20 FORMAT('1 LYAPUNOV STABILITY MODELING OF SECOND ORDER SYSTEM'////
                1' STARTING PRAMETERS OF THE MODEL SYSTEM...'//T10,'B1= ',1PE10.3,T
                230,'B2= ',E10.3,T60,'C1= ',E10.3,T80,'C2= ',E10.3///)
0044          21 FORMAT(' MATRIX ELEMENTS.....'//' N11= ',1PE10.3,10X,'N22= ',E10.
                13,10X,'N12= ',E10.3/' Q11= ',E10.3,10X,'Q22= ',E10.3,10X,'Q12= ',E
                210.3////)
0045          23 FORMAT(' DELTA T= ',1PE10.3//)
0046          25 FORMAT(' M MATRIX.....'//' M11= ',1PE10.3,10X,'M22= ',E10.3,10X,'
                1M12= ',E10.3//)
0047          26 FORMAT(16(20A4/)//)
0048        1000 FORMAT(4G10.3)
0049        1001 FORMAT(3G10.3)
0050        1002 FORMAT(G10.3)
0051             STOP
0052             END
```

LYAPUNOV STABILITY MODELING OF SECOND ORDER SYSTEM

STARTING PRAMETERS OF THE MODEL SYSTEM...

B1= 5.000E 01 B2= 5.00CE 01 C1= 1.870E 02 C2= 1.020E 02

DELTA T= 1.000E-04

M MATRIX.....

M11= 1.000E 02 M22= 2.700E 01 M12= 2.700E 01

MATRIX ELEMENTS.....

N11= 1.00CE 00 N22= 1.0CCE 00 N12= 8.944E-01
Q11= 1.00CE 00 Q22= 1.CCCE 00 Q12= 9.487E-01

COMMENTS.....

CYCLE	TIME	B1	B2	X1	Z1	X2	Z2	Y1	Y2
1	0.0	5.000E C1	5.000E 01	0.0	0.0	0.0	0.0	0.0	C.0
200	1.990E-02	5.458E 01	4.504E C1	1.664E 00	1.664E 00	6.657E 01	6.702E 01	1.109E-03	5.339E-02
400	3.990E-02	5.736E 01	4.2 CCE 01	2.731E 00	2.730E 00	4.167E 01	4.119E 01	8.051E-03	1.880E-01
600	5.990E-02	5.65CE C1	4.327E 01	3.353E 00	3.350E 00	2.208E 01	2.197E 01	2.470E-02	3.724E-01
800	7.989E-02	6.772E C1	2.988E C1	3.635E 00	3.640E 00	8.114E 00	7.742E 00	5.332E-02	5.835E-01
1000	9.988E-C2	7.333E 01	2.724E C1	3.710E 00	3.682E 00	-3.722E-02	-2.900E 00	9.497E-02	8.043E-C1
1200	1.199E-C1	1.269E 02	-2.629E 01	3.624E 00	3.540E 00	-1.036E 01	-1.087E 01	1.498E-01	1.022E 00
1400	1.399E-01	6.776E 01	3.725E C1	3.319E 00	3.250E 00	-1.443E 01	-1.680E 01	2.174E-01	1.226E C0
1600	1.599E-C1	5.986E 01	4.652E C1	2.938E 00	2.878E 00	-2.189E 01	-2.115E C1	2.966E-01	1.411E 00
1800	1.798E-C1	6.843E C1	3.749E 01	2.487E 00	2.422E 00	-2.574E 01	-2.422E C1	3.862E-01	1.570E 00
2000	1.998E-01	6.981E C1	3.615E C1	1.981E 00	1.916E 00	-2.744E 01	-2.625E 01	4.844E-01	1.700E 00
2200	2.198E-C1	6.928E 01	3.685E C1	1.442E 00	1.378E 00	-2.794E 01	-2.740E 01	5.896E-01	1.799E 00
2400	2.398E-C1	7.067E 01	3.538E C1	8.889E-01	8.250E-01	-2.777E 01	-2.779E 01	6.996E-01	1.865E 00
2600	2.598E-C1	7.308E 01	3.276E 01	3.343E-01	2.707E-01	-2.725E 01	-2.754E C1	8.127E-01	1.897E 00
2800	2.798E-01	7.448E C1	3.124E 01	-2.098E-01	-2.727E-01	-2.645E 01	-2.672E 01	9.267E-01	1.897E 00
3000	2.998E-01	7.478E C1	3.094E 01	-7.328E-01	-7.945E-01	-2.539E 01	-2.540E 01	1.040E 00	1.865E 00
3200	3.198E-01	7.645E 01	2.908E C1	-1.225E 00	-1.285E 00	-2.404E 01	-2.365E 01	1.150E C0	1.802E C0
3400	3.398E-01	8.142E 01	2.345E C1	-1.675E 00	-1.738E 00	-2.201E 01	-2.154E 01	1.255E 00	1.711E C0
3600	3.598E-C1	8.068E 01	2.425E C1	-2.084E 00	-2.145E 00	-1.901E 01	-1.913E C1	1.354E 00	1.594E 00
3800	3.798E-01	7.444E 01	3.147E 01	-2.445E 00	-2.501E 00	-1.663E 01	-1.648E 01	1.446E 00	1.454E 00
4000	3.998E-01	7.630E 01	2.928E C1	-2.746E 00	-2.802E 00	-1.376E 01	-1.366E 01	1.528E 00	1.295E C0
4200	4.197E-01	7.117E 01	3.542E C1	-2.996E 00	-3.046E 00	-1.107E 01	-1.070E 01	1.601E 00	1.119E 00
4400	4.397E-C1	6.645E 01	4.130E 01	-3.187E 00	-3.230E 00	-8.108E 00	-7.682E C0	1.662E 00	9.303E-01
4600	4.597E-01	6.214E C1	4.732E 01	-3.323E 00	-3.353E 00	-5.581E 00	-4.648E C0	1.712E 00	7.325E-01
4800	4.797E-01	6.0C8E C1	5.240E C1	-3.413E 00	-3.415E 00	-3.554E 00	-1.652E 00	1.749E 00	5.291E-01
5000	4.997E-01	6.758E 01	4.930E C1	-3.467E 00	-3.419E 00	-1.877E 00	1.257E C0	1.775E 00	3.238E-01
5200	5.197E-01	9.420E 01	2.727E C1	-3.485E 00	-3.365E 00	1.723E-01	4.034E C0	1.788E 00	1.200E-C1
5400	5.397E-C1	1.399E 02	-1.702E C1	-3.440E 00	-3.258E 00	5.390E 00	6.638E 00	1.789E 00	-7.892E-02
5600	5.597E-01	8.185E 01	4.472E C1	-3.248E 00	-3.101E 00	1.096E 01	9.032E 00	1.779E 00	-2.699E-C1
5800	5.797E-C1	1.187E 02	5.983E 00	-3.068E 00	-2.898E 00	9.293E 00	1.119E 01	1.757E 00	-4.500E-01
6000	5.997E-C1	8.745E C1	3.979E C1	-2.808E 00	-2.655E 00	1.425E 01	1.307E 01	1.725E 00	-6.168E-01
6200	6.197E-01	1.233E 02	1.247E 00	-2.546E 00	-2.377E 00	1.477E 01	1.467E 01	1.683E 00	-7.678E-01
6400	6.397E-C1	9.744E 01	2.933E 01	-2.225E 00	-2.070E 00	1.495E 01	1.597E C1	1.633E 00	-9.013E-01
6600	6.596E-01	9.853E 01	2.826E 01	-1.894E 00	-1.740E 00	1.503E 01	1.695E 01	1.575E 00	-1.016E 00
6800	6.796E-01	1.142E 02	1.109E 01	-1.551E 00	-1.393E 00	1.500E 01	1.762E 01	1.511E 00	-1.110E 00
7000	6.996E-01	1.045E C2	2.173E C1	-1.188E 00	-1.037E 00	1.738E 01	1.797E 01	1.442E C0	-1.182E C0
7200	7.196E-C1	9.813E 01	2.883E C1	-8.221E-01	-6.766E-01	1.829E 01	1.801E 01	1.369E 00	-1.234E C0
7400	7.396E-C1	1.072E 02	1.882E 01	-4.651E-01	-3.186E-01	1.850E 01	1.775E 01	1.294E 00	-1.263E 00
7600	7.596E-C1	1.051E 02	2.114E C1	-1.115E-01	3.151E-02	1.700E 01	1.721E 01	1.218E 00	-1.272E C0
7800	7.796E-01	1.003E C2	2.644E 01	2.302E-01	3.681E-01	1.667E 01	1.641E 01	1.142E 00	-1.259E 00
8000	7.996E-C1	1.055E 02	2.057E 01	5.482E-01	6.861E-01	1.555E 01	1.537E 01	1.067E 00	-1.229E 00
8200	8.196E-01	1.005E C2	2.625E 01	8.489E-01	9.812E-01	1.420E 01	1.411E 01	9.948E-01	-1.177E 00
8400	8.396E-C1	1.038E C2	2.277E C1	1.117E 00	1.247E 00	1.284E 01	1.267E 01	9.261E-01	-1.110E 00
8600	8.596E-C1	1.002E 02	2.664E C1	1.360E 00	1.487E 00	1.129E 01	1.107E 01	8.619E-01	-1.020E C0
8800	8.795E-01	1.003E C2	2.646E 01	1.567E 00	1.691E 00	9.637E 00	9.356E C0	8.030E-01	-9.323E-01
9000	8.995E-C1	9.995E 01	2.692E 01	1.739E 00	1.863E 00	7.784E 00	7.552E 00	7.503E-01	-8.255E-01
9200	9.195E-C1	9.789E C1	2.942E 01	1.877E 00	1.992E 00	6.042E 00	5.693E 00	7.042E-01	-7.097E-01
9400	9.395E-01	9.580E 01	3.209E C1	1.980E 00	2.087E 00	4.208E 00	3.811E 00	6.653E-01	-5.872E-01
9600	9.595E-C1	9.446E 01	3.419E C1	2.049E 00	2.144E 00	2.076E 00	1.939E 00	6.336E-01	-4.600E-01
9800	9.795E-C1	9.534E 01	3.426E 01	2.088E 00	2.165E 00	1.249E 00	1.063E-01	6.101E-01	-3.306E-01
10000	9.995E-01	1.010E C2	2.957E 01	2.099E 00	2.149E 00	-1.110E-01	-1.659E 00	5.942E-01	-2.010E-01
10200	1.019E C0	1.133E 02	1.779E C1	2.081E 00	2.098E 00	-1.794E 00	-3.329E 00	5.860E-01	-7.340E-02
10400	1.039E 00	1.263E 02	4.543E 00	2.020E 00	2.016E 00	-4.548E 00	-4.882E 00	5.853E-01	5.018E-02
10600	1.059E 00	1.135E 02	1.819E 01	1.896E 00	1.904E 00	-7.429E 00	-6.296E 00	5.919E-01	1.679E-01
10800	1.079E 00	1.030E 02	2.945E 01	1.748E 00	1.765E 00	-7.084E 00	-7.553E 00	6.054E-01	2.781E-01
11000	1.099E 00	1.183E 02	1.297E 01	1.600E 00	1.603E 00	-8.257E 00	-8.638E 00	6.251E-01	3.792E-01

CYCLE	TIME	B1	B2	X1	Z1	X2	Z2	Y1	Y2
11200	1.119E 00	1.092E 02	2.288E 01	1.411E 00	1.420E 00	-1.012E 01	-9.541E 00	6.507E-01	4.699E-01
11400	1.138E 00	1.099E 02	2.217E 01	1.214E 00	1.222E 00	-9.742E 00	-1.025E 01	6.813E-01	5.492E-01
11600	1.158E 00	1.140E 02	1.771E 01	1.006E 00	1.011E 00	-1.110E 01	-1.077E 01	7.163E-01	6.162E-01
11800	1.178E 00	1.075E 02	2.477E 01	7.831E-01	7.923E-01	-1.091E 01	-1.109E 01	7.550E-01	6.703E-01
12000	1.198E 00	1.135E 02	1.813E 01	5.641E-01	5.687E-01	-1.124E 01	-1.122E 01	7.965E-01	7.111E-01
12200	1.218E 00	1.092E 02	2.408E 01	3.364E-01	3.449E-01	-1.122E 01	-1.116E 01	8.401E-01	7.389E-01
12400	1.238E 00	1.114E 02	2.052E 01	1.180E-01	1.237E-01	-1.077E 01	-1.091E 01	8.849E-01	7.525E-01
12600	1.257E 00	1.100E 02	2.201E 01	-9.737E-02	-9.057E-02	-1.066E 01	-1.050E 01	9.301E-01	7.534E-01
12800	1.277E 00	1.089E 02	2.327E 01	-3.027E-01	-2.952E-01	-9.845E 00	-9.936E 00	9.750E-01	7.417E-01
13000	1.297E 00	1.106E 02	2.138E 01	-4.929E-01	-4.870E-01	-9.214E 00	-9.224E 00	1.019E 00	7.182E-01
13200	1.317E 00	1.093E 02	2.288E 01	-6.703E-01	-6.632E-01	-8.471E 00	-8.386E 00	1.061E 00	6.836E-01
13400	1.337E 00	1.084E 02	2.385E 01	-8.295E-01	-8.216E-01	-7.634E 00	-7.444E 00	1.100E 00	6.389E-01
13600	1.357E 00	1.087E 02	2.351E 01	-9.676E-01	-9.603E-01	-6.390E 00	-6.417E 00	1.137E 00	5.853E-01
13800	1.376E 00	1.086E 02	2.360E 01	-1.085E 00	-1.078E 00	-5.359E 00	-5.326E 00	1.170E 00	5.240E-01
14000	1.396E 00	1.080E 02	2.431E 01	-1.181E 00	-1.173E 00	-4.279E 00	-4.190E 00	1.200E 00	4.564E-01
14200	1.416E 00	1.073E 02	2.517E 01	-1.255E 00	-1.245E 00	-3.168E 00	-3.029E 00	1.225E 00	3.837E-01
14400	1.436E 00	1.068E 02	2.587E 01	-1.308E 00	-1.294E 00	-2.071E 00	-1.864E 00	1.245E 00	3.074E-01
14600	1.456E 00	1.068E 02	2.611E 01	-1.339E 00	-1.319E 00	-1.021E 00	-7.134E-01	1.261E 00	2.289E-01
14800	1.476E 00	1.078E 02	2.535E 01	-1.349E 00	-1.322E 00	-1.795E-02	4.044E-01	1.273E 00	1.496E-01
15000	1.495E 00	1.102E 02	2.308E 01	-1.339E 00	-1.303E 00	9.837E-01	1.473E 00	1.279E 00	7.072E-02
15200	1.515E 00	1.138E 02	1.942E 01	-1.309E 00	-1.263E 00	2.075E 00	2.476E 00	1.281E 00	-6.364E-03
15400	1.535E 00	1.167E 02	1.635E 01	-1.255E 00	-1.204E 00	3.323E 00	3.399E 00	1.278E 00	-8.047E-02
15600	1.555E 00	1.156E 02	1.760E 01	-1.178E 00	-1.128E 00	4.544E 00	4.231E 00	1.271E 00	-1.505E-01
15800	1.575E 00	1.110E 02	2.246E 01	-1.076E 00	-1.035E 00	5.248E 00	4.962E 00	1.260E 00	-2.156E-01
16000	1.595E 00	1.099E 02	2.366E 01	-9.683E-01	-9.298E-01	5.521E 00	5.583E 00	1.245E 00	-2.744E-01
16200	1.614E 00	1.127E 02	2.069E 01	-8.539E-01	-8.128E-01	5.971E 00	6.089E 00	1.227E 00	-3.267E-01
16400	1.634E 00	1.133E 02	1.994E 01	-7.281E-01	-6.870E-01	6.600E 00	6.476E 00	1.206E 00	-3.718E-01
16600	1.654E 00	1.110E 02	2.247E 01	-5.923E-01	-5.546E-01	6.887E 00	6.742E 00	1.182E 00	-4.090E-01
16800	1.674E 00	1.107E 02	2.281E 01	-4.548E-01	-4.181E-01	6.860E 00	6.886E 00	1.157E 00	-4.382E-01
17000	1.694E 00	1.120E 02	2.140E 01	-3.173E-01	-2.799E-01	6.908E 00	6.913E 00	1.130E 00	-4.591E-01
17200	1.714E 00	1.117E 02	2.174E 01	-1.786E-01	-1.423E-01	6.926E 00	6.825E 00	1.102E 00	-4.717E-01
17400	1.733E 00	1.106E 02	2.290E 01	-4.198E-02	-7.616E-03	6.699E 00	6.627E 00	1.073E 00	-4.762E-01
17600	1.753E 00	1.106E 02	2.295E 01	8.844E-02	1.221E-01	6.338E 00	6.328E 00	1.045E 00	-4.727E-01
17800	1.773E 00	1.109E 02	2.259E 01	2.115E-01	2.449E-01	5.963E 00	5.938E 00	1.017E 00	-4.616E-01
18000	1.793E 00	1.107E 02	2.279E 01	3.265E-01	3.590E-01	5.528E 00	5.462E 00	9.893E-01	-4.434E-01
18200	1.813E 00	1.102E 02	2.336E 01	4.318E-01	4.628E-01	4.990E 00	4.912E 00	9.634E-01	-4.187E-01
18400	1.833E 00	1.098E 02	2.388E 01	5.255E-01	5.550E-01	4.375E 00	4.303E 00	9.392E-01	-3.881E-01
18600	1.852E 00	1.094E 02	2.427E 01	6.065E-01	6.345E-01	3.720E 00	3.649E 00	9.170E-01	-3.523E-01
18800	1.872E 00	1.091E 02	2.466E 01	6.741E-01	7.006E-01	3.047E 00	2.960E 00	8.970E-01	-3.122E-01
19000	1.892E 00	1.087E 02	2.508E 01	7.283E-01	7.527E-01	2.369E 00	2.249E 00	8.796E-01	-2.685E-01
19200	1.912E 00	1.084E 02	2.551E 01	7.688E-01	7.905E-01	1.695E 00	1.529E 00	8.648E-01	-2.221E-01
19400	1.932E 00	1.082E 02	2.581E 01	7.961E-01	8.138E-01	1.039E 00	8.121E-01	8.530E-01	-1.739E-01
19600	1.952E 00	1.083E 02	2.580E 01	8.105E-01	8.230E-01	4.074E-01	1.090E-01	8.440E-01	-1.247E-01
19800	1.971E 00	1.090E 02	2.523E 01	8.125E-01	8.183E-01	-2.015E-01	-5.690E-01	8.380E-01	-7.541E-02
20000	1.991E 00	1.103E 02	2.393E 01	8.024E-01	8.004E-01	-8.020E-01	-1.212E 00	8.349E-01	-2.679E-02
20200	2.011E 00	1.123E 02	2.191E 01	7.802E-01	7.700E-01	-1.420E 00	-1.810E 00	8.348E-01	2.038E-02
20400	2.031E 00	1.145E 02	1.959E 01	7.453E-01	7.282E-01	-2.080E 00	-2.356E 00	8.373E-01	6.537E-02
20600	2.051E 00	1.160E 02	1.798E 01	6.967E-01	6.761E-01	-2.772E 00	-2.842E 00	8.425E-01	1.075E-01
20800	2.071E 00	1.158E 02	1.825E 01	6.346E-01	6.149E-01	-3.410E 00	-3.263E 00	8.502E-01	1.463E-01
21000	2.091E 00	1.129E 02	2.037E 01	5.616E-01	5.460E-01	-3.844E 00	-3.614E 00	8.600E-01	1.811E-01
21200	2.110E 00	1.119E 02	2.248E 01	4.826E-01	4.708E-01	-4.023E 00	-3.893E 00	8.718E-01	2.117E-01
21400	2.130E 00	1.114E 02	2.296E 01	4.015E-01	3.908E-01	-4.076E 00	-4.098E 00	8.853E-01	2.375E-01
21600	2.150E 00	1.122E 02	2.208E 01	3.194E-01	3.074E-01	-4.145E 00	-4.227E 00	9.002E-01	2.584E-01
21800	2.170E 00	1.131E 02	2.116E 01	2.354E-01	2.222E-01	-4.249E 00	-4.282E 00	9.162E-01	2.743E-01
22000	2.190E 00	1.131E 02	2.110E 01	1.497E-01	1.366E-01	-4.312E 00	-4.265E 00	9.330E-01	2.851E-01
22200	2.210E 00	1.125E 02	2.177E 01	6.375E-02	5.201E-02	-4.259E 00	-4.178E 00	9.503E-01	2.907E-01

CYCLE	TIME	B1	B2	X1	Z1	X2	Z2	Y1	Y2
22400	2.229E 00	1.119E 02	2.248E 01	-1.986E-02	-3.013E-02	-4.086E 00	-4.027E 00	9.678E-01	2.913E-01
22600	2.249E 00	1.116E 02	2.280E 01	-9.915E-02	-1.096E-01	-3.838E 00	-3.815E 00	9.852E-01	2.871E-01
22800	2.269E 00	1.115E 02	2.283E 01	-1.731E-01	-1.823E-01	-3.591E 00	-3.547E 00	1.002E 00	2.783E-01
23000	2.289E 00	1.116E 02	2.279E 01	-2.410E-01	-2.501E-01	-3.234E 00	-3.225E 00	1.018E 00	2.653E-01
23200	2.309E 00	1.115E 02	2.285E 01	-3.022E-01	-3.110E-01	-2.891E 00	-2.866E 00	1.034E 00	2.484E-01
23400	2.329E 00	1.114E 02	2.301E 01	-3.564E-01	-3.644E-01	-2.518E 00	-2.474E 00	1.048E 00	2.281E-01
23600	2.348E 00	1.112E 02	2.325E 01	-4.027E-01	-4.099E-01	-2.119E 00	-2.058E 00	1.061E 00	2.048E-01
23800	2.368E 00	1.110E 02	2.351E 01	-4.409E-01	-4.466E-01	-1.702E 00	-1.625E 00	1.072E 00	1.791E-01
24000	2.388E 00	1.108E 02	2.374E 01	-4.707E-01	-4.747E-01	-1.278E 00	-1.182E 00	1.082E 00	1.514E-01
24200	2.408E 00	1.106E 02	2.391E 01	-4.920E-01	-4.938E-01	-8.538E-01	-7.373E-01	1.090E 00	1.223E-01
24400	2.428E 00	1.106E 02	2.398E 01	-5.049E-01	-5.041E-01	-4.379E-01	-2.978E-01	1.097E 00	9.231E-02
24600	2.448E 00	1.107E 02	2.388E 01	-5.095E-01	-5.058E-01	-3.360E-02	1.301E-01	1.101E 00	6.196E-02
24800	2.467E 00	1.111E 02	2.358E 01	-5.063E-01	-4.990E-01	3.563E-01	5.387E-01	1.104E 00	3.178E-02
25000	2.487E 00	1.116E 02	2.305E 01	-4.953E-01	-4.843E-01	7.338E-01	9.234E-01	1.105E 00	2.246E-03
25200	2.507E 00	1.123E 02	2.232E 01	-4.769E-01	-4.622E-01	1.079E 00	1.277E 00	1.104E 00	-2.618E-02
25400	2.527E 00	1.130E 02	2.151E 01	-4.514E-01	-4.334E-01	1.454E 00	1.596E 00	1.101E 00	-5.308E-02
25600	2.547E 00	1.137E 02	2.079E 01	-4.188E-01	-3.986E-01	1.794E 00	1.877E 00	1.097E 00	-7.806E-02
25800	2.567E 00	1.141E 02	2.037E 01	-3.797E-01	-3.586E-01	2.100E 00	2.117E 00	1.092E 00	-1.008E-01
26000	2.586E 00	1.141E 02	2.038E 01	-3.349E-01	-3.142E-01	2.367E 00	2.312E 00	1.085E 00	-1.210E-01
26200	2.606E 00	1.137E 02	2.082E 01	-2.855E-01	-2.664E-01	2.589E 00	2.463E 00	1.077E 00	-1.384E-01
26400	2.626E 00	1.131E 02	2.145E 01	-2.331E-01	-2.160E-01	2.668E 00	2.567E 00	1.068E 00	-1.529E-01
26600	2.646E 00	1.126E 02	2.204E 01	-1.792E-01	-1.640E-01	2.705E 00	2.626E 00	1.059E 00	-1.643E-01
26800	2.666E 00	1.122E 02	2.241E 01	-1.252E-01	-1.112E-01	2.688E 00	2.638E 00	1.049E 00	-1.725E-01
27000	2.686E 00	1.121E 02	2.255E 01	-7.205E-02	-5.870E-02	2.629E 00	2.607E 00	1.038E 00	-1.776E-01
27200	2.705E 00	1.121E 02	2.256E 01	-2.026E-02	-7.207E-03	2.546E 00	2.537E 00	1.027E 00	-1.795E-01
27400	2.725E 00	1.121E 02	2.253E 01	2.962E-02	4.249E-02	2.458E 00	2.428E 00	1.016E 00	-1.785E-01
27600	2.745E 00	1.121E 02	2.254E 01	7.701E-02	8.957E-02	2.298E 00	2.279E 00	1.006E 00	-1.745E-01
27800	2.765E 00	1.120E 02	2.261E 01	1.213E-01	1.334E-01	2.127E 00	2.096E 00	9.953E-01	-1.677E-01
28000	2.785E 00	1.119E 02	2.274E 01	1.619E-01	1.732E-01	1.975E 00	1.884E 00	9.859E-01	-1.585E-01
28200	2.805E 00	1.119E 02	2.289E 01	1.981E-01	2.086E-01	1.702E 00	1.651E 00	9.763E-01	-1.470E-01
28400	2.824E 00	1.116E 02	2.306E 01	2.298E-01	2.391E-01	1.460E 00	1.401E 00	9.679E-01	-1.336E-01
28600	2.844E 00	1.115E 02	2.323E 01	2.564E-01	2.645E-01	1.206E 00	1.138E 00	9.603E-01	-1.184E-01
28800	2.864E 00	1.114E 02	2.337E 01	2.779E-01	2.845E-01	9.449E-01	8.677E-01	9.537E-01	-1.019E-01
29000	2.884E 00	1.113E 02	2.348E 01	2.942E-01	2.991E-01	6.810E-01	5.937E-01	9.481E-01	-8.436E-02
29200	2.904E 00	1.112E 02	2.355E 01	3.051E-01	3.082E-01	4.189E-01	3.207E-01	9.436E-01	-6.611E-02
29400	2.924E 00	1.112E 02	2.355E 01	3.109E-01	3.120E-01	1.620E-01	5.311E-02	9.402E-01	-4.747E-02
29600	2.943E 00	1.113E 02	2.347E 01	3.116E-01	3.104E-01	-8.692E-02	-2.050E-01	9.379E-01	-2.870E-02
29800	2.963E 00	1.115E 02	2.331E 01	3.075E-01	3.038E-01	-3.298E-01	-4.498E-01	9.367E-01	-1.033E-02
30000	2.983E 00	1.117E 02	2.306E 01	2.987E-01	2.925E-01	-5.532E-01	-6.777E-01	9.366E-01	7.581E-03
30200	3.003E 00	1.120E 02	2.273E 01	2.854E-01	2.768E-01	-7.677E-01	-8.858E-01	9.376E-01	2.468E-02
30400	3.023E 00	1.124E 02	2.237E 01	2.680E-01	2.572E-01	-9.677E-01	-1.071E 00	9.396E-01	4.071E-02
30600	3.043E 00	1.127E 02	2.200E 01	2.468E-01	2.341E-01	-1.151E 00	-1.232E 00	9.425E-01	5.546E-02
30800	3.062E 00	1.130E 02	2.168E 01	2.221E-01	2.080E-01	-1.314E 00	-1.367E 00	9.462E-01	6.873E-02
31000	3.082E 00	1.132E 02	2.146E 01	1.944E-01	1.796E-01	-1.451E 00	-1.474E 00	9.507E-01	8.036E-02
31200	3.102E 00	1.133E 02	2.136E 01	1.642E-01	1.493E-01	-1.560E 00	-1.552E 00	9.558E-01	9.022E-02
31400	3.122E 00	1.133E 02	2.139E 01	1.322E-01	1.177E-01	-1.634E 00	-1.602E 00	9.616E-01	9.822E-02
31600	3.142E 00	1.132E 02	2.151E 01	9.906E-02	8.534E-02	-1.673E 00	-1.624E 00	9.675E-01	1.043E-01
31800	3.162E 00	1.130E 02	2.170E 01	6.551E-02	5.286E-02	-1.676E 00	-1.619E 00	9.739E-01	1.084E-01
32000	3.182E 00	1.128E 02	2.191E 01	3.224E-02	2.076E-02	-1.646E 00	-1.587E 00	9.805E-01	1.106E-01
32200	3.201E 00	1.126E 02	2.212E 01	-1.369E-04	-1.045E-02	-1.587E 00	-1.530E 00	9.871E-01	1.109E-01
32400	3.221E 00	1.124E 02	2.231E 01	-3.107E-02	-4.029E-02	-1.503E 00	-1.451E 00	9.938E-01	1.094E-01
32600	3.241E 00	1.123E 02	2.246E 01	-6.011E-02	-6.833E-02	-1.398E 00	-1.350E 00	1.000E 00	1.061E-01
32800	3.261E 00	1.122E 02	2.259E 01	-8.680E-02	-9.409E-02	-1.270E 00	-1.225E 00	1.006E 00	1.012E-01
33000	3.281E 00	1.121E 02	2.270E 01	-1.108E-01	-1.172E-01	-1.129E 00	-1.085E 00	1.012E 00	9.485E-02
33200	3.301E 00	1.120E 02	2.280E 01	-1.319E-01	-1.374E-01	-9.799E-01	-9.350E-01	1.018E 00	8.719E-02
33400	3.320E 00	1.119E 02	2.289E 01	-1.499E-01	-1.545E-01	-8.239E-01	-7.767E-01	1.022E 00	7.841E-02

CYCLE	TIME	B1	B2	X1	Z1	X2	Z2	Y1	Y2
33600	3.340E 00	1.119E 02	2.296E 01	-1.648E-01	-1.684E-01	-6.691E-01	-6.124E-01	1.027E 00	6.870E-02
33800	3.360E 00	1.118E 02	2.301E 01	-1.764E-01	-1.790E-01	-4.997E-01	-4.448E-01	1.030E 00	5.826E-02
34000	3.380E 00	1.118E 02	2.305E 01	-1.846E-01	-1.862E-01	-3.363E-01	-2.770E-01	1.034E 00	4.729E-02
34200	3.400E 00	1.118E 02	2.306E 01	-1.898E-01	-1.900E-01	-1.742E-01	-1.107E-01	1.036E 00	3.598E-02
34400	3.420E 00	1.118E 02	2.305E 01	-1.917E-01	-1.906E-01	-1.643E-02	5.043E-02	1.038E 00	2.455E-02
34600	3.439E 00	1.118E 02	2.300E 01	-1.905E-01	-1.883E-01	1.393E-01	2.043E-01	1.039E 00	1.317E-02
34800	3.459E 00	1.119E 02	2.293E 01	-1.863E-01	-1.825E-01	2.800E-01	3.492E-01	1.039E 00	2.042E-03
35000	3.479E 00	1.120E 02	2.282E 01	-1.794E-01	-1.741E-01	4.143E-01	4.816E-01	1.039E 00	-8.668E-03
35200	3.499E 00	1.121E 02	2.270E 01	-1.698E-01	-1.633E-01	5.381E-01	6.010E-01	1.039E 00	-1.880E-02
35400	3.519E 00	1.122E 02	2.256E 01	-1.579E-01	-1.502E-01	6.507E-01	7.065E-01	1.036E 00	-2.821E-02
35600	3.539E 00	1.124E 02	2.243E 01	-1.438E-01	-1.351E-01	7.504E-01	7.969E-01	1.034E 00	-3.678E-02
35800	3.558E 00	1.125E 02	2.230E 01	-1.280E-01	-1.184E-01	8.344E-01	8.698E-01	1.032E 00	-4.439E-02
36000	3.578E 00	1.126E 02	2.220E 01	-1.105E-01	-1.004E-01	9.029E-01	9.260E-01	1.029E 00	-5.095E-02
36200	3.598E 00	1.126E 02	2.212E 01	-9.192E-02	-8.143E-02	9.555E-01	9.661E-01	1.025E 00	-5.641E-02
36400	3.618E 00	1.127E 02	2.208E 01	-7.244E-02	-6.186E-02	9.879E-01	9.866E-01	1.022E 00	-6.070E-02
36600	3.638E 00	1.127E 02	2.207E 01	-5.247E-02	-4.203E-02	1.003E 00	9.907E-01	1.018E 00	-6.381E-02
36800	3.658E 00	1.127E 02	2.208E 01	-3.237E-02	-2.225E-02	1.003E 00	9.819E-01	1.014E 00	-6.573E-02
37000	3.677E 00	1.126E 02	2.212E 01	-1.252E-02	-2.907E-03	9.782E-01	9.500E-01	1.010E 00	-6.648E-02
37200	3.697E 00	1.126E 02	2.218E 01	6.658E-03	1.565E-02	9.382E-01	9.045E-01	1.006E 00	-6.608E-02
37400	3.717E 00	1.125E 02	2.224E 01	2.494E-02	3.322E-02	8.897E-01	8.519E-01	1.002E 00	-6.460E-02
37600	3.737E 00	1.125E 02	2.231E 01	4.214E-02	4.963E-02	8.249E-01	7.843E-01	9.982E-01	-6.210E-02
37800	3.757E 00	1.124E 02	2.238E 01	5.785E-02	6.451E-02	7.452E-01	7.027E-01	9.946E-01	-5.867E-02
38000	3.777E 00	1.123E 02	2.244E 01	7.188E-02	7.767E-02	6.581E-01	6.141E-01	9.912E-01	-5.439E-02
38200	3.796E 00	1.123E 02	2.250E 01	8.411E-02	8.901E-02	5.650E-01	5.198E-01	9.880E-01	-4.938E-02
38400	3.816E 00	1.122E 02	2.254E 01	9.443E-02	9.842E-02	4.674E-01	4.213E-01	9.852E-01	-4.375E-02
38600	3.836E 00	1.122E 02	2.258E 01	1.028E-01	1.058E-01	3.670E-01	3.202E-01	9.828E-01	-3.761E-02
38800	3.856E 00	1.122E 02	2.261E 01	1.091E-01	1.112E-01	2.653E-01	2.180E-01	9.807E-01	-3.108E-02
39000	3.876E 00	1.122E 02	2.262E 01	1.134E-01	1.145E-01	1.638E-01	1.164E-01	9.791E-01	-2.430E-02
39200	3.896E 00	1.122E 02	2.262E 01	1.156E-01	1.158E-01	6.407E-02	1.695E-02	9.778E-01	-1.738E-02
39400	3.915E 00	1.122E 02	2.261E 01	1.159E-01	1.152E-01	-3.264E-02	-7.887E-02	9.770E-01	-1.044E-02
39600	3.935E 00	1.122E 02	2.258E 01	1.143E-01	1.127E-01	-1.250E-01	-1.696E-01	9.765E-01	-3.593E-03
39800	3.955E 00	1.122E 02	2.255E 01	1.109E-01	1.084E-01	-2.119E-01	-2.541E-01	9.765E-01	3.049E-03
40000	3.975E 00	1.123E 02	2.250E 01	1.059E-01	1.026E-01	-2.922E-01	-3.311E-01	9.769E-01	9.386E-03
40200	3.995E 00	1.123E 02	2.246E 01	9.928E-02	9.524E-02	-3.649E-01	-3.997E-01	9.776E-01	1.533E-02
40400	4.015E 00	1.124E 02	2.241E 01	9.132E-02	8.663E-02	-4.292E-01	-4.591E-01	9.787E-01	2.079E-02
40600	4.034E 00	1.124E 02	2.236E 01	8.216E-02	7.692E-02	-4.843E-01	-5.087E-01	9.801E-01	2.570E-02
40800	4.054E 00	1.124E 02	2.232E 01	7.200E-02	6.633E-02	-5.297E-01	-5.481E-01	9.818E-01	3.000E-02
41000	4.074E 00	1.125E 02	2.228E 01	6.103E-02	5.506E-02	-5.648E-01	-5.770E-01	9.837E-01	3.364E-02
41200	4.094E 00	1.125E 02	2.225E 01	4.947E-02	4.332E-02	-5.893E-01	-5.953E-01	9.858E-01	3.659E-02
41400	4.114E 00	1.125E 02	2.224E 01	3.753E-02	3.132E-02	-6.031E-01	-6.031E-01	9.880E-01	3.883E-02
41600	4.134E 00	1.125E 02	2.223E 01	2.541E-02	1.926E-02	-6.063E-01	-6.008E-01	9.904E-01	4.034E-02
41800	4.153E 00	1.125E 02	2.223E 01	1.334E-02	7.348E-03	-5.993E-01	-5.887E-01	9.929E-01	4.114E-02
42000	4.173E 00	1.125E 02	2.224E 01	1.507E-03	-4.226E-03	-5.824E-01	-5.673E-01	9.953E-01	4.123E-02
42200	4.193E 00	1.125E 02	2.226E 01	-9.895E-03	-1.529E-02	-5.565E-01	-5.376E-01	9.978E-01	4.063E-02
42400	4.213E 00	1.125E 02	2.228E 01	-2.069E-02	-2.567E-02	-5.218E-01	-4.996E-01	1.000E 00	3.940E-02
42600	4.233E 00	1.124E 02	2.230E 01	-3.068E-02	-3.519E-02	-4.741E-01	-4.493E-01	1.002E 00	3.757E-02
42800	4.253E 00	1.124E 02	2.232E 01	-3.962E-02	-4.361E-02	-4.222E-01	-3.952E-01	1.005E 00	3.520E-02
43000	4.273E 00	1.124E 02	2.234E 01	-4.748E-02	-5.092E-02	-3.652E-01	-3.366E-01	1.006E 00	3.235E-02
43200	4.292E 00	1.124E 02	2.236E 01	-5.419E-02	-5.704E-02	-3.065E-01	-2.768E-01	1.008E 00	2.911E-02
43400	4.312E 00	1.124E 02	2.238E 01	-5.971E-02	-6.196E-02	-2.467E-01	-2.163E-01	1.010E 00	2.553E-02
43600	4.332E 00	1.123E 02	2.239E 01	-6.401E-02	-6.564E-02	-1.861E-01	-1.554E-01	1.011E 00	2.170E-02
43800	4.352E 00	1.123E 02	2.240E 01	-6.704E-02	-6.807E-02	-1.216E-01	-9.097E-02	1.012E 00	1.766E-02
44000	4.372E 00	1.123E 02	2.240E 01	-6.888E-02	-6.922E-02	-6.092E-02	-3.086E-02	1.013E 00	1.355E-02
44200	4.392E 00	1.123E 02	2.239E 01	-6.949E-02	-6.931E-02	-2.503E-03	2.655E-02	1.014E 00	9.386E-03
44400	4.411E 00	1.123E 02	2.238E 01	-6.894E-02	-6.819E-02	5.596E-02	8.361E-02	1.014E 00	5.255E-03
44600	4.431E 00	1.123E 02	2.237E 01	-6.728E-02	-6.591E-02	1.099E-01	1.357E-01	1.014E 00	1.224E-03

CYCLE	TIME	B1	B2	X1	Z1	X2	Z2	Y1	Y2
44800	4.451E 00	1.124E 02	2.230E 01	-6.459E-02	-5.281E-02	1.584E-01	1.821E-01	1.014E 00	-2.644E-03
45000	4.471E 00	1.124E 02	2.234E 01	-5.096E-02	-5.873E-02	2.025E-01	2.235E-01	1.014E 00	-6.294E-03
45200	4.491E 00	1.124E 02	2.232E 01	-5.648E-02	-5.386E-02	2.421E-01	2.602E-01	1.013E 00	-9.674E-03
45400	4.511E 00	1.124E 02	2.230E 01	-5.125E-02	-4.830E-02	2.770E-01	2.920E-01	1.012E 00	-1.274E-02
45600	4.530E 00	1.124E 02	2.229E 01	-4.538E-02	-4.216E-02	3.071E-01	3.188E-01	1.011E 00	-1.546E-02
45800	4.550E 00	1.124E 02	2.227E 01	-3.899E-02	-3.558E-02	3.314E-01	3.397E-01	1.010E 00	-1.779E-02
46000	4.570E 00	1.124E 02	2.226E 01	-3.222E-02	-2.868E-02	3.465E-01	3.514E-01	1.009E 00	-1.972E-02
46200	4.590E 00	1.124E 02	2.225E 01	-2.514E-02	-2.153E-02	3.586E-01	3.602E-01	1.008E 00	-2.122E-02
46400	4.610E 00	1.124E 02	2.225E 01	-1.797E-02	-1.436E-02	3.575E-01	3.558E-01	1.006E 00	-2.230E-02
46600	4.630E 00	1.124E 02	2.225E 01	-1.079E-02	-7.241E-03	3.612E-01	3.565E-01	1.005E 00	-2.294E-02
46800	4.649E 00	1.124E 02	2.225E 01	-3.582E-03	-1.598E-04	3.576E-01	3.502E-01	1.003E 00	-2.316E-02
47000	4.669E 00	1.124E 02	2.225E 01	3.471E-03	6.720E-03	3.469E-01	3.370E-01	1.002E 00	-2.296E-02
47200	4.689E 00	1.124E 02	2.226E 01	1.026E-02	1.329E-02	3.299E-01	3.178E-01	1.000E 00	-2.236E-02
47400	4.709E 00	1.124E 02	2.226E 01	1.652E-02	1.929E-02	2.962E-01	2.822E-01	9.989E-01	-2.138E-02
47600	4.729E 00	1.124E 02	2.227E 01	2.210E-02	2.457E-02	2.621E-01	2.465E-01	9.977E-01	-2.006E-02
47800	4.749E 00	1.124E 02	2.228E 01	2.700E-02	2.914E-02	2.271E-01	2.101E-01	9.965E-01	-1.844E-02
48000	4.768E 00	1.124E 02	2.228E 01	3.118E-02	3.297E-02	1.912E-01	1.733E-01	9.955E-01	-1.657E-02
48200	4.788E 00	1.124E 02	2.229E 01	3.463E-02	3.606E-02	1.545E-01	1.360E-01	9.945E-01	-1.450E-02
48400	4.808E 00	1.124E 02	2.229E 01	3.735E-02	3.840E-02	1.173E-01	9.858E-02	9.937E-01	-1.226E-02
48600	4.828E 00	1.124E 02	2.229E 01	3.932E-02	4.000E-02	8.015E-02	6.151E-02	9.931E-01	-9.905E-03
48800	4.848E 00	1.124E 02	2.229E 01	4.055E-02	4.086E-02	4.345E-02	2.520E-02	9.926E-01	-7.475E-03
49000	4.868E 00	1.124E 02	2.229E 01	4.106E-02	4.101E-02	7.692E-03	-9.889E-03	9.922E-01	-5.015E-03
49200	4.887E 00	1.124E 02	2.229E 01	4.087E-02	4.048E-02	-2.667E-02	-4.331E-02	9.919E-01	-2.567E-03
49400	4.907E 00	1.124E 02	2.228E 01	4.000E-02	3.929E-02	-5.918E-02	-7.464E-02	9.918E-01	-1.709E-04
49600	4.927E 00	1.124E 02	2.227E 01	3.851E-02	3.750E-02	-8.933E-02	-1.034E-01	9.919E-01	2.135E-03
49800	4.947E 00	1.124E 02	2.227E 01	3.644E-02	3.517E-02	-1.168E-01	-1.293E-01	9.921E-01	4.318E-03
50000	4.967E 00	1.124E 02	2.226E 01	3.385E-02	3.235E-02	-1.413E-01	-1.521E-01	9.924E-01	6.345E-03
50200	4.987E 00	1.124E 02	2.226E 01	3.081E-02	2.911E-02	-1.626E-01	-1.715E-01	9.928E-01	8.190E-03
50400	5.006E 00	1.124E 02	2.225E 01	2.737E-02	2.551E-02	-1.804E-01	-1.874E-01	9.934E-01	9.829E-03
50600	5.026E 00	1.124E 02	2.224E 01	2.362E-02	2.163E-02	-1.945E-01	-1.995E-01	9.940E-01	1.124E-02
50800	5.046E 00	1.124E 02	2.224E 01	1.961E-02	1.755E-02	-2.049E-01	-2.079E-01	9.947E-01	1.242E-02
51000	5.066E 00	1.124E 02	2.224E 01	1.544E-02	1.334E-02	-2.115E-01	-2.126E-01	9.955E-01	1.334E-02
51200	5.086E 00	1.124E 02	2.223E 01	1.118E-02	9.072E-03	-2.144E-01	-2.136E-01	9.963E-01	1.402E-02
51400	5.106E 00	1.124E 02	2.223E 01	6.891E-03	4.819E-03	-2.137E-01	-2.111E-01	9.971E-01	1.443E-02
51600	5.125E 00	1.124E 02	2.223E 01	2.655E-03	6.507E-04	-2.095E-01	-2.053E-01	9.980E-01	1.459E-02
51800	5.145E 00	1.124E 02	2.223E 01	-1.465E-03	-3.370E-03	-2.021E-01	-1.964E-01	9.989E-01	1.451E-02
52000	5.165E 00	1.124E 02	2.223E 01	-5.403E-03	-7.180E-03	-1.914E-01	-1.843E-01	9.997E-01	1.419E-02
52200	5.185E 00	1.124E 02	2.223E 01	-9.073E-03	-1.070E-02	-1.743E-01	-1.661E-01	1.001E 00	1.365E-02
52400	5.205E 00	1.124E 02	2.223E 01	-1.239E-02	-1.384E-02	-1.576E-01	-1.484E-01	1.001E 00	1.291E-02
52600	5.225E 00	1.124E 02	2.223E 01	-1.529E-02	-1.659E-02	-1.307E-01	-1.207E-01	1.002E 00	1.200E-02
52800	5.244E 00	1.124E 02	2.223E 01	-1.766E-02	-1.871E-02	-1.074E-01	-9.686E-02	1.002E 00	1.094E-02
53000	5.264E 00	1.124E 02	2.223E 01	-1.962E-02	-2.046E-02	-9.030E-02	-7.943E-02	1.003E 00	9.762E-03
53200	5.284E 00	1.124E 02	2.223E 01	-2.118E-02	-2.180E-02	-6.435E-02	-5.335E-02	1.003E 00	8.490E-03
53400	5.304E 00	1.124E 02	2.223E 01	-2.229E-02	-2.265E-02	-4.414E-02	-3.324E-02	1.004E 00	7.155E-03
53600	5.324E 00	1.124E 02	2.223E 01	-2.296E-02	-2.314E-02	-2.332E-02	-1.270E-02	1.004E 00	5.778E-03
53800	5.344E 00	1.124E 02	2.223E 01	-2.319E-02	-2.316E-02	-1.480E-03	8.691E-03	1.004E 00	4.387E-03
54000	5.364E 00	1.124E 02	2.223E 01	-2.307E-02	-2.284E-02	1.437E-02	2.392E-02	1.004E 00	3.005E-03
54200	5.383E 00	1.124E 02	2.222E 01	-2.253E-02	-2.213E-02	3.708E-02	4.590E-02	1.004E 00	1.654E-03
54400	5.403E 00	1.124E 02	2.222E 01	-2.164E-02	-2.107E-02	5.929E-02	6.825E-02	1.004E 00	3.573E-04
54600	5.423E 00	1.124E 02	2.222E 01	-2.051E-02	-1.978E-02	8.052E-02	8.722E-02	1.004E 00	-8.697E-04
54800	5.443E 00	1.124E 02	2.222E 01	-1.901E-02	-1.816E-02	8.125E-02	8.722E-02	1.004E 00	-2.005E-03
55000	5.463E 00	1.124E 02	2.221E 01	-1.730E-02	-1.634E-02	8.853E-02	9.322E-02	1.004E 00	-3.044E-03
55200	5.483E 00	1.124E 02	2.221E 01	-1.544E-02	-1.439E-02	1.014E-01	1.051E-01	1.004E 00	-3.967E-03
55400	5.502E 00	1.124E 02	2.221E 01	-1.329E-02	-1.218E-02	1.119E-01	1.145E-01	1.003E 00	-4.765E-03
55600	5.522E 00	1.124E 02	2.220E 01	-1.100E-02	-9.849E-03	1.157E-01	1.173E-01	1.003E 00	-5.425E-03
55800	5.542E 00	1.124E 02	2.220E 01	-8.688E-03	-7.514E-03	1.152E-01	1.156E-01	1.003E 00	-5.945E-03

CYCLE	TIME	B1	B2	X1	Z1	X2	Z2	Y1	Y2
56000	5.562E 00	1.124E 02	2.220E 01	-6.415E-03	-5.242E-03	1.118E-01	1.112E-01	1.002E 00	-6.326E-03
56200	5.582E 00	1.124E 02	2.220E 01	-4.226E-03	-3.075E-03	1.085E-01	1.070E-01	1.002E 00	-6.575E-03
56400	5.602E 00	1.124E 02	2.220E 01	-1.949E-03	-8.389E-04	1.179E-01	1.154E-01	1.001E 00	-6.692E-03
56600	5.621E 00	1.124E 02	2.220E 01	4.509E-04	1.504E-03	1.213E-01	1.181E-01	1.001E 00	-6.672E-03
56800	5.641E 00	1.123E 02	2.220E 01	2.869E-03	3.851E-03	1.169E-01	1.130E-01	1.000E 00	-6.510E-03
57000	5.661E 00	1.123E 02	2.220E 01	5.029E-03	5.925E-03	9.973E-02	9.514E-02	9.997E-01	-6.214E-03
57200	5.681E 00	1.123E 02	2.220E 01	6.869E-03	7.667E-03	8.463E-02	7.947E-02	9.993E-01	-5.804E-03
57400	5.701E 00	1.123E 02	2.220E 01	8.419E-03	9.110E-03	7.064E-02	6.503E-02	9.990E-01	-5.299E-03
57600	5.721E 00	1.123E 02	2.220E 01	9.698E-03	1.027E-02	5.740E-02	5.148E-02	9.987E-01	-4.716E-03
57800	5.740E 00	1.123E 02	2.220E 01	1.072E-02	1.117E-02	4.465E-02	3.856E-02	9.984E-01	-4.071E-03
58000	5.760E 00	1.123E 02	2.220E 01	1.148E-02	1.182E-02	3.234E-02	2.622E-02	9.982E-01	-3.380E-03
58200	5.780E 00	1.123E 02	2.220E 01	1.201E-02	1.222E-02	2.035E-02	1.431E-02	9.980E-01	-2.657E-03
58400	5.800E 00	1.123E 02	2.220E 01	1.230E-02	1.237E-02	8.825E-03	2.982E-03	9.979E-01	-1.918E-03
58600	5.820E 00	1.123E 02	2.220E 01	1.236E-02	1.234E-02	-2.169E-03	-7.714E-03	9.978E-01	-1.175E-03
58800	5.840E 00	1.123E 02	2.219E 01	1.222E-02	1.209E-02	-1.257E-02	-1.774E-02	9.977E-01	-4.407E-04
59000	5.859E 00	1.123E 02	2.219E 01	1.187E-02	1.164E-02	-2.225E-02	-2.696E-02	9.977E-01	2.718E-04
59200	5.879E 00	1.123E 02	2.219E 01	1.133E-02	1.101E-02	-3.106E-02	-3.526E-02	9.977E-01	9.520E-04
59400	5.899E 00	1.123E 02	2.218E 01	1.063E-02	1.023E-02	-3.897E-02	-4.261E-02	9.978E-01	1.590E-03
59600	5.919E 00	1.123E 02	2.218E 01	9.775E-03	9.312E-03	-4.594E-02	-4.899E-02	9.979E-01	2.177E-03
59800	5.939E 00	1.123E 02	2.218E 01	8.794E-03	8.276E-03	-5.191E-02	-5.435E-02	9.980E-01	2.705E-03
60000	5.959E 00	1.123E 02	2.218E 01	7.705E-03	7.145E-03	-5.669E-02	-5.851E-02	9.982E-01	3.167E-03
60200	5.978E 00	1.123E 02	2.217E 01	5.532E-03	5.941E-03	-6.039E-02	-6.159E-02	9.984E-01	3.560E-03
60400	5.998E 00	1.123E 02	2.217E 01	5.296E-03	4.687E-03	-6.301E-02	-6.360E-02	9.986E-01	3.879E-03
60600	6.018E 00	1.123E 02	2.217E 01	4.019E-03	3.405E-03	-6.440E-02	-6.440E-02	9.989E-01	4.121E-03
60800	6.038E 00	1.123E 02	2.217E 01	2.727E-03	2.118E-03	-6.475E-02	-6.420E-02	9.991E-01	4.286E-03
61000	6.058E 00	1.123E 02	2.217E 01	1.441E-03	8.481E-04	-6.368E-02	-6.261E-02	9.994E-01	4.375E-03
61200	6.078E 00	1.123E 02	2.217E 01	1.780E-04	-3.882E-04	-6.237E-02	-6.082E-02	9.996E-01	4.388E-03
61400	6.097E 00	1.123E 02	2.217E 01	-1.044E-03	-1.575E-03	-5.944E-02	-5.747E-02	9.999E-01	4.328E-03
61600	6.117E 00	1.123E 02	2.217E 01	-2.180E-03	-2.668E-03	-5.494E-02	-5.060E-02	1.000E 00	4.199E-03
61800	6.137E 00	1.123E 02	2.217E 01	-3.160E-03	-3.598E-03	-4.537E-02	-4.271E-02	1.000E 00	4.010E-03
62000	6.157E 00	1.123E 02	2.217E 01	-4.005E-03	-4.387E-03	-3.945E-02	-3.654E-02	1.000E 00	3.770E-03
62200	6.177E 00	1.123E 02	2.217E 01	-4.745E-03	-5.067E-03	-3.480E-02	-3.172E-02	1.001E 00	3.486E-03
62400	6.197E 00	1.123E 02	2.217E 01	-5.402E-03	-5.661E-03	-3.026E-02	-2.709E-02	1.001E 00	3.163E-03
62600	6.216E 00	1.123E 02	2.217E 01	-5.809E-03	-6.004E-03	-1.174E-02	-8.513E-03	1.001E 00	2.811E-03
62800	6.236E 00	1.123E 02	2.217E 01	-5.911E-03	-6.041E-03	5.711E-04	3.776E-03	1.001E 00	2.449E-03
63000	6.256E 00	1.123E 02	2.217E 01	-5.814E-03	-5.881E-03	8.446E-03	1.154E-02	1.001E 00	2.090E-03
63200	6.276E 00	1.123E 02	2.217E 01	-5.592E-03	-5.600E-03	1.319E-02	1.608E-02	1.001E 00	1.745E-03
63400	6.296E 00	1.123E 02	2.217E 01	-5.300E-03	-5.252E-03	1.576E-02	1.838E-02	1.001E 00	1.420E-03
63600	6.316E 00	1.123E 02	2.217E 01	-4.971E-03	-4.874E-03	1.683E-02	1.914E-02	1.001E 00	1.116E-03
63800	6.335E 00	1.123E 02	2.217E 01	-4.632E-03	-4.492E-03	1.692E-02	1.888E-02	1.001E 00	8.349E-04
64000	6.355E 00	1.123E 02	2.217E 01	-4.298E-03	-4.122E-03	1.635E-02	1.798E-02	1.001E 00	5.766E-04
64200	6.375E 00	1.123E 02	2.217E 01	-3.980E-03	-3.775E-03	1.540E-02	1.670E-02	1.001E 00	2.399E-04
64400	6.395E 00	1.123E 02	2.217E 01	-3.683E-03	-3.456E-03	1.423E-02	1.522E-02	1.001E 00	1.232E-04
64600	6.415E 00	1.123E 02	2.217E 01	-3.411E-03	-3.167E-03	1.297E-02	1.367E-02	1.001E 00	-7.532E-05
64800	6.435E 00	1.123E 02	2.217E 01	-3.144E-03	-2.888E-03	1.770E-02	1.816E-02	1.001E 00	-2.572E-04
65000	6.455E 00	1.123E 02	2.217E 01	-2.654E-03	-2.391E-03	3.027E-02	3.053E-02	1.001E 00	-4.167E-04
65200	6.474E 00	1.123E 02	2.217E 01	-1.966E-03	-1.699E-03	3.782E-02	3.788E-02	1.000E 00	-5.400E-04
65400	6.494E 00	1.123E 02	2.217E 01	-1.164E-03	-8.981E-04	4.186E-02	4.171E-02	1.000E 00	-6.182E-04
65600	6.514E 00	1.123E 02	2.217E 01	-3.065E-04	-4.634E-05	4.352E-02	4.312E-02	1.000E 00	-6.465E-04
65800	6.534E 00	1.123E 02	2.217E 01	4.719E-04	7.214E-04	3.312E-02	3.245E-02	1.000E 00	-6.249E-04
66000	6.554E 00	1.123E 02	2.217E 01	1.032E-03	1.266E-03	2.324E-02	2.230E-02	9.999E-01	-5.642E-04
66200	6.574E 00	1.123E 02	2.217E 01	1.419E-03	1.631E-03	1.589E-02	1.472E-02	9.999E-01	-4.765E-04
66400	6.593E 00	1.123E 02	2.217E 01	1.680E-03	1.867E-03	1.031E-02	8.982E-03	9.999E-01	-3.709E-04
66600	6.613E 00	1.123E 02	2.217E 01	1.838E-03	1.998E-03	5.845E-03	4.426E-03	9.998E-01	-2.544E-04
66800	6.633E 00	1.123E 02	2.217E 01	1.918E-03	2.049E-03	2.159E-03	7.076E-04	9.998E-01	-1.326E-04
67000	6.653E 00	1.122E 02	2.217E 01	1.932E-03	2.034E-03	-5.749E-04	-2.005E-03	9.998E-01	-9.841E-06

CYCLE	TIME	B1	B2	X1	Z1	X2	Z2	Y1	Y2
67200	6.673E 00	1.123E 02	2.217E 01	1.892E-03	1.966E-03	-3.244E-03	-4.610E-03	9.998E-01	1.104E-04
67400	6.693E 00	1.123E 02	2.217E 01	1.809E-03	1.855E-03	-5.112E-03	-6.380E-03	9.998E-01	2.252E-04
67600	6.712E 00	1.123E 02	2.217E 01	1.687E-03	1.711E-03	-6.859E-03	-8.006E-03	9.998E-01	3.324E-04
67800	6.732E 00	1.123E 02	2.217E 01	1.538E-03	1.540E-03	-8.160E-03	-9.168E-03	9.998E-01	4.300E-04
68000	6.752E 00	1.123E 02	2.217E 01	1.362E-03	1.345E-03	-9.356E-03	-1.022E-02	9.999E-01	5.166E-04
68200	6.772E 00	1.123E 02	2.217E 01	1.169E-03	1.136E-03	-9.856E-03	-1.056E-02	9.999E-01	5.910E-04
68400	6.792E 00	1.123E 02	2.217E 01	9.614E-04	9.153E-04	-1.082E-02	-1.138E-02	9.999E-01	6.526E-04
68600	6.812E 00	1.123E 02	2.217E 01	7.400E-04	6.853E-04	-1.122E-02	-1.163E-02	9.999E-01	7.006E-04
68800	6.831E 00	1.123E 02	2.217E 01	5.153E-04	4.539E-04	-1.118E-02	-1.145E-02	1.000E 00	7.347E-04
69000	6.851E 00	1.123E 02	2.217E 01	3.066E-04	2.412E-04	-8.935E-03	-9.066E-03	1.000E 00	7.552E-04
69200	6.871E 00	1.123E 02	2.217E 01	1.575E-04	9.082E-05	-6.136E-03	-6.141E-03	1.000E 00	7.649E-04
69400	6.891E 00	1.123E 02	2.217E 01	5.615E-05	-9.533E-06	-4.118E-03	-4.019E-03	1.000E 00	7.670E-04
69600	6.911E 00	1.123E 02	2.217E 01	-1.087E-05	-7.379E-05	-2.674E-03	-2.496E-03	1.000E 00	7.644E-04
69800	6.931E 00	1.123E 02	2.217E 01	-5.348E-05	-1.122E-04	-1.692E-03	-1.419E-03	1.000E 00	7.587E-04
70000	6.950E 00	1.123E 02	2.217E 01	-7.888E-05	-1.326E-04	-9.356E-04	-6.696E-04	1.000E 00	7.512E-04
70200	6.970E 00	1.123E 02	2.217E 01	-9.232E-05	-1.405E-04	-4.424E-04	-1.612E-04	1.000E 00	7.429E-04
70400	6.990E 00	1.123E 02	2.217E 01	-9.760E-05	-1.402E-04	-1.101E-04	1.723E-04	1.000E 00	7.345E-04
70600	7.010E 00	1.123E 02	2.217E 01	-9.746E-05	-1.344E-04	1.072E-04	3.802E-04	1.000E 00	7.262E-04
70800	7.030E 00	1.123E 02	2.217E 01	-9.384E-05	-1.255E-04	2.426E-04	4.992E-04	1.000E 00	7.184E-04
71000	7.050E 00	1.123E 02	2.217E 01	-8.812E-05	-1.149E-04	3.207E-04	5.563E-04	1.000E 00	7.111E-04
71200	7.069E 00	1.123E 02	2.217E 01	-8.126E-05	-1.035E-04	3.592E-04	5.714E-04	1.000E 00	7.046E-04
71400	7.089E 00	1.123E 02	2.217E 01	-7.392E-05	-9.220E-05	3.709E-04	5.588E-04	1.000E 00	6.987E-04
71600	7.109E 00	1.123E 02	2.217E 01	-6.654E-05	-8.130E-05	3.650E-04	5.288E-04	1.000E 00	6.934E-04
71800	7.129E 00	1.123E 02	2.217E 01	-5.940E-05	-7.111E-05	3.480E-04	4.989E-04	1.000E 00	6.889E-04
72000	7.149E 00	1.123E 02	2.217E 01	-5.266E-05	-6.178E-05	3.245E-04	4.442E-04	1.000E 00	6.849E-04
72200	7.169E 00	1.123E 02	2.217E 01	-4.644E-05	-5.336E-05	2.977E-04	3.980E-04	1.000E 00	6.814E-04
72400	7.188E 00	1.123E 02	2.217E 01	-4.076E-05	-4.585E-05	2.697E-04	3.527E-04	1.000E 00	6.784E-04
72600	7.208E 00	1.123E 02	2.217E 01	-3.565E-05	-3.923E-05	2.420E-04	3.098E-04	1.000E 00	6.758E-04
72800	7.228E 00	1.123E 02	2.217E 01	-3.107E-05	-3.344E-05	2.155E-04	2.701E-04	1.000E 00	6.736E-04
73000	7.248E 00	1.123E 02	2.217E 01	-2.702E-05	-2.841E-05	1.907E-04	2.340E-04	1.000E 00	6.718E-04
73200	7.268E 00	1.123E 02	2.217E 01	-2.343E-05	-2.406E-05	1.678E-04	2.016E-04	1.000E 00	6.702E-04
73400	7.288E 00	1.123E 02	2.217E 01	-2.029E-05	-2.032E-05	1.471E-04	1.729E-04	1.000E 00	6.688E-04
73600	7.307E 00	1.123E 02	2.217E 01	-1.754E-05	-1.712E-05	1.285E-04	1.477E-04	1.000E 00	6.677E-04
73800	7.327E 00	1.123E 02	2.217E 01	-1.513E-05	-1.437E-05	1.119E-04	1.257E-04	1.000E 00	6.667E-04
74000	7.347E 00	1.123E 02	2.217E 01	-1.305E-05	-1.207E-05	9.720E-05	1.066E-04	1.000E 00	6.659E-04
74200	7.367E 00	1.123E 02	2.217E 01	-1.124E-05	-1.011E-05	8.426E-05	9.017E-05	1.000E 00	6.652E-04
74400	7.387E 00	1.123E 02	2.217E 01	-9.667E-06	-8.449E-06	7.290E-05	7.607E-05	1.000E 00	6.646E-04
74600	7.407E 00	1.123E 02	2.217E 01	-8.311E-06	-7.052E-06	6.298E-05	6.402E-05	1.000E 00	6.642E-04
74800	7.427E 00	1.123E 02	2.217E 01	-7.140E-06	-5.877E-06	5.434E-05	5.377E-05	1.000E 00	6.638E-04
75000	7.446E 00	1.123E 02	2.217E 01	-6.131E-06	-4.892E-06	4.682E-05	4.507E-05	1.000E 00	6.634E-04
75200	7.466E 00	1.123E 02	2.217E 01	-5.261E-06	-4.066E-06	4.031E-05	3.771E-05	1.000E 00	6.631E-04
75400	7.486E 00	1.123E 02	2.217E 01	-4.513E-06	-3.376E-06	3.467E-05	3.150E-05	1.000E 00	6.629E-04
75600	7.506E 00	1.123E 02	2.217E 01	-3.870E-06	-2.800E-06	2.980E-05	2.627E-05	1.000E 00	6.627E-04
75800	7.526E 00	1.123E 02	2.217E 01	-3.317E-06	-2.320E-06	2.560E-05	2.188E-05	1.000E 00	6.625E-04
76000	7.546E 00	1.123E 02	2.217E 01	-2.842E-06	-1.921E-06	2.197E-05	1.820E-05	1.000E 00	6.624E-04
76200	7.565E 00	1.123E 02	2.217E 01	-2.435E-06	-1.588E-06	1.886E-05	1.512E-05	1.000E 00	6.622E-04
76400	7.585E 00	1.123E 02	2.217E 01	-2.086E-06	-1.313E-06	1.617E-05	1.255E-05	1.000E 00	6.621E-04
76600	7.605E 00	1.123E 02	2.217E 01	-1.786E-06	-1.084E-06	1.386E-05	1.040E-05	1.000E 00	6.620E-04
76800	7.625E 00	1.123E 02	2.217E 01	-1.529E-06	-8.940E-07	1.188E-05	8.616E-06	1.000E 00	6.619E-04
77000	7.645E 00	1.123E 02	2.217E 01	-1.309E-06	-7.371E-07	1.018E-05	7.129E-06	1.000E 00	6.619E-04
77200	7.665E 00	1.123E 02	2.217E 01	-1.120E-06	-6.073E-07	8.720E-06	5.894E-06	1.000E 00	6.618E-04
77400	7.684E 00	1.123E 02	2.217E 01	-9.585E-07	-5.001E-07	7.468E-06	4.868E-06	1.000E 00	6.618E-04
77600	7.704E 00	1.123E 02	2.217E 01	-8.202E-07	-4.115E-07	6.394E-06	4.018E-06	1.000E 00	6.617E-04
77800	7.724E 00	1.123E 02	2.217E 01	-7.018E-07	-3.384E-07	5.474E-06	3.314E-06	1.000E 00	6.617E-04
78000	7.744E 00	1.123E 02	2.217E 01	-6.005E-07	-2.782E-07	4.686E-06	2.732E-06	1.000E 00	6.616E-04
78200	7.764E 00	1.123E 02	2.217E 01	-5.137E-07	-2.286E-07	4.010E-06	2.250E-06	1.000E 00	6.616E-04

CYCLE	TIME	B1	B2	X1	Z1	X2	Z2	Y1	Y2
78400	7.784E 00	1.123E 02	2.217E 01	-4.395E-07	-1.877E-07	3.432E-06	1.852E-06	1.000E 00	6.616E-04
78600	7.803E 00	1.123E 02	2.217E 01	-3.759E-07	-1.540E-07	2.937E-06	1.524E-06	1.000E 00	6.615E-04
78800	7.823E 00	1.123E 02	2.217E 01	-3.215E-07	-1.264E-07	2.513E-06	1.253E-06	1.000E 00	6.615E-04
79000	7.843E 00	1.123E 02	2.217E 01	-2.750E-07	-1.036E-07	2.150E-06	1.029E-06	1.000E 00	6.614E-04
79200	7.863E 00	1.123E 02	2.217E 01	-2.353E-07	-8.494E-08	1.839E-06	8.455E-07	1.000E 00	6.614E-04
79400	7.883E 00	1.123E 02	2.217E 01	-2.012E-07	-6.959E-08	1.573E-06	6.942E-07	1.000E 00	6.613E-04
79600	7.903E 00	1.123E 02	2.217E 01	-1.721E-07	-5.700E-08	1.346E-06	5.696E-07	1.000E 00	6.613E-04
79800	7.922E 00	1.123E 02	2.217E 01	-1.472E-07	-4.667E-08	1.151E-06	4.672E-07	1.000E 00	6.612E-04
80000	7.942E 00	1.123E 02	2.217E 01	-1.259E-07	-3.819E-08	9.845E-07	3.831E-07	1.000E 00	6.612E-04
80200	7.962E 00	1.123E 02	2.217E 01	-1.076E-07	-3.125E-08	8.420E-07	3.139E-07	1.000E 00	6.612E-04
80400	7.982E 00	1.123E 02	2.217E 01	-9.206E-08	-2.556E-08	7.202E-07	2.572E-07	1.000E 00	6.612E-04
80600	8.002E 00	1.123E 02	2.217E 01	-7.872E-08	-2.090E-08	6.160E-07	2.106E-07	1.000E 00	6.612E-04
80800	8.022E 00	1.123E 02	2.217E 01	-6.732E-08	-1.708E-08	5.268E-07	1.724E-07	1.000E 00	6.612E-04
81000	8.041E 00	1.123E 02	2.217E 01	-5.756E-08	-1.396E-08	4.505E-07	1.411E-07	1.000E 00	6.612E-04
81200	8.061E 00	1.123E 02	2.217E 01	-4.923E-08	-1.141E-08	3.853E-07	1.154E-07	1.000E 00	6.612E-04
81400	8.081E 00	1.123E 02	2.217E 01	-4.209E-08	-9.315E-09	3.295E-07	9.438E-08	1.000E 00	6.612E-04
81600	8.101E 00	1.123E 02	2.217E 01	-3.600E-08	-7.606E-09	2.818E-07	7.716E-08	1.000E 00	6.612E-04
81800	8.121E 00	1.123E 02	2.217E 01	-3.078E-08	-6.209E-09	2.409E-07	6.306E-08	1.000E 00	6.612E-04
82000	8.141E 00	1.123E 02	2.217E 01	-2.632E-08	-5.067E-09	2.060E-07	5.153E-08	1.000E 00	6.612E-04
82200	8.160E 00	1.123E 02	2.217E 01	-2.251E-08	-4.134E-09	1.762E-07	4.209E-08	1.000E 00	6.612E-04
82400	8.180E 00	1.123E 02	2.217E 01	-1.925E-08	-3.372E-09	1.507E-07	3.437E-08	1.000E 00	6.612E-04
82600	8.200E 00	1.123E 02	2.217E 01	-1.646E-08	-2.750E-09	1.288E-07	2.806E-08	1.000E 00	6.612E-04
82800	8.220E 00	1.123E 02	2.217E 01	-1.408E-08	-2.243E-09	1.102E-07	2.291E-08	1.000E 00	6.612E-04
83000	8.240E 00	1.123E 02	2.217E 01	-1.204E-08	-1.828E-09	9.421E-08	1.869E-08	1.000E 00	6.612E-04
83200	8.260E 00	1.123E 02	2.217E 01	-1.029E-08	-1.490E-09	8.056E-08	1.525E-08	1.000E 00	6.612E-04
83400	8.279E 00	1.123E 02	2.217E 01	-8.801E-09	-1.214E-09	6.889E-08	1.244E-08	1.000E 00	6.612E-04
83600	8.299E 00	1.123E 02	2.217E 01	-7.526E-09	-9.894E-10	5.891E-08	1.014E-08	1.000E 00	6.612E-04
83800	8.319E 00	1.123E 02	2.217E 01	-6.435E-09	-8.060E-10	5.037E-08	8.270E-09	1.000E 00	6.612E-04
84000	8.339E 00	1.123E 02	2.217E 01	-5.503E-09	-6.564E-10	4.308E-08	6.741E-09	1.000E 00	6.612E-04
84200	8.359E 00	1.123E 02	2.217E 01	-4.705E-09	-5.345E-10	3.684E-08	5.494E-09	1.000E 00	6.612E-04
84400	8.379E 00	1.123E 02	2.217E 01	-4.023E-09	-4.352E-10	3.150E-08	4.476E-09	1.000E 00	6.612E-04
84600	8.398E 00	1.123E 02	2.217E 01	-3.440E-09	-3.543E-10	2.693E-08	3.647E-09	1.000E 00	6.612E-04
84800	8.418E 00	1.123E 02	2.217E 01	-2.942E-09	-2.884E-10	2.303E-08	2.971E-09	1.000E 00	6.612E-04
85000	8.438E 00	1.123E 02	2.217E 01	-2.515E-09	-2.347E-10	1.969E-08	2.419E-09	1.000E 00	6.612E-04
85200	8.458E 00	1.123E 02	2.217E 01	-2.151E-09	-1.909E-10	1.684E-08	1.970E-09	1.000E 00	6.612E-04
85400	8.478E 00	1.123E 02	2.217E 01	-1.839E-09	-1.553E-10	1.440E-08	1.604E-09	1.000E 00	6.612E-04
85600	8.498E 00	1.123E 02	2.217E 01	-1.573E-09	-1.264E-10	1.231E-08	1.305E-09	1.000E 00	6.612E-04
85800	8.518E 00	1.123E 02	2.217E 01	-1.345E-09	-1.028E-10	1.053E-08	1.063E-09	1.000E 00	6.612E-04
86000	8.537E 00	1.123E 02	2.217E 01	-1.150E-09	-8.359E-11	9.003E-09	8.646E-10	1.000E 00	6.612E-04
86200	8.557E 00	1.123E 02	2.217E 01	-9.833E-10	-6.797E-11	7.698E-09	7.035E-10	1.000E 00	6.612E-04
86400	8.577E 00	1.123E 02	2.217E 01	-8.408E-10	-5.526E-11	6.583E-09	5.723E-10	1.000E 00	6.612E-04
86600	8.597E 00	1.123E 02	2.217E 01	-7.190E-10	-4.492E-11	5.629E-09	4.655E-10	1.000E 00	6.612E-04
86800	8.617E 00	1.123E 02	2.217E 01	-6.148E-10	-3.652E-11	4.813E-09	3.786E-10	1.000E 00	6.612E-04
87000	8.637E 00	1.123E 02	2.217E 01	-5.257E-10	-2.968E-11	4.116E-09	3.079E-10	1.000E 00	6.612E-04
87200	8.656E 00	1.123E 02	2.217E 01	-4.495E-10	-2.412E-11	3.519E-09	2.503E-10	1.000E 00	6.612E-04
87400	8.676E 00	1.123E 02	2.217E 01	-3.844E-10	-1.960E-11	3.009E-09	2.035E-10	1.000E 00	6.612E-04
87600	8.696E 00	1.123E 02	2.217E 01	-3.287E-10	-1.592E-11	2.573E-09	1.654E-10	1.000E 00	6.612E-04
87800	8.716E 00	1.123E 02	2.217E 01	-2.810E-10	-1.293E-11	2.200E-09	1.345E-10	1.000E 00	6.612E-04
88000	8.736E 00	1.123E 02	2.217E 01	-2.403E-10	-1.051E-11	1.882E-09	1.093E-10	1.000E 00	6.612E-04
88200	8.756E 00	1.123E 02	2.217E 01	-2.055E-10	-8.534E-12	1.609E-09	8.880E-11	1.000E 00	6.612E-04
88400	8.775E 00	1.123E 02	2.217E 01	-1.757E-10	-6.931E-12	1.376E-09	7.215E-11	1.000E 00	6.612E-04
88600	8.795E 00	1.123E 02	2.217E 01	-1.502E-10	-5.629E-12	1.176E-09	5.862E-11	1.000E 00	6.612E-04
88800	8.815E 00	1.123E 02	2.217E 01	-1.285E-10	-4.573E-12	1.006E-09	4.762E-11	1.000E 00	6.612E-04
89000	8.835E 00	1.123E 02	2.217E 01	-1.099E-10	-3.711E-12	8.601E-10	3.868E-11	1.000E 00	6.612E-04
89200	8.855E 00	1.123E 02	2.217E 01	-9.394E-11	-3.013E-12	7.355E-10	3.142E-11	1.000E 00	6.612E-04
89400	8.875E 00	1.123E 02	2.217E 01	-8.033E-11	-2.446E-12	6.289E-10	2.551E-11	1.000E 00	6.612E-04

CYCLE	TIME	B1	B2	X1	Z1	X2	Z2	Y1	Y2
89600	8.894E 00	1.123E 02	2.217E 01	-6.869E-11	-1.985E-12	5.378E-10	2.072E-11	1.000E 00	6.612E-04
89800	8.914E 00	1.123E 02	2.217E 01	-5.873E-11	-1.611E-12	4.598E-10	1.682E-11	1.000E 00	6.612E-04
90000	8.934E 00	1.123E 02	2.217E 01	-5.022E-11	-1.308E-12	3.932E-10	1.366E-11	1.000E 00	6.612E-04
90200	8.954E 00	1.123E 02	2.217E 01	-4.295E-11	-1.061E-12	3.362E-10	1.109E-11	1.000E 00	6.612E-04
90400	8.974E 00	1.123E 02	2.217E 01	-3.672E-11	-8.611E-13	2.875E-10	9.000E-12	1.000E 00	6.612E-04
90600	8.994E 00	1.123E 02	2.217E 01	-3.140E-11	-5.987E-13	2.458E-10	7.306E-12	1.000E 00	6.612E-04
90800	9.013E 00	1.123E 02	2.217E 01	-2.685E-11	-5.551E-13	2.102E-10	5.929E-12	1.000E 00	6.612E-04
91000	9.033E 00	1.123E 02	2.217E 01	-2.296E-11	-4.599E-13	1.797E-10	4.812E-12	1.000E 00	6.612E-04
91200	9.053E 00	1.123E 02	2.217E 01	-1.963E-11	-3.731E-13	1.537E-10	3.905E-12	1.000E 00	6.612E-04
91400	9.073E 00	1.123E 02	2.217E 01	-1.679E-11	-3.026E-13	1.314E-10	3.169E-12	1.000E 00	6.612E-04
91600	9.093E 00	1.123E 02	2.217E 01	-1.435E-11	-2.455E-13	1.124E-10	2.571E-12	1.000E 00	6.612E-04
91800	9.113E 00	1.123E 02	2.217E 01	-1.227E-11	-1.991E-13	9.610E-11	2.086E-12	1.000E 00	6.612E-04
92000	9.132E 00	1.123E 02	2.217E 01	-1.049E-11	-1.615E-13	8.217E-11	1.692E-12	1.000E 00	6.612E-04
92200	9.152E 00	1.123E 02	2.217E 01	-8.974E-12	-1.310E-13	7.026E-11	1.373E-12	1.000E 00	6.612E-04
92400	9.172E 00	1.123E 02	2.217E 01	-7.673E-12	-1.062E-13	6.008E-11	1.113E-12	1.000E 00	6.612E-04
92600	9.192E 00	1.123E 02	2.217E 01	-6.561E-12	-8.611E-14	5.137E-11	9.030E-13	1.000E 00	6.612E-04
92800	9.212E 00	1.123E 02	2.217E 01	-5.611E-12	-6.981E-14	4.393E-11	7.324E-13	1.000E 00	6.612E-04
93000	9.232E 00	1.123E 02	2.217E 01	-4.798E-12	-5.660E-14	3.756E-11	5.940E-13	1.000E 00	6.612E-04
93200	9.251E 00	1.123E 02	2.217E 01	-4.102E-12	-4.589E-14	3.212E-11	4.817E-13	1.000E 00	6.612E-04
93400	9.271E 00	1.123E 02	2.217E 01	-3.508E-12	-3.720E-14	2.746E-11	3.906E-13	1.000E 00	6.612E-04
93600	9.291E 00	1.123E 02	2.217E 01	-3.000E-12	-3.016E-14	2.348E-11	3.167E-13	1.000E 00	6.612E-04
93800	9.311E 00	1.123E 02	2.217E 01	-2.565E-12	-2.444E-14	2.008E-11	2.568E-13	1.000E 00	6.612E-04
94000	9.331E 00	1.123E 02	2.217E 01	-2.193E-12	-1.981E-14	1.717E-11	2.082E-13	1.000E 00	6.612E-04
94200	9.351E 00	1.123E 02	2.217E 01	-1.875E-12	-1.606E-14	1.468E-11	1.688E-13	1.000E 00	6.612E-04
94400	9.370E 00	1.123E 02	2.217E 01	-1.604E-12	-1.302E-14	1.255E-11	1.368E-13	1.000E 00	6.612E-04
94600	9.390E 00	1.123E 02	2.217E 01	-1.371E-12	-1.055E-14	1.074E-11	1.109E-13	1.000E 00	6.612E-04
94800	9.410E 00	1.123E 02	2.217E 01	-1.173E-12	-8.548E-15	9.180E-12	8.990E-14	1.000E 00	6.612E-04
95000	9.430E 00	1.123E 02	2.217E 01	-1.003E-12	-6.927E-15	7.850E-12	7.287E-14	1.000E 00	6.612E-04
95200	9.450E 00	1.123E 02	2.217E 01	-8.572E-13	-5.613E-15	6.712E-12	5.906E-14	1.000E 00	6.612E-04
95400	9.470E 00	1.123E 02	2.217E 01	-7.330E-13	-4.549E-15	5.740E-12	4.786E-14	1.000E 00	6.612E-04
95600	9.489E 00	1.123E 02	2.217E 01	-6.268E-13	-3.685E-15	4.908E-12	3.879E-14	1.000E 00	6.612E-04
95800	9.509E 00	1.123E 02	2.217E 01	-5.360E-13	-2.986E-15	4.196E-12	3.144E-14	1.000E 00	6.612E-04
96000	9.529E 00	1.123E 02	2.217E 01	-4.583E-13	-2.419E-15	3.588E-12	2.547E-14	1.000E 00	6.612E-04
96200	9.549E 00	1.123E 02	2.217E 01	-3.919E-13	-1.960E-15	3.068E-12	2.064E-14	1.000E 00	6.612E-04
96400	9.569E 00	1.123E 02	2.217E 01	-3.351E-13	-1.589E-15	2.624E-12	1.672E-14	1.000E 00	6.612E-04
96600	9.589E 00	1.123E 02	2.217E 01	-2.866E-13	-1.286E-15	2.243E-12	1.355E-14	1.000E 00	6.612E-04
96800	9.609E 00	1.123E 02	2.217E 01	-2.450E-13	-1.042E-15	1.918E-12	1.098E-14	1.000E 00	6.612E-04
97000	9.628E 00	1.123E 02	2.217E 01	-2.095E-13	-8.439E-16	1.640E-12	8.895E-15	1.000E 00	6.612E-04
97200	9.648E 00	1.123E 02	2.217E 01	-1.792E-13	-6.835E-16	1.403E-12	7.206E-15	1.000E 00	6.612E-04
97400	9.668E 00	1.123E 02	2.217E 01	-1.532E-13	-5.536E-16	1.199E-12	5.837E-15	1.000E 00	6.612E-04
97600	9.688E 00	1.123E 02	2.217E 01	-1.310E-13	-4.484E-16	1.026E-12	4.728E-15	1.000E 00	6.612E-04
97800	9.708E 00	1.123E 02	2.217E 01	-1.120E-13	-3.631E-16	8.769E-13	3.830E-15	1.000E 00	6.612E-04
98000	9.728E 00	1.123E 02	2.217E 01	-9.578E-14	-2.941E-16	7.499E-13	3.102E-15	1.000E 00	6.612E-04
98200	9.747E 00	1.123E 02	2.217E 01	-8.190E-14	-2.382E-16	6.412E-13	2.513E-15	1.000E 00	6.612E-04
98400	9.767E 00	1.123E 02	2.217E 01	-7.003E-14	-1.929E-16	5.483E-13	2.035E-15	1.000E 00	6.612E-04
98600	9.787E 00	1.123E 02	2.217E 01	-5.988E-14	-1.562E-16	4.689E-13	1.648E-15	1.000E 00	6.612E-04
98800	9.807E 00	1.123E 02	2.217E 01	-5.120E-14	-1.265E-16	4.009E-13	1.335E-15	1.000E 00	6.612E-04
99000	9.827E 00	1.123E 02	2.217E 01	-4.378E-14	-1.024E-16	3.428E-13	1.081E-15	1.000E 00	6.612E-04
99200	9.847E 00	1.123E 02	2.217E 01	-3.744E-14	-8.292E-17	2.931E-13	8.756E-16	1.000E 00	6.612E-04
99400	9.866E 00	1.123E 02	2.217E 01	-3.201E-14	-6.714E-17	2.506E-13	7.090E-16	1.000E 00	6.612E-04
99600	9.886E 00	1.123E 02	2.217E 01	-2.737E-14	-5.436E-17	2.143E-13	5.741E-16	1.000E 00	6.612E-04
99800	9.906E 00	1.123E 02	2.217E 01	-2.341E-14	-4.401E-17	1.833E-13	4.649E-16	1.000E 00	6.612E-04
*****	9.926E 00	1.123E 02	2.217E 01	-2.002E-14	-3.563E-17	1.567E-13	3.764E-16	1.000E 00	6.612E-04

```
      DATA Z1,Z2,Y1,Y2/0.0,0.0,0.0,0.0/
      REWIND 9
      READ(5,1)A1,A0,B1,B0
    1 FORMAT(4G10.3)
      WRITE(6,1)A1,A0,B1,B0
      R=1.0
      DT=1.E-4
      C=3.0
      DO 100 J=1,100000
C     ----------OBSERVABLE FORM-WITH-FEEDBACK----------
      Y1D=C*Y2
      Y2D=C*Z1
      Z1D=-A1*Z1+Z2+B1*(R-Y1)
      Z2D=-A0*Z1+B0*(R-Y1)
C
      Y1=Y1+DT*Y1D
      Y2=Y2+DT*Y2D
      Z1=Z1+DT*Z1D
      Z2=Z2+DT*Z2D
      WRITE(9,2)J,R,Z1,Z2,Y1,Y2
    2 FORMAT(I6,F4.1,4E15.7)
  100 CONTINUE
      END FILE 9
      REWIND 9
      STOP
      END
```

```
C-----------------------------START PROGRAM-----------------------------
      IMPLICIT REAL(M,N)
      INTEGER MCD
      REWIND 5
      DATA Z1,Z2,X1,X2,Y1,Y2/0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0/
      READ(5,200)H1,H0,G1,GC
      READ(5,201)M11,M22,M12
      READ(5,202)N11,N22,N12
      READ(5,203)C11,C22,C12
      READ(5,204)DT
      WRITE(6,20)H1,H0,G1,G0,DT
      WRITE(6,25)M11,M22,M12
      WRITE(6,21)N11,N22,N12,C11,C22,C12
      WRITE(6,22)
      T=0.0
C
      DO 100 K=1,80000
      IF(K.EC.1.OR.MOD(K,100).EC.0)WRITE(6,23)T,H1,H0,G1,G0,Z1,Z2,X1,X2,
     1Y1,Y2
      T=T+DT
C-------------------------READING OF REFERENCE SYSTEM---------------------
      READ(5,1000)J,R,Z1,Z2,Y1,Y2
 1000 FORMAT(I6,F4.1,4E15.7)
      IF(J.EC.1)G1=Z1/DT
      IF(J.EC.1)GC=Z2/DT
C
C                ----------MODEL SYSTEM STATE EQUATIONS-----------------
      X1D=-H1*X1+X2+G1*(R-Y1)
      X2D=-HC*X1+GC*(R-Y1)
C
      X1=X1+DT*X1D
      X2=X2+DT*X2D
C
      E1=Z1-X1
      E2=Z2-X2
C
      H1D=-X1*(M11*E1+M12*E2)/N11
      HOD=-X1*(M12*E1+M22*E2)/N22
C
      H1=H1+DT*H1D
      HO=HO+DT*HOD
  100 CONTINUE
   20 FORMAT('1 LIAPUNOV STABILITY MODELLING OF SECOND ORDER SYSTEM'////
     1' STARTING PARAMETERS OF MODEL...'/T10,'H1= ',1PE10.3,T30,'HO= ',E
     210.3,T60,'G1= ',E10.3,T80,'GO= ',E10.3///' DELTA T= ',E10.3//)
   21 FORMAT(' MATRIX ELEMENTS.....'//' N11= ',1PE10.3,10X,'N22= ',E10.
     13,10X,'N12= ',E10.3/' C11= ',E10.3,10X,'C22= ',E10.3,10X,'C12= ',E
     210.3////)
   22 FORMAT(' TIME',9X,'H1',9X,'HO',9X,'G1',9X,'GO',9X,'Z1',9X,'Z2',9X,
     1'X1',9X,'X2',9X,'Y1',9X,'Y2'//)
   23 FORMAT(T1,11(1X,1PE10.3))
   25 FORMAT(' M MATRIX.....'//' M11= ',1PE10.3,10X,'M22= ',E10.3,10X,'
     1M12= ',E10.3//)
  200 FORMAT(4F10.3)
  201 FORMAT(3F10.3)
  202 FORMAT(3F10.3)
  203 FORMAT(3F10.3)
  204 FORMAT(F20.7)
```

```
      C     ----------END OF PROGRAM----------
CC43          REWIND 5
CC44          STOP
CC45          END
```

LIAPUNOV STABILITY MODELLING OF SECOND ORDER SYSTEM

STARTING PARAMETERS OF MODEL...
H1= 2.000E 00 H0= 2.000E 02 G1= 0.0 G0= 0.0

DELTA T= 1.000E-04

M MATRIX.....

M11= 7.000E 02 M22= 3.000E 01 M12= -1.000E 02

MATRIX ELEMENTS.....

N11= 5.000E-01 N22= 5.000E-02 N12= 0.0
Q11= 1.000E 00 Q22= 1.000E 00 Q12= 0.0

TIME	H1	H0	G1	G0	Z1	Z2	X1	X2	Y1	Y2
0.0	2.000E 00	2.000E 02	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.900E-03	2.538E 00	1.989E 02	1.020E 02	1.870E 02	9.150E-01	1.290E 00	1.005E 00	8.657E-01	1.372E-04	1.391E-02
1.990E-02	9.944E 00	1.822E 02	1.020E 02	1.870E 02	1.664E 00	1.587E 00	1.947E 00	-1.261E-01	1.077E-03	5.289E-02
2.990E-02	3.074E 01	1.359E 02	1.020E 02	1.870E 02	2.262E 00	1.768E 00	2.503E 00	-1.921E 00	3.497E-03	1.120E-01
3.990E-02	4.697E 01	8.935E 01	1.020E 02	1.870E 02	2.731E 00	-1.021E-01	2.478E 00	-2.849E 00	7.938E-03	1.871E-01
4.990E-02	3.920E 01	8.445E 01	1.020E 02	1.870E 02	3.089E 00	-1.782E 00	2.377E 00	-3.004E 00	1.402E-02	2.746E-01
5.990E-02	1.509E 01	1.158E 02	1.020E 02	1.870E 02	3.351E 00	-3.051E 00	2.657E 00	-3.598E 00	2.448E-02	3.714E-01
6.990E-02	-4.263E 00	1.479E 02	1.020E 02	1.870E 02	3.522E 00	-4.709E 00	3.508E 00	-5.882E 00	3.714E-02	4.748E-01
7.990E-02	1.967E 01	1.102E 02	1.020E 02	1.870E 02	3.641E 00	-8.769E 00	4.257E 00	-9.485E 00	5.298E-02	5.826E-01
8.990E-02	4.379E 01	7.080E 01	1.020E 02	1.870E 02	3.650E 00	-1.146E 01	3.675E 00	-1.112E 01	7.209E-02	6.927E-01
9.990E-02	2.222E 01	1.140E 02	1.020E 02	1.870E 02	3.685E 00	-1.421E 01	3.280E 00	-1.238E 01	9.451E-02	8.034E-01
1.099E-01	3.509E-01	1.646E 02	1.020E 02	1.870E 02	3.634E 00	-1.697E 01	3.743E 00	-1.565E 01	1.202E-01	9.133E-01
1.199E-01	2.305E 01	1.354E 02	1.020E 02	1.870E 02	3.543E 00	-1.970E 01	4.129E 00	-2.037E 01	1.492E-01	1.021E 00
1.299E-01	4.613E 01	9.231E 01	1.020E 02	1.870E 02	3.418E 00	-2.235E 01	3.336E 00	-2.296E 01	1.814E-01	1.126E 00
1.399E-01	3.056E 01	1.139E 02	1.020E 02	1.870E 02	3.264E 00	-2.490E 01	2.704E 00	-2.439E 01	2.167E-01	1.226E 00
1.499E-01	7.930E 00	1.527E 02	1.020E 02	1.870E 02	3.084E 00	-2.731E 01	2.722E 00	-2.652E 01	2.549E-01	1.321E 00
1.599E-01	3.075E 00	1.626E 02	1.020E 02	1.870E 02	2.882E 00	-2.957E 01	3.093E 00	-2.987E 01	2.959E-01	1.411E 00
1.699E-01	2.581E 01	1.203E 02	1.020E 02	1.870E 02	2.662E 00	-3.165E 01	3.065E 00	-3.314E 01	3.394E-01	1.494E 00
1.799E-01	4.213E 01	8.441E 01	1.020E 02	1.870E 02	2.426E 00	-3.353E 01	2.397E 00	-3.470E 01	3.854E-01	1.570E 00
1.899E-01	3.833E 01	8.549E 01	1.020E 02	1.870E 02	2.178E 00	-3.522E 01	1.788E 00	-3.531E 01	4.335E-01	1.639E 00
1.999E-01	2.700E 01	1.037E 02	1.020E 02	1.870E 02	1.920E 00	-3.668E 01	1.454E 00	-3.580E 01	4.836E-01	1.701E 00
2.099E-01	1.561E 01	1.252E 02	1.020E 02	1.870E 02	1.654E 00	-3.793E 01	1.302E 00	-3.644E 01	5.355E-01	1.754E 00
2.199E-01	7.101E 00	1.427E 02	1.020E 02	1.870E 02	1.382E 00	-3.895E 01	1.239E 00	-3.733E 01	5.888E-01	1.800E 00
2.299E-01	3.021E 00	1.553E 02	1.020E 02	1.870E 02	1.106E 00	-3.974E 01	1.194E 00	-3.844E 01	6.434E-01	1.837E 00
2.399E-01	3.761E 00	1.578E 02	1.020E 02	1.870E 02	8.286E-01	-4.029E 01	1.104E 00	-3.964E 01	6.989E-01	1.866E 00
2.499E-01	7.938E 00	1.527E 02	1.020E 02	1.870E 02	5.506E-01	-4.062E 01	9.234E-01	-4.073E 01	7.552E-01	1.887E 00
2.599E-01	1.287E 01	1.446E 02	1.020E 02	1.870E 02	2.738E-01	-4.071E 01	6.506E-01	-4.151E 01	8.121E-01	1.899E 00
2.699E-01	1.633E 01	1.380E 02	1.020E 02	1.870E 02	-2.756E-04	-4.058E 01	3.240E-01	-4.190E 01	8.691E-01	1.903E 00
2.799E-01	1.741E 01	1.359E 02	1.020E 02	1.870E 02	-2.762E-01	-4.022E 01	-1.749E-02	-4.192E 01	9.262E-01	1.899E 00
2.899E-01	1.616E 01	1.387E 02	1.020E 02	1.870E 02	-5.249E-01	-3.965E 01	-3.581E-01	-4.158E 01	9.830E-01	1.887E 00
2.999E-01	1.310E 01	1.464E 02	1.020E 02	1.870E 02	-7.929E-01	-3.887E 01	-7.052E-01	-4.085E 01	1.039E 00	1.867E 00
3.099E-01	9.433E 00	1.569E 02	1.020E 02	1.870E 02	-1.043E 00	-3.788E 01	-1.078E 00	-3.963E 01	1.095E 00	1.840E 00
3.199E-01	7.908E 00	1.648E 02	1.020E 02	1.870E 02	-1.285E 00	-3.670E 01	-1.485E 00	-3.779E 01	1.150E 00	1.805E 00
3.299E-01	1.279E 01	1.668E 02	1.020E 02	1.870E 02	-1.517E 00	-3.534E 01	-1.868E 00	-3.536E 01	1.203E 00	1.763E 00

3.398E-01	2.509E 01	1.398E 02	1.020E 02	1.870E 02	-1.738E 00	-3.380E 01	-2.078E 00	-3.277E 01	1.255E 00	1.714E 00
3.498E-01	3.683E 01	1.147E 02	1.020E 02	1.870E 02	-1.944E 00	-3.209E 01	-2.027E 00	-3.068E 01	1.306E 00	1.658E 00
3.598E-01	3.943E 01	1.031E 02	1.020E 02	1.870E 02	-2.146E 00	-3.023E 01	-1.899E 00	-2.919E 01	1.354E 00	1.597E 00
3.698E-01	3.240E 01	1.092E 02	1.020E 02	1.870E 02	-2.331E 00	-2.824E 01	-1.883E 00	-2.793E 01	1.401E 00	1.530E 00
3.798E-01	1.959E 01	1.278E 02	1.020E 02	1.870E 02	-2.503E 00	-2.609E 01	-2.074E 00	-2.641E 01	1.444E 00	1.457E 00
3.898E-01	8.082E 00	1.470E 02	1.020E 02	1.870E 02	-2.662E 00	-2.384E 01	-2.507E 00	-2.415E 01	1.489E 00	1.380E 00
3.998E-01	1.059E 01	1.428E 02	1.020E 02	1.870E 02	-2.806E 00	-2.148E 01	-3.040E 00	-2.059E 01	1.529E 00	1.298E 00
4.097E-01	2.885E 01	1.083E 02	1.020E 02	1.870E 02	-2.935E 00	-1.903E 01	-3.183E 00	-1.801E 01	1.566E 00	1.211E 00
4.197E-01	3.605E 01	9.063E 01	1.020E 02	1.870E 02	-3.050E 00	-1.650E 01	-2.904E 00	-1.616E 01	1.601E 00	1.122E 00
4.297E-01	2.396E 01	1.096E 02	1.020E 02	1.870E 02	-3.150E 00	-1.390E 01	-2.807E 00	-1.456E 01	1.634E 00	1.029E 00
4.397E-01	8.707E 00	1.392E 02	1.020E 02	1.870E 02	-3.235E 00	-1.125E 01	-3.145E 00	-1.209E 01	1.663E 00	9.327E-01
4.497E-01	1.300E 01	1.376E 02	1.020E 02	1.870E 02	-3.304E 00	-8.559E 00	-3.648E 00	-8.492E 00	1.689E 00	8.346E-01
4.597E-01	3.320E 01	1.040E 02	1.020E 02	1.870E 02	-3.359E 00	-5.838E 00	-3.571E 00	-5.365E 00	1.713E 00	7.346E-01
4.697E-01	3.319E 01	1.027E 02	1.020E 02	1.870E 02	-3.398E 00	-3.101E 00	-3.160E 00	-3.382E 00	1.733E 00	6.333E-01
4.797E-01	1.640E 01	1.327E 02	1.020E 02	1.870E 02	-3.422E 00	-3.622E-01	-3.155E 00	-1.141E 00	1.751E 00	5.309E-01
4.897E-01	9.157E 00	1.486E 02	1.020E 02	1.870E 02	-3.431E 00	2.368E 00	-3.563E 00	2.252E 00	1.765E 00	4.281E-01
4.997E-01	2.556E 01	1.197E 02	1.020E 02	1.870E 02	-3.426E 00	5.076E 00	-3.709E 00	5.869E 00	1.777E 00	3.252E-01
5.097E-01	3.569E 01	9.820E 01	1.020E 02	1.870E 02	-3.407E 00	7.751E 00	-3.282E 00	8.129E 00	1.785E 00	2.226E-01
5.197E-01	2.341E 01	1.164E 02	1.020E 02	1.870E 02	-3.373E 00	1.038E 01	-3.013E 00	9.924E 00	1.790E 00	1.209E-01
5.297E-01	9.460E 00	1.418E 02	1.020E 02	1.870E 02	-3.326E 00	1.296E 01	-3.246E 00	1.249E 01	1.792E 00	2.037E-02
5.397E-01	1.546E 01	1.327E 02	1.020E 02	1.870E 02	-3.266E 00	1.547E 01	-3.556E 00	1.586E 01	1.791E 00	-7.856E-02
5.497E-01	3.257E 01	1.027E 02	1.020E 02	1.870E 02	-3.194E 00	1.790E 01	-3.334E 00	1.850E 01	1.787E 00	-1.755E-01
5.597E-01	3.151E 01	1.011E 02	1.020E 02	1.870E 02	-3.109E 00	2.025E 01	-2.887E 00	2.009E 01	1.780E 00	-2.701E-01
5.697E-01	1.840E 01	1.248E 02	1.020E 02	1.870E 02	-3.013E 00	2.250E 01	-2.755E 00	2.176E 01	1.771E 00	-3.619E-01
5.797E-01	9.534E 00	1.436E 02	1.020E 02	1.870E 02	-2.906E 00	2.465E 01	-2.942E 00	2.417E 01	1.759E 00	-4.508E-01
5.897E-01	1.741E 01	1.329E 02	1.020E 02	1.870E 02	-2.789E 00	2.669E 01	-3.086E 00	2.705E 01	1.744E 00	-5.362E-01
5.997E-01	3.156E 01	1.073E 02	1.020E 02	1.870E 02	-2.663E 00	2.862E 01	-2.013E 00	2.925E 01	1.727E 00	-6.181E-01
6.097E-01	3.356E 01	1.009E 02	1.020E 02	1.870E 02	-2.528E 00	3.042E 01	-2.372E 00	3.056E 01	1.707E 00	-6.960E-01
6.197E-01	2.537E 01	1.139E 02	1.020E 02	1.870E 02	-2.384E 00	3.209E 01	-2.103E 00	3.161E 01	1.685E 00	-7.697E-01
6.297E-01	1.552E 01	1.322E 02	1.020E 02	1.870E 02	-2.234E 00	3.363E 01	-2.048E 00	3.289E 01	1.661E 00	-8.390E-01
6.397E-01	1.058E 01	1.434E 02	1.020E 02	1.870E 02	-2.077E 00	3.502E 01	-2.114E 00	3.456E 01	1.634E 00	-9.037E-01
6.497E-01	1.422E 01	1.393E 02	1.020E 02	1.870E 02	-1.914E 00	3.628E 01	-2.142E 00	3.645E 01	1.606E 00	-9.636E-01
6.596E-01	2.345E 01	1.231E 02	1.020E 02	1.870E 02	-1.746E 00	3.739E 01	-1.985E 00	3.809E 01	1.577E 00	-1.018E 00
6.696E-01	3.083E 01	1.080E 02	1.020E 02	1.870E 02	-1.574E 00	3.835E 01	-1.668E 00	3.915E 01	1.545E 00	-1.068E 00
6.796E-01	3.317E 01	1.013E 02	1.020E 02	1.870E 02	-1.399E 00	3.916E 01	-1.328E 00	3.972E 01	1.512E 00	-1.113E 00
6.896E-01	3.157E 01	1.016E 02	1.020E 02	1.870E 02	-1.221E 00	3.982E 01	-1.047E 00	3.999E 01	1.478E 00	-1.152E 00
6.996E-01	2.534E 01	1.054E 02	1.020E 02	1.870E 02	-1.041E 00	4.032E 01	-8.286E-01	4.009E 01	1.443E 00	-1.186E 00
7.096E-01	2.654E 01	1.104E 02	1.020E 02	1.870E 02	-8.609E-01	4.068E 01	-6.542E-01	4.009E 01	1.407E 00	-1.215E 00
7.196E-01	2.414E 01	1.151E 02	1.020E 02	1.870E 02	-6.801E-01	4.088E 01	-5.034E-01	4.002E 01	1.370E 00	-1.238E 00
7.296E-01	2.235E 01	1.190E 02	1.020E 02	1.870E 02	-4.998E-01	4.094E 01	-3.610E-01	3.987E 01	1.333E 00	-1.255E 00
7.396E-01	2.119E 01	1.217E 02	1.020E 02	1.870E 02	-3.208E-01	4.085E 01	-2.207E-01	3.963E 01	1.295E 00	-1.268E 00
7.496E-01	2.064E 01	1.231E 02	1.020E 02	1.870E 02	-1.438E-01	4.061E 01	-7.600E-02	3.930E 01	1.257E 00	-1.275E 00
7.596E-01	2.063E 01	1.231E 02	1.020E 02	1.870E 02	3.057E-02	4.024E 01	7.314E-02	3.885E 01	1.219E 00	-1.276E 00
7.696E-01	2.112E 01	1.217E 02	1.020E 02	1.870E 02	2.014E-01	3.972E 01	2.250E-01	3.830E 01	1.180E 00	-1.273E 00
7.796E-01	2.204E 01	1.190E 02	1.020E 02	1.870E 02	3.665E-01	3.908E 01	3.759E-01	3.764E 01	1.142E 00	-1.264E 00
7.896E-01	2.332E 01	1.152E 02	1.020E 02	1.870E 02	5.309E-01	3.830E 01	5.213E-01	3.688E 01	1.104E 00	-1.251E 00
7.996E-01	2.479E 01	1.105E 02	1.020E 02	1.870E 02	6.880E-01	3.740E 01	6.571E-01	3.606E 01	1.067E 00	-1.232E 00
8.096E-01	2.618E 01	1.056E 02	1.020E 02	1.870E 02	8.394E-01	3.639E 01	7.804E-01	3.519E 01	1.030E 00	-1.209E 00
8.196E-01	2.711E 01	1.014E 02	1.020E 02	1.870E 02	9.844E-01	3.526E 01	8.921E-01	3.430E 01	9.944E-01	-1.182E 00
8.296E-01	2.716E 01	9.859E 01	1.020E 02	1.870E 02	1.123E 00	3.403E 01	9.973E-01	3.340E 01	9.594E-01	-1.150E 00
8.396E-01	2.603E 01	9.919E 01	1.020E 02	1.870E 02	1.254E 00	3.270E 01	1.105E 00	3.247E 01	9.254E-01	-1.115E 00
8.496E-01	2.359E 01	1.026E 02	1.020E 02	1.870E 02	1.377E 00	3.128E 01	1.228E 00	3.147E 01	8.926E-01	-1.075E 00
8.596E-01	2.014E 01	1.091E 02	1.020E 02	1.870E 02	1.492E 00	2.977E 01	1.378E 00	3.032E 01	8.609E-01	-1.032E 00
8.696E-01	1.657E 01	1.174E 02	1.020E 02	1.870E 02	1.599E 00	2.819E 01	1.564E 00	2.895E 01	8.307E-01	-9.857E-01
8.795E-01	1.452E 01	1.243E 02	1.020E 02	1.870E 02	1.698E 00	2.653E 01	1.778E 00	2.727E 01	8.018E-01	-9.362E-01
8.895E-01	1.587E 01	1.261E 02	1.020E 02	1.870E 02	1.787E 00	2.482E 01	1.978E 00	2.530E 01	7.745E-01	-8.839E-01
8.995E-01	2.083E 01	1.210E 02	1.020E 02	1.870E 02	1.868E 00	2.305E 01	2.093E 00	2.321E 01	7.488E-01	-8.291E-01
9.095E-01	2.631E 01	1.135E 02	1.020E 02	1.870E 02	1.939E 00	2.124E 01	2.087E 00	2.124E 01	7.247E-01	-7.720E-01
9.195E-01	2.850E 01	1.106E 02	1.020E 02	1.870E 02	2.001E 00	1.939E 01	2.013E 00	1.949E 01	7.025E-01	-7.129E-01
9.295E-01	2.641E 01	1.149E 02	1.020E 02	1.870E 02	2.053E 00	1.751E 01	1.963E 00	1.784E 01	6.820E-01	-6.520E-01
9.395E-01	2.181E 01	1.241E 02	1.020E 02	1.870E 02	2.096E 00	1.561E 01	1.990E 00	1.611E 01	6.633E-01	-5.898E-01

9.495E-01	1.768E 01	1.33CE 02	1.020E 02	1.870E 02	2.130E 00	1.370E 01	2.095E 00	1.413E 01	6.466E-01	-5.263E-01
9.555E-01	1.710E 01	1.357E 02	1.020E 02	1.870E 02	2.154E 00	1.179E 01	2.226E 00	1.190E 01	6.317E-01	-4.621E-01
9.655E-01	2.C58E 01	1.294E 02	1.020E 02	1.870E 02	2.169E 00	9.069E 00	2.291E 00	9.561E 00	6.188E-01	-3.972E-01
9.795E-01	2.6C9E 01	1.19CE 02	1.020E 02	1.870E.02	2.175E 00	7.963E 00	2.234E 00	7.462E 00	6.079E-01	-3.320E-01
9.895E-01	2.8C7E 01	1.12CE 02	1.020E 02	1.870E 02	2.172E 00	6.074E 00	2.108E 00	5.694E 00	5.989E-01	-2.668E-01
9.995E-01	2.581E 01	1.147E 02	1.020E 02	1.870E 02	2.159E 00	4.210E 00	2.01CE 00	4.125E 00	5.918E-01	-2.018E-01
1.CC5E 00	2.125E 01	1.216E 02	1.020E 02	1.870E 02	2.138E 00	2.377E 00	1.992E 00	2.543E 00	5.867E-01	-1.373E-01
1.C15E 00	1.722E 01	1.285E 02	1.020E 02	1.870E 02	2.109E 00	5.926E-01	2.047E 00	7.969E-01	5.836E-01	-7.356E-02
1.C25E 00	1.664E 01	1.3C4E 02	1.020E 02	1.870E 02	2.072E 00	-1.168E 00	2.124E 00	-3.101E 00	5.823E-01	-1.082E-02
1.C35E 00	1.586E 01	1.251E 02	1.020E 02	1.870E 02	2.026E 00	-2.947E 00	2.144E 00	-5.101E 00	5.829E-01	5.068E-02
1.C45E 00	2.443E 01	1.164E 02	1.020E 02	1.870E 02	1.974E 00	-4.910E 00	2.060E 00	-6.873E 00	5.853E-01	1.107E-01
1.C55E 00	2.694E 01	1.1CBE 02	1.020E 02	1.870E 02	1.914E 00	-6.991E 00	1.910E 00	-8.353E 00	5.895E-01	1.69CE-01
1.C65E 00	2.629E 01	1.1C9E 02	1.020E 02	1.870E 02	1.847E 00	-7.695E 00	1.763E 00	-7.615E 00	5.954E-01	2.255E-01
1.C75E 00	2.336E 01	1.157E 02	1.020E 02	1.870E 02	1.774E 00	-9.048E 00	1.664E 00	-8.797E 00	6.030E-01	2.798E-01
1.C85E 00	1.996E 01	1.223E 02	1.020E 02	1.870E 02	1.696E 00	-1.041E 01	1.616E 00	-1.001E 01	6.121E-01	3.319E-01
1.C95E 00	1.757E 01	1.279E 02	1.020E 02	1.870E 02	1.611E 00	-1.170E 01	1.60CE 00	-1.131E 01	6.228E-01	3.815E-01
1.1C5E 00	1.714E 01	1.3C1E 02	1.020E 02	1.870E 02	1.522E 00	-1.290E 01	1.585E 00	-1.267E 01	6.350E-01	4.286E-01
1.115E 00	1.876E 01	1.283E 02	1.020E 02	1.870E 02	1.428E 00	-1.402E 01	1.598E 00	-1.403E 01	6.485E-01	4.728E-01
1.125E 00	2.154E 01	1.237E 02	1.020E 02	1.870E 02	1.330E 00	-1.504E 01	1.443E 00	-1.527E 01	6.633E-01	5.142E-01
1.135E 00	2.421E 01	1.186E 02	1.020E 02	1.870E 02	1.229E 00	-1.598E 01	1.304E 00	-1.633E 01	6.793E-01	5.527E-01
1.145E 00	2.594E 01	1.148E 02	1.020E 02	1.870E 02	1.124E 00	-1.682E 01	1.147E 00	-1.717E 01	6.964E-01	5.880E-01
1.155E 00	2.658E 01	1.128E 02	1.020E 02	1.870E 02	1.017E 00	-1.756E 01	9.905E-01	-1.784E 01	7.145E-01	6.201E-01
1.165E 00	2.639E 01	1.124E 02	1.020E 02	1.870E 02	9.080E-01	-1.821E 01	8.472E-01	-1.835E 01	7.336E-01	6.490E-01
1.175E 00	2.572E 01	1.132E 02	1.020E 02	1.870E 02	7.972E-01	-1.876E 01	7.190E-01	-1.876E 01	7.534E-01	6.746E-01
1.185E 00	2.487E 01	1.146E 02	1.020E 02	1.870E 02	6.852E-01	-1.922E 01	6.034E-01	-1.907E 01	7.740E-01	6.969E-01
1.195E 00	2.402E 01	1.162E 02	1.020E 02	1.870E 02	5.725E-01	-1.958E 01	4.967E-01	-1.930E 01	7.952E-01	7.157E-01
1.205E 00	2.328E 01	1.177E 02	1.020E 02	1.870E 02	4.597E-01	-1.984E 01	3.951E-01	-1.946E 01	8.169E-01	7.312E-01
1.215E 00	2.271E 01	1.19CE 02	1.020E 02	1.870E 02	3.471E-01	-2.000E 01	2.959E-01	-1.954E 01	8.390E-01	7.434E-01
1.225E 00	2.231E 01	1.199E 02	1.020E 02	1.870E 02	2.353E-01	-2.008E 01	1.974E-01	-1.956E 01	8.615E-01	7.521E-01
1.235E 00	2.208E 01	1.205E 02	1.020E 02	1.870E 02	1.240E-01	-2.006E 01	9.870E-02	-1.950E 01	8.841E-01	7.575E-01
1.245E 00	2.201E 01	1.207E 02	1.020E 02	1.870E 02	1.585E-02	-1.994E 01	-1.546E-04	-1.936E 01	9.069E-01	7.596E-01
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1.275E 00	2.255E 01	1.191E 02	1.020E 02	1.870E 02	-2.970E-01	-1.910E 01	-2.915E-01	-1.850E 01	9.749E-01	7.469E-01
1.285E 00	2.290E 01	1.18CE 02	1.020E 02	1.870E 02	-3.953E-01	-1.865E 01	-3.837E-01	-1.808E 01	9.971E-01	7.365E-01
1.295E 00	2.329E 01	1.167E 02	1.020E 02	1.870E 02	-4.901E-01	-1.813E 01	-4.717E-01	-1.759E 01	1.019E 00	7.232E-01
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1.365E 00	2.199E 01	1.155E 02	1.020E 02	1.870E 02	-1.029E 00	-1.271E 01	-9.837E-01	-1.290E 01	1.155E 00	5.596E-01
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1.385E 00	2.CC3E 01	1.2C1E 02	1.020E 02	1.870E 02	-1.134E 00	-1.073E 01	-1.131E 00	-1.105E 01	1.187E 00	4.946E-01
1.395E 00	1.943E 01	1.222E 02	1.020E 02	1.870E 02	-1.181E 00	-9.686E 00	-1.204E 00	-9.997E 00	1.201E 00	4.598E-01
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1.475E 00	2.333E 01	1.182E 02	1.020E 02	1.870E 02	-1.332E 00	-8.744E-01	-1.294E 00	-9.708E-01	1.275E 00	1.5C7E-01
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1.495E 00	2.117E 01	1.226E 02	1.020E 02	1.870E 02	-1.318E 00	1.290E 00	-1.288E 00	1.086E 00	1.281E 00	7.125E-02
1.505E 00	2.037E 01	1.245E 02	1.020E 02	1.870E 02	-1.256E 00	2.341E 00	-1.292E 00	2.153E 00	1.283E 00	3.209E-02
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1.535E 00	2.119E 01	1.243E 02	1.020E 02	1.870E 02	-1.214E 00	5.326E 00	-1.258E 00	5.394E 00	1.281E 00	-8.121E-02
1.545E 00	2.218E 01	1.224E 02	1.020E 02	1.870E 02	-1.178E 00	6.252E 00	-1.215E 00	6.400E 00	1.278E 00	-1.171E-01

1.555E 00	2.208E 01	1.205E 02	1.020E 02	1.870E 02	-1.137E 00	7.137E 00	-1.150E 00	7.327E 00	1.273E 00 -1.518E-01
1.565E 00	2.209E 01	1.185E 02	1.020E 02	1.870E 02	-1.093E 00	7.980E 00	-1.094E 00	8.169E 00	1.260E 00 -1.853E-01
1.575E 00	2.352E 01	1.180E 02	1.020E 02	1.870E 02	-1.044E 00	8.777E 00	-1.026E 00	8.928E 00	1.242E 00 -2.174E-01
1.585E 00	2.300E 01	1.178E 02	1.020E 02	1.870E 02	-9.927E-01	9.526E 00	-9.600E-01	9.615E 00	1.255E 00 -2.480E-01
1.595E 00	2.341E 01	1.182E 02	1.020E 02	1.870E 02	-9.380E-01	1.022E 01	-8.977E-01	1.024E 01	1.247E 00 -2.769E-01
1.605E 00	2.288E 01	1.190E 02	1.020E 02	1.870E 02	-8.803E-01	1.087E 01	-8.391E-01	1.082E 01	1.239E 00 -3.042E-01
1.614E 00	2.229E 01	1.201E 02	1.020E 02	1.870E 02	-8.201E-01	1.146E 01	-7.835E-01	1.135E 01	1.229E 00 -3.297E-01
1.624E 00	2.174E 01	1.212E 02	1.020E 02	1.870E 02	-7.576E-01	1.200E 01	-7.294E-01	1.184E 01	1.219E 00 -3.534E-01
1.634E 00	2.127E 01	1.222E 02	1.020E 02	1.870E 02	-6.932E-01	1.248E 01	-6.751E-01	1.230E 01	1.208E 00 -3.752E-01
1.644E 00	2.092E 01	1.231E 02	1.020E 02	1.870E 02	-6.271E-01	1.290E 01	-6.195E-01	1.272E 01	1.196E 00 -3.950E-01
1.654E 00	2.068E 01	1.239E 02	1.020E 02	1.870E 02	-5.596E-01	1.326E 01	-5.614E-01	1.309E 01	1.184E 00 -4.128E-01
1.664E 00	2.056E 01	1.242E 02	1.020E 02	1.870E 02	-4.911E-01	1.357E 01	-5.005E-01	1.342E 01	1.171E 00 -4.286E-01
1.674E 00	2.051E 01	1.245E 02	1.020E 02	1.870E 02	-4.219E-01	1.381E 01	-4.367E-01	1.369E 01	1.158E 00 -4.423E-01
1.684E 00	2.052E 01	1.246E 02	1.020E 02	1.870E 02	-3.523E-01	1.400E 01	-3.703E-01	1.391E 01	1.145E 00 -4.539E-01
1.694E 00	2.056E 01	1.246E 02	1.020E 02	1.870E 02	-2.825E-01	1.412E 01	-3.018E-01	1.407E 01	1.131E 00 -4.634E-01
1.704E 00	2.062E 01	1.246E 02	1.020E 02	1.870E 02	-2.128E-01	1.419E 01	-2.318E-01	1.418E 01	1.117E 00 -4.709E-01
1.714E 00	2.067E 01	1.245E 02	1.020E 02	1.870E 02	-1.434E-01	1.420E 01	-1.611E-01	1.422E 01	1.103E 00 -4.762E-01
1.724E 00	2.070E 01	1.244E 02	1.020E 02	1.870E 02	-7.512E-02	1.419E 01	-9.029E-02	1.419E 01	1.088E 00 -4.795E-01
1.733E 00	2.072E 01	1.244E 02	1.020E 02	1.870E 02	-7.621E-03	1.405E 01	-1.982E-02	1.411E 01	1.074E 00 -4.808E-01
1.743E 00	2.071E 01	1.244E 02	1.020E 02	1.870E 02	5.863E-02	1.390E 01	4.976E-02	1.397E 01	1.059E 00 -4.800E-01
1.753E 00	2.069E 01	1.245E 02	1.020E 02	1.870E 02	1.234E-01	1.369E 01	1.181E-01	1.377E 01	1.045E 00 -4.773E-01
1.763E 00	2.066E 01	1.245E 02	1.020E 02	1.870E 02	1.884E-01	1.343E 01	1.848E-01	1.351E 01	1.031E 00 -4.726E-01
1.773E 00	2.063E 01	1.246E 02	1.020E 02	1.870E 02	2.474E-01	1.313E 01	2.496E-01	1.319E 01	1.017E 00 -4.661E-01
1.783E 00	2.061E 01	1.247E 02	1.020E 02	1.870E 02	3.063E-01	1.277E 01	3.122E-01	1.283E 01	1.003E 00 -4.578E-01
1.793E 00	2.062E 01	1.247E 02	1.020E 02	1.870E 02	3.627E-01	1.238E 01	3.722E-01	1.241E 01	9.890E-01 -4.478E-01
1.803E 00	2.067E 01	1.247E 02	1.020E 02	1.870E 02	4.166E-01	1.194E 01	4.294E-01	1.194E 01	9.757E-01 -4.361E-01
1.813E 00	2.077E 01	1.246E 02	1.020E 02	1.870E 02	4.676E-01	1.146E 01	4.832E-01	1.143E 01	9.629E-01 -4.228E-01
1.823E 00	2.094E 01	1.242E 02	1.020E 02	1.870E 02	5.151E-01	1.095E 01	5.332E-01	1.088E 01	9.504E-01 -4.081E-01
1.833E 00	2.117E 01	1.237E 02	1.020E 02	1.870E 02	5.600E-01	1.040E 01	5.788E-01	1.029E 01	9.384E-01 -3.919E-01
1.843E 00	2.147E 01	1.231E 02	1.020E 02	1.870E 02	6.027E-01	9.820E 00	6.198E-01	9.679E 00	9.269E-01 -3.744E-01
1.853E 00	2.181E 01	1.223E 02	1.020E 02	1.870E 02	6.412E-01	9.214E 00	6.557E-01	9.044E 00	9.159E-01 -3.558E-01
1.862E 00	2.217E 01	1.214E 02	1.020E 02	1.870E 02	6.764E-01	8.584E 00	6.865E-01	8.393E 00	9.055E-01 -3.360E-01
1.872E 00	2.251E 01	1.204E 02	1.020E 02	1.870E 02	7.080E-01	7.932E 00	7.123E-01	7.733E 00	8.957E-01 -3.152E-01
1.882E 00	2.281E 01	1.196E 02	1.020E 02	1.870E 02	7.362E-01	7.261E 00	7.335E-01	7.069E 00	8.866E-01 -2.936E-01
1.892E 00	2.301E 01	1.188E 02	1.020E 02	1.870E 02	7.607E-01	6.576E 00	7.509E-01	6.405E 00	8.781E-01 -2.711E-01
1.902E 00	2.310E 01	1.183E 02	1.020E 02	1.870E 02	7.816E-01	5.877E 00	7.651E-01	5.741E 00	8.703E-01 -2.480E-01
1.912E 00	2.307E 01	1.181E 02	1.020E 02	1.870E 02	7.989E-01	5.170E 00	7.771E-01	5.079E 00	8.632E-01 -2.243E-01
1.922E 00	2.291E 01	1.182E 02	1.020E 02	1.870E 02	8.125E-01	4.457E 00	7.875E-01	4.416E 00	8.569E-01 -2.001E-01
1.932E 00	2.265E 01	1.185E 02	1.020E 02	1.870E 02	8.225E-01	3.740E 00	7.968E-01	3.752E 00	8.512E-01 -1.755E-01
1.942E 00	2.231E 01	1.191E 02	1.020E 02	1.870E 02	8.289E-01	3.023E 00	8.052E-01	3.084E 00	8.463E-01 -1.508E-01
1.952E 00	2.193E 01	1.198E 02	1.020E 02	1.870E 02	8.318E-01	2.310E 00	8.127E-01	2.409E 00	8.422E-01 -1.258E-01
1.962E 00	2.157E 01	1.206E 02	1.020E 02	1.870E 02	8.312E-01	1.602E 00	8.187E-01	1.726E 00	8.388E-01 -1.009E-01
1.971E 00	2.125E 01	1.214E 02	1.020E 02	1.870E 02	8.271E-01	9.020E-01	8.227E-01	1.037E 00	8.361E-01 -7.599E-02
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2.011E 00	2.109E 01	1.227E 02	1.020E 02	1.870E 02	7.784E-01	-1.758E 00	8.007E-01	-1.721E 00	8.328E-01 2.085E-02
2.021E 00	2.132E 01	1.224E 02	1.020E 02	1.870E 02	7.586E-01	-2.377E 00	7.823E-01	-2.380E 00	8.338E-01 4.391E-02
2.031E 00	2.161E 01	1.219E 02	1.020E 02	1.870E 02	7.362E-01	-2.972E 00	7.586E-01	-3.013E 00	8.354E-01 6.634E-02
2.041E 00	2.191E 01	1.214E 02	1.020E 02	1.870E 02	7.111E-01	-3.542E 00	7.301E-01	-3.613E 00	8.378E-01 8.806E-02
2.051E 00	2.220E 01	1.208E 02	1.020E 02	1.870E 02	6.835E-01	-4.086E 00	6.977E-01	-4.177E 00	8.407E-01 1.090E-01
2.061E 00	2.244E 01	1.202E 02	1.020E 02	1.870E 02	6.536E-01	-4.600E 00	6.621E-01	-4.702E 00	8.443E-01 1.290E-01
2.071E 00	2.262E 01	1.197E 02	1.020E 02	1.870E 02	6.216E-01	-5.085E 00	6.244E-01	-5.187E 00	8.484E-01 1.482E-01
2.081E 00	2.274E 01	1.194E 02	1.020E 02	1.870E 02	5.877E-01	-5.538E 00	5.853E-01	-5.632E 00	8.531E-01 1.663E-01
2.091E 00	2.280E 01	1.191E 02	1.020E 02	1.870E 02	5.520E-01	-5.958E 00	5.453E-01	-6.036E 00	8.584E-01 1.834E-01
2.101E 00	2.281E 01	1.190E 02	1.020E 02	1.870E 02	5.146E-01	-6.344E 00	5.048E-01	-6.402E 00	8.641E-01 1.994E-01
2.111E 00	2.278E 01	1.190E 02	1.020E 02	1.870E 02	4.759E-01	-6.695E 00	4.640E-01	-6.730E 00	8.703E-01 2.143E-01
2.121E 00	2.272E 01	1.190E 02	1.020E 02	1.870E 02	4.359E-01	-7.010E 00	4.232E-01	-7.022E 00	8.770E-01 2.280E-01
2.131E 00	2.265E 01	1.191E 02	1.020E 02	1.870E 02	3.949E-01	-7.290E 00	3.821E-01	-7.278E 00	8.840E-01 2.405E-01
2.141E 00	2.257E 01	1.193E 02	1.020E 02	1.870E 02	3.531E-01	-7.532E 00	3.410E-01	-7.500E 00	8.914E-01 2.517E-01
2.151E 00	2.249E 01	1.194E 02	1.020E 02	1.870E 02	3.106E-01	-7.738E 00	2.997E-01	-7.686E 00	8.991E-01 2.616E-01

2.160E CO	2.242E 01	1.196E C2	1.020E 02	1.870E 02	2.676E-01	-7.907E 00	2.582E-01	-7.830E 00	9.071E-01	2.703E-01
2.170E CO	2.235E 01	1.197E C2	1.020E 02	1.870E C2	2.244E-01	-8.138E 00	2.166E-01	-7.957E 00	9.153E-01	2.777E-01
2.180E CO	2.230E C1	1.199E C2	1.020E 02	1.870E C2	1.810E-01	-8.137E 00	1.749E-01	-8.041E 00	9.237E-01	2.838E-01
2.190E CO	2.226E 01	1.200E C2	1.020E 02	1.870E C2	1.378E-01	-8.191E 00	1.333E-01	-8.091E 00	9.323E-01	2.886E-01
2.200E CO	2.223E 01	1.200E C2	1.020E 02	1.870E 02	9.479E-02	-8.214E 00	9.100E-02	-8.108E 00	9.410E-01	2.921E-01
2.210E CO	2.221E C1	1.201E C2	1.020E 02	1.870E 02	5.223E-02	-8.201E 00	5.050E-02	-8.092E 00	9.498E-01	2.943E-01
2.219E CO	2.220E C1	1.201E C2	1.020E 02	1.870E C2	1.029E-02	-8.153E 00	9.815E-03	-8.042E 00	9.586E-01	2.952E-01
2.229E CO	2.220E 01	1.201E C2	1.020E 02	1.870E C2	-3.089E-02	-8.071E 00	-3.034E-02	-7.961E 00	9.675E-01	2.949E-01
2.239E CO	2.221E C1	1.201E C2	1.020E 02	1.870E 02	-7.115E-02	-7.957E 00	-6.971E-02	-7.849E 00	9.763E-01	2.934E-01
2.249E CO	2.223E C1	1.200E C2	1.020E 02	1.870E C2	-1.103E-01	-7.811E 00	-1.081E-01	-7.706E 00	9.851E-01	2.906E-01
2.259E CO	2.225E C1	1.199E C2	1.020E 02	1.870E C2	-1.483E-01	-7.635E 00	-1.454E-01	-7.534E 00	9.937E-01	2.868E-01
2.269E CO	2.227E C1	1.199E C2	1.020E 02	1.870E C2	-1.849E-01	-7.429E 00	-1.814E-01	-7.335E 00	1.002E 00	2.818E-01
2.279E CO	2.230E C1	1.198E C2	1.020E 02	1.870E C2	-2.200E-01	-7.196E 00	-2.160E-01	-7.109E 00	1.011E 00	2.757E-01
2.289E CO	2.232E C1	1.197E C2	1.020E 02	1.870E C2	-2.535E-01	-6.937E 00	-2.490E-01	-6.858E 00	1.019E 00	2.686E-01
2.299E CO	2.234E C1	1.196E C2	1.020E 02	1.870E C2	-2.853E-01	-6.653E 00	-2.802E-01	-6.584E 00	1.027E 00	2.605E-01
2.309E CO	2.236E C1	1.195E C2	1.020E 02	1.870E C2	-3.152E-01	-6.347E 00	-3.098E-01	-6.288E 00	1.034E 00	2.515E-01
2.319E CO	2.236E 01	1.194E 02	1.020E 02	1.870E 02	-3.433E-01	-6.019E 00	-3.374E-01	-5.972E 00	1.042E 00	2.416E-01
2.329E CO	2.236E 01	1.194E C2	1.020E 02	1.870E C2	-3.693E-01	-5.672E 00	-3.632E-01	-5.639E 00	1.049E 00	2.309E-01
2.339E CO	2.235E C1	1.194E C2	1.020E 02	1.870E C2	-3.933E-01	-5.308E 00	-3.870E-01	-5.288E 00	1.055E 00	2.195E-01
2.349E CO	2.232E 01	1.194E C2	1.020E 02	1.870E C2	-4.153E-01	-4.928E 00	-4.089E-01	-4.922E 00	1.062E 00	2.073E-01
2.359E CO	2.228E 01	1.194E C2	1.020E 02	1.870E C2	-4.350E-01	-4.534E 00	-4.289E-01	-4.543E 00	1.068E 00	1.946E-01
2.369E CO	2.223E 01	1.195E C2	1.020E 02	1.870E C2	-4.525E-01	-4.129E 00	-4.468E-01	-4.152E 00	1.073E 00	1.813E-01
2.379E CO	2.217E C1	1.197E C2	1.020E 02	1.870E C2	-4.679E-01	-3.714E 00	-4.628E-01	-3.749E 00	1.078E 00	1.674E-01
2.389E CO	2.210E C1	1.198E C2	1.020E 02	1.870E C2	-4.810E-01	-3.290E 00	-4.767E-01	-3.338E 00	1.083E 00	1.532E-01
2.399E CO	2.202E C1	1.200E C2	1.020E 02	1.870E C2	-4.918E-01	-2.861E 00	-4.886E-01	-2.919E 00	1.088E 00	1.386E-01
2.409E CO	2.194E C1	1.202E C2	1.020E C2	1.870E C2	-5.004E-01	-2.428E 00	-4.985E-01	-2.493E 00	1.091E 00	1.237E-01
2.419E CO	2.187E C1	1.204E C2	1.020E 02	1.870E C2	-5.067E-01	-1.993E 00	-5.063E-01	-2.063E 00	1.095E 00	1.086E-01
2.429E CO	2.180E C1	1.206E C2	1.020E 02	1.870E 02	-5.108E-01	-1.557E 00	-5.119E-01	-1.629E 00	1.098E 00	9.334E-02
2.439E CO	2.174E C1	1.208E C2	1.020E 02	1.870E C2	-5.127E-01	-1.123E 00	-5.154E-01	-1.194E 00	1.100E 00	7.798E-02
2.449E CO	2.169E C1	1.210E C2	1.020E 02	1.870E C2	-5.125E-01	-6.924E-01	-5.166E-01	-7.596E-01	1.102E 00	6.259E-02
2.457E CO	2.166E C1	1.212E C2	1.020E 02	1.870E C2	-5.101E-01	-2.667E-01	-5.155E-01	-3.276E-01	1.104E 00	4.725E-02
2.467E CO	2.164E C1	1.213E C2	1.020E 02	1.870E C2	-5.056E-01	1.524E-01	-5.121E-01	9.989E-02	1.105E 00	3.201E-02
2.477E CO	2.164E 01	1.214E 02	1.020E 02	1.870E C2	-4.991E-01	5.431E-01	-5.065E-01	5.206E-01	1.106E 00	1.693E-02
2.487E CO	2.165E C1	1.214E C2	1.020E C2	1.870E C2	-4.907E-01	9.440E-01	-4.985E-01	9.326E-01	1.106E 00	2.074E-03
2.497E CO	2.168E C1	1.214E C2	1.020E 02	1.870E C2	-4.804E-01	1.353E 00	-4.884E-01	1.334E 00	1.106E 00	-1.250E-02
2.507E CO	2.172E C1	1.214E C2	1.020E 02	1.870E C2	-4.684E-01	1.730E 00	-4.761E-01	1.722E 00	1.105E 00	-2.674E-02
2.517E CO	2.177E C1	1.213E C2	1.020E 02	1.870E C2	-4.546E-01	2.093E 00	-4.619E-01	2.095E 00	1.104E 00	-4.059E-02
2.527E CO	2.182E C1	1.212E C2	1.020E C2	1.870E C2	-4.391E-01	2.440E 00	-4.458E-01	2.452E 00	1.103E 00	-5.400E-02
2.537E CO	2.187E C1	1.211E C2	1.020E 02	1.870E 02	-4.222E-01	2.771E 00	-4.280E-01	2.791E 00	1.101E 00	-6.692E-02
2.547E CO	2.192E C1	1.210E 02	1.020E 02	1.870E C2	-4.039E-01	3.084E 00	-4.086E-01	3.111E 00	1.099E 00	-7.932E-02
2.557E CO	2.197E C1	1.209E C2	1.020E 02	1.870E C2	-3.842E-01	3.379E 00	-3.879E-01	3.411E 00	1.096E 00	-9.114E-02
2.567E CO	2.201E 01	1.208E C2	1.020E C2	1.870E C2	-3.633E-01	3.654E 00	-3.660E-01	3.690E 00	1.093E 00	-1.024E-01
2.576E CO	2.204E C1	1.207E C2	1.020E 02	1.870E C2	-3.413E-01	3.910E 00	-3.430E-01	3.947E 00	1.090E 00	-1.129E-01
2.586E CO	2.207E 01	1.206E C2	1.020E 02	1.870E C2	-3.183E-01	4.144E 00	-3.191E-01	4.182E 00	1.086E 00	-1.228E-01
2.596E CO	2.210E C1	1.205E C2	1.020E 02	1.870E 02	-2.944E-01	4.357E 00	-2.945E-01	4.394E 00	1.082E 00	-1.320E-01
2.606E CO	2.212E C1	1.205E C2	1.020E C2	1.870E C2	-2.698E-01	4.548E 00	-2.692E-01	4.584E 00	1.078E 00	-1.405E-01
2.616E CO	2.213E C1	1.204E C2	1.020E 02	1.870E C2	-2.445E-01	4.717E 00	-2.434E-01	4.750E 00	1.074E 00	-1.482E-01
2.626E CO	2.214E 01	1.204E C2	1.020E 02	1.870E C2	-2.187E-01	4.864E 00	-2.172E-01	4.894E 00	1.069E 00	-1.551E-01
2.636E CO	2.215E 01	1.204E C2	1.020E 02	1.870E C2	-1.925E-01	4.987E 00	-1.907E-01	5.014E 00	1.065E 00	-1.613E-01
2.646E CO	2.215E C1	1.204E C2	1.020E 02	1.870E C2	-1.659E-01	5.088E 00	-1.640E-01	5.112E 00	1.060E 00	-1.667E-01
2.656E CO	2.215E C1	1.203E C2	1.020E 02	1.870E C2	-1.392E-01	5.166E 00	-1.372E-01	5.187E 00	1.054E 00	-1.713E-01
2.666E CO	2.215E C1	1.203E C2	1.020E 02	1.870E C2	-1.125E-01	5.222E 00	-1.105E-01	5.239E 00	1.049E 00	-1.750E-01
2.676E CO	2.215E 01	1.203E C2	1.020E C2	1.870E C2	-8.576E-02	5.254E 00	-8.384E-02	5.269E 00	1.044E 00	-1.780E-01
2.686E CO	2.215E 01	1.203E C2	1.020E 02	1.870E C2	-5.920E-02	5.265E 00	-5.739E-02	5.277E 00	1.038E 00	-1.802E-01
2.696E CC	2.215E 01	1.203E C2	1.020E 02	1.870E C2	-3.291E-02	5.254E 00	-3.126E-02	5.264E 00	1.033E 00	-1.816E-01
2.706E CO	2.215E C1	1.203E C2	1.020E 02	1.870E C2	-6.918E-03	5.222E 00	-5.497E-03	5.229E 00	1.027E 00	-1.822E-01
2.715E CO	2.215E C1	1.203E C2	1.020E C2	1.870E C2	1.891E-02	5.169E 00	1.980E-02	5.175E CO	1.022E 00	-1.820E-01
2.725E CO	2.215E 01	1.203E C2	1.020E 02	1.870E C2	4.346E-02	5.095E 00	4.455E-02	5.103E 00	1.016E 00	-1.811E-01
2.735E CO	2.215E C1	1.203E C2	1.020E C2	1.870E C2	6.773E-02	5.002E 00	6.861E-02	5.007E CC	1.011E 00	-1.794E-01
2.745E CO	2.215E C1	1.203E C2	1.020E C2	1.870E C2	9.125E-02	4.891E 00	9.194E-02	4.894E 00	1.006E 00	-1.770E-01
2.755E CO	2.215E C1	1.203E C2	1.020E 02	1.870E C2	1.139E-01	4.761E 00	1.144E-01	4.765E 00	1.000E 00	-1.739E-01

2.765E 00	2.215E 01	1.203E 02	1.020E 02	1.870E 02	1.357E-01	4.614E 00	1.360E-01	4.619E 00	9.95ME-01	-1.702E-01
2.775E 00	2.215E 01	1.203E 02	1.020E 02	1.870E 02	1.564E-01	4.451E 00	1.566E-01	4.456E 00	9.901E-01	-1.658E-01
2.785E 00	2.214E 01	1.203E 02	1.020E 02	1.870E 02	1.761E-01	4.278E 00	1.761E-01	4.279E 00	9.852E-01	-1.608E-01
2.795E 00	2.214E 01	1.203E 02	1.020E 02	1.870E 02	1.946E-01	4.081E 00	1.945E-01	4.089E 00	9.804E-01	-1.553E-01
2.805E 00	2.214E 01	1.203E 02	1.020E 02	1.870E 02	2.120E-01	3.876E 00	2.117E-01	3.885E 00	9.759E-01	-1.492E-01
2.815E 00	2.213E 01	1.204E 02	1.020E 02	1.870E 02	2.281E-01	3.659E 00	2.278E-01	3.670E 00	9.715E-01	-1.426E-01
2.824E 00	2.212E 01	1.204E 02	1.020E 02	1.870E 02	2.429E-01	3.431E 00	2.426E-01	3.444E 00	9.673E-01	-1.355E-01
2.834E 00	2.211E 01	1.204E 02	1.020E 02	1.870E 02	2.565E-01	3.193E 00	2.561E-01	3.209E 00	9.634E-01	-1.280E-01
2.844E 00	2.210E 01	1.204E 02	1.020E 02	1.870E 02	2.687E-01	2.947E 00	2.683E-01	2.965E 00	9.596E-01	-1.201E-01
2.854E 00	2.209E 01	1.205E 02	1.020E 02	1.870E 02	2.796E-01	2.694E 00	2.792E-01	2.714E 00	9.561E-01	-1.119E-01
2.864E 00	2.208E 01	1.205E 02	1.020E 02	1.870E 02	2.891E-01	2.435E 00	2.888E-01	2.457E 00	9.529E-01	-1.033E-01
2.874E 00	2.206E 01	1.206E 02	1.020E 02	1.870E 02	2.972E-01	2.171E 00	2.970E-01	2.195E 00	9.499E-01	-9.454E-02
2.884E 00	2.205E 01	1.206E 02	1.020E 02	1.870E 02	3.039E-01	1.904E 00	3.038E-01	1.929E 00	9.472E-01	-8.552E-02
2.894E 00	2.203E 01	1.206E 02	1.020E 02	1.870E 02	3.092E-01	1.634E 00	3.093E-01	1.660E 00	9.448E-01	-7.632E-02
2.904E 00	2.201E 01	1.207E 02	1.020E 02	1.870E 02	3.131E-01	1.362E 00	3.134E-01	1.389E 00	9.426E-01	-6.698E-02
2.914E 00	2.200E 01	1.207E 02	1.020E 02	1.870E 02	3.157E-01	1.091E 00	3.162E-01	1.118E 00	9.408E-01	-5.755E-02
2.924E 00	2.198E 01	1.208E 02	1.020E 02	1.870E 02	3.169E-01	8.201E-01	3.176E-01	8.479E-01	9.392E-01	-4.806E-02
2.934E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	3.167E-01	5.516E-01	3.176E-01	5.791E-01	9.379E-01	-3.855E-02
2.943E 00	2.195E 01	1.209E 02	1.020E 02	1.870E 02	3.153E-01	2.863E-01	3.164E-01	3.131E-01	9.369E-01	-2.906E-02
2.953E 00	2.194E 01	1.209E 02	1.020E 02	1.870E 02	3.126E-01	2.507E-02	3.138E-01	5.088E-02	9.361E-01	-1.964E-02
2.963E 00	2.193E 01	1.209E 02	1.020E 02	1.870E 02	3.086E-01	-2.710E-01	3.10CE-01	-2.065E-01	9.357E-01	-1.032E-02
2.973E 00	2.192E 01	1.210E 02	1.020E 02	1.870E 02	3.034E-01	-4.909E-01	3.05CE-01	-4.581E-01	9.355E-01	-1.138E-03
2.983E 00	2.191E 01	1.210E 02	1.020E 02	1.870E 02	2.971E-01	-7.737E-01	2.987E-01	-7.029E-01	9.356E-01	7.872E-03
2.993E 00	2.191E 01	1.210E 02	1.020E 02	1.870E 02	2.896E-01	-9.587E-01	2.914E-01	-9.399E-01	9.360E-01	1.668E-02
3.003E 00	2.191E 01	1.210E 02	1.020E 02	1.870E 02	2.811E-01	-1.185E 00	2.829E-01	-1.168E 00	9.366E-01	2.524E-02
3.013E 00	2.190E 01	1.211E 02	1.020E 02	1.870E 02	2.716E-01	-1.402E 00	2.734E-01	-1.387E 00	9.375E-01	3.354E-02
3.023E 00	2.190E 01	1.211E 02	1.020E 02	1.870E 02	2.612E-01	-1.608E 00	2.630E-01	-1.596E 00	9.386E-01	4.153E-02
3.033E 00	2.190E 01	1.211E 02	1.020E 02	1.870E 02	2.498E-01	-1.804E 00	2.516E-01	-1.794E 00	9.399E-01	4.920E-02
3.043E 00	2.190E 01	1.211E 02	1.020E 02	1.870E 02	2.377E-01	-1.988E 00	2.394E-01	-1.981E 00	9.415E-01	5.652E-02
3.053E 00	2.191E 01	1.211E 02	1.020E 02	1.870E 02	2.248E-01	-2.160E 00	2.264E-01	-2.155E 00	9.433E-01	6.346E-02
3.062E 00	2.191E 01	1.211E 02	1.020E 02	1.870E 02	2.112E-01	-2.320E 00	2.127E-01	-2.317E 00	9.453E-01	7.000E-02
3.072E 00	2.191E 01	1.211E 02	1.020E 02	1.870E 02	1.970E-01	-2.467E 00	1.984E-01	-2.466E 00	9.475E-01	7.612E-02
3.082E 00	2.191E 01	1.211E 02	1.020E 02	1.870E 02	1.823E-01	-2.600E 00	1.835E-01	-2.601E 00	9.499E-01	8.181E-02
3.092E 00	2.192E 01	1.211E 02	1.020E 02	1.870E 02	1.671E-01	-2.720E 00	1.681E-01	-2.723E 00	9.524E-01	8.705E-02
3.102E 00	2.192E 01	1.211E 02	1.020E 02	1.870E 02	1.515E-01	-2.827E 00	1.524E-01	-2.830E 00	9.551E-01	9.183E-02
3.112E 00	2.192E 01	1.211E 02	1.020E 02	1.870E 02	1.355E-01	-2.919E 00	1.363E-01	-2.924E 00	9.579E-01	9.614E-02
3.122E 00	2.192E 01	1.212E 02	1.020E 02	1.870E 02	1.193E-01	-2.997E 00	1.200E-01	-3.003E 00	9.608E-01	9.996E-02
3.132E 00	2.192E 01	1.212E 02	1.020E 02	1.870E 02	1.030E-01	-3.061E 00	1.035E-01	-3.068E 00	9.639E-01	1.033E-01
3.142E 00	2.193E 01	1.212E 02	1.020E 02	1.870E 02	8.649E-02	-3.111E 00	8.687E-02	-3.119E 00	9.670E-01	1.061E-01
3.152E 00	2.193E 01	1.212E 02	1.020E 02	1.870E 02	6.996E-02	-3.147E 00	7.022E-02	-3.155E 00	9.703E-01	1.085E-01
3.162E 00	2.193E 01	1.212E 02	1.020E 02	1.870E 02	5.346E-02	-3.170E 00	5.361E-02	-3.178E 00	9.735E-01	1.103E-01
3.172E 00	2.193E 01	1.212E 02	1.020E 02	1.870E 02	3.706E-02	-3.178E 00	3.711E-02	-3.186E 00	9.769E-01	1.117E-01
3.182E 00	2.193E 01	1.212E 02	1.020E 02	1.870E 02	2.082E-02	-3.173E 00	2.078E-02	-3.181E 00	9.802E-01	1.126E-01
3.191E 00	2.193E 01	1.212E 02	1.020E 02	1.870E 02	4.811E-03	-3.155E 00	4.676E-03	-3.163E 00	9.836E-01	1.129E-01
3.201E 00	2.193E 01	1.212E 02	1.020E 02	1.870E 02	-1.091E-02	-3.123E 00	-1.113E-02	-3.131E 00	9.870E-01	1.129E-01
3.211E 00	2.192E 01	1.212E 02	1.020E 02	1.870E 02	-2.629E-02	-3.080E 00	-2.658E-02	-3.087E 00	9.904E-01	1.123E-01
3.221E 00	2.192E 01	1.212E 02	1.020E 02	1.870E 02	-4.126E-02	-3.024E 00	-4.162E-02	-3.031E 00	9.937E-01	1.113E-01
3.231E 00	2.192E 01	1.212E 02	1.020E 02	1.870E 02	-5.578E-02	-2.956E 00	-5.619E-02	-2.964E 00	9.970E-01	1.098E-01
3.241E 00	2.192E 01	1.212E 02	1.020E 02	1.870E 02	-6.976E-02	-2.878E 00	-7.024E-02	-2.885E 00	1.000E 00	1.079E-01
3.251E 00	2.192E 01	1.212E 02	1.020E 02	1.870E 02	-8.318E-02	-2.789E 00	-8.370E-02	-2.795E 00	1.003E 00	1.056E-01
3.261E 00	2.192E 01	1.212E 02	1.020E 02	1.870E 02	-9.595E-02	-2.690E 00	-9.651E-02	-2.695E 00	1.007E 00	1.029E-01
3.271E 00	2.192E 01	1.212E 02	1.020E 02	1.870E 02	-1.080E-01	-2.581E 00	-1.086E-01	-2.586E 00	1.010E 00	9.989E-02
3.281E 00	2.192E 01	1.212E 02	1.020E 02	1.870E 02	-1.194E-01	-2.464E 00	-1.201E-01	-2.468E 00	1.012E 00	9.647E-02
3.291E 00	2.192E 01	1.212E 02	1.020E 02	1.870E 02	-1.301E-01	-2.339E 00	-1.307E-01	-2.342E 00	1.015E 00	9.273E-02
3.301E 00	2.192E 01	1.212E 02	1.020E 02	1.870E 02	-1.400E-01	-2.206E 00	-1.407E-01	-2.209E 00	1.018E 00	8.867E-02
3.310E 00	2.192E 01	1.212E 02	1.020E 02	1.870E 02	-1.491E-01	-2.067E 00	-1.498E-01	-2.069E 00	1.020E 00	8.433E-02
3.320E 00	2.192E 01	1.212E 02	1.020E 02	1.870E 02	-1.574E-01	-1.922E 00	-1.581E-01	-1.923E 00	1.023E 00	7.973E-02
3.330E 00	2.192E 01	1.212E 02	1.020E 02	1.870E 02	-1.649E-01	-1.772E 00	-1.656E-01	-1.772E 00	1.025E 00	7.489E-02
3.340E 00	2.192E 01	1.212E 02	1.020E 02	1.870E 02	-1.715E-01	-1.617E 00	-1.722E-01	-1.616E 00	1.027E 00	6.984E-02
3.350E 00	2.192E 01	1.212E 02	1.020E 02	1.870E 02	-1.773E-01	-1.459E 00	-1.780E-01	-1.457E 00	1.029E 00	6.461E-02
3.360E 00	2.192E 01	1.212E 02	1.020E 02	1.870E 02	-1.823E-01	-1.298E 00	-1.830E-01	-1.295E 00	1.031E 00	5.921E-02

3.37CE CO	2.1S2E 01	1.210E 02	1.020E 02	1.870E 02	-1.864E-01	-1.134E 00	-1.870E-01	-1.131E 00	1.033E 00	5.360E-02
3.38CE CO	2.1S3E C1	1.21CE C2	1.020E 02	1.870E C2	-1.856E-01	-9.690E-01	-1.902E-01	-9.648E-01	1.034E 00	4.804E-02
3.39CE CO	2.1S3E C1	1.21CE C2	1.020E 02	1.870E C2	-1.920E-01	-8.032E-01	-1.926E-01	-7.982E-01	1.035E 00	4.231E-02
3.4CCE CO	2.1S3E 01	1.21CE C2	1.020E 02	1.870E 02	-1.925E-01	-6.372E-01	-1.941E-01	-6.316E-01	1.037C 00	3.653E-02
3.41CE CO	2.1S3E C1	1.21CC C2	1.020L 02	1.870E C2	-1.942E-01	-4.719E-01	-1.948E-01	-4.657E-01	1.038E 00	3.071E-02
3.42CE CO	2.1S4E 01	1.21CE C2	1.020E 02	1.870E C2	-1.941E-01	-3.078E-01	-1.946E-01	-3.011E-01	1.038C CO	2.488E-02
3.42SE CO	2.1S4E C1	1.2C9E C2	1.020E 02	1.870E C2	-1.932E-01	-1.457E-01	-1.937L-01	-1.385E-01	1.039E 00	1.907E-02
3.43SE CO	2.1S4E C1	1.2C9E C2	1.020E 02	1.870E C2	-1.915E-01	1.784E-02	-1.919E-01	2.149E-02	1.039E 00	1.330E-02
3.44SE CO	2.1S5E 01	1.2C9E C2	1.020E 02	1.870E C2	-1.890E-01	1.702E-01	-1.894E-01	1.781E-01	1.040E 00	7.585E-03
3.45SE CO	2.1S5E C1	1.2C9E C2	1.020E C2	1.870E C2	-1.858E-01	3.329E-01	-1.861E-01	3.309E-01	1.040E 00	1.960E-03
3.46SE CO	2.1S5E C1	1.2C9E C2	1.020E 02	1.870E C2	-1.819E-01	4.711E-01	-1.822E-01	4.794E-01	1.040E 00	-3.559E-03
3.47SE CO	2.1S6E C1	1.2C9E C2	1.020E C2	1.870E 02	-1.773E-01	6.145E-01	-1.775E-01	6.229E-01	1.039E 00	-8.951E-03
3.48SE CO	2.1S6E C1	1.2C9E C2	1.020L 02	1.870E 02	-1.721E-01	7.526E-01	-1.723E-01	7.609E-01	1.039E 00	-1.419E-02
3.49SE CO	2.1S6E C1	1.2C9E C2	1.020E C2	1.870E C2	-1.663E-01	8.848E-01	-1.664E-01	8.931E-01	1.039E 00	-1.927E-02
3.5C5E CO	2.1S6E C1	1.2C9E C2	1.020E 02	1.870E C2	-1.599E-01	1.011E 00	-1.599E-01	1.019E 00	1.038E 00	-2.417E-02
3.51SE CO	2.1S6E C1	1.2C9E C2	1.020E 02	1.870E C2	-1.529E-01	1.130E 00	-1.529E-01	1.138E 00	1.037E 00	-2.886E-02
3.52SE CO	2.1S7E C1	1.2C9E C2	1.020E 02	1.870E C2	-1.455E-01	1.242E 00	-1.454E-01	1.250E 00	1.036E 00	-3.334E-02
3.53SE CO	2.1S7E C1	1.2C9E C2	1.020E C2	1.870E C2	-1.376E-01	1.347E 00	-1.375E-01	1.355E 00	1.035E 00	-3.759E-02
3.54EE CO	2.1S7E C1	1.2C9E C2	1.020E C2	1.870E 02	-1.292E-01	1.445E 00	-1.292E-01	1.452E 00	1.034E 00	-4.159E-02
3.55EE CO	2.1S7E C1	1.2C9E C2	1.020E 02	1.870E 02	-1.205E-01	1.534E 00	-1.204E-01	1.541E 00	1.032E 00	-4.534E-02
3.56EE CO	2.1S7E C1	1.2C9E C2	1.020E 02	1.870E C2	-1.115E-01	1.615E 00	-1.114E-01	1.622E 00	1.031E 00	-4.882E-02
3.57EE CO	2.1S7E C1	1.2C9E C2	1.020E C2	1.870E C2	-1.022E-01	1.688E 00	-1.020E-01	1.695E 00	1.029E 00	-5.203E-02
3.58EE CO	2.1S7E 01	1.2C9E C2	1.020E 02	1.870E C2	-9.264E-02	1.753E 00	-9.247E-02	1.759E 00	1.028E 00	-5.495E-02
3.59EE CO	2.1S7E 01	1.2C9E C2	1.020E 02	1.870E C2	-8.287E-02	1.809E 00	-8.270E-02	1.814E 00	1.026E 00	-5.759E-02
3.6C9E CO	2.1S7E C1	1.2C9E C2	1.020E C2	1.870E C2	-7.295E-02	1.856E 00	-7.277E-02	1.862E CC	1.024E 00	-5.993E-02
3.61BE CO	2.1S7E C1	1.2C9E C2	1.020E C2	1.870E C2	-6.293E-02	1.895E 00	-6.278E-02	1.900E 00	1.022E 00	-6.197E-02
3.62BE CO	2.1S7E C1	1.2C9E C2	1.020E 02	1.870E C2	-5.283E-02	1.925E 00	-5.263E-02	1.930E 00	1.020E 00	-6.370E-02
3.63BE CO	2.1S7E C1	1.2C9E C2	1.020E 02	1.870E C2	-4.271E-02	1.947E 00	-4.251E-02	1.951E 00	1.018E 00	-6.514E-02
3.64BE CO	2.1S7E C1	1.2C9E C2	1.020E 02	1.870E C2	-3.260E-02	1.960E 00	-3.239E-02	1.964E 00	1.016E 00	-6.626E-02
3.65EE CO	2.1S7E C1	1.2C9E C2	1.020E C2	1.870E C2	-2.258E-02	1.965E 00	-2.236E-02	1.968E CO	1.014E 00	-6.709E-02
3.66EE CO	2.1S7E C1	1.2C9E C2	1.020L 02	1.870E C2	-1.264E-02	1.961E 00	-1.241E-02	1.964E 00	1.012E 00	-6.762E-02
3.67EE CO	2.1S7E 01	1.2C9E C2	1.020E 02	1.870E C2	-2.8C5E-03	1.949L 00	-2.580E-03	1.953E 00	1.010E 00	-6.785E-02
3.68EE CO	2.1S7E 01	1.2C9E C2	1.020E 02	1.870E C2	6.864E-03	1.930E 00	7.093E-03	1.933E 00	1.008E 00	-6.778E-02
3.69EE CO	2.1S7E C1	1.2C9E C2	1.020E 02	1.870E C2	1.623E-02	1.903E 00	1.657E-02	1.905E CC	1.006E 00	-6.743E-02
3.7C7E CO	2.1S7E C1	1.2C9E C2	1.020E 02	1.870E C2	2.557E-02	1.868E CO	2.581E-02	1.871E 00	1.004E 00	-6.680E-02
3.71TE CO	2.1S7E 01	1.2C9E C2	1.020E 02	1.870E 02	3.451E-02	1.826E 00	3.475E-02	1.829E 00	1.002E 00	-6.590E-02
3.72TE CO	2.1S7E C1	1.2C9E C2	1.020E C2	1.870E C2	4.310E-02	1.778E 00	4.334E-02	1.780E CC	9.999E-01	-6.473E-02
3.73TE CO	2.1S7E C1	1.2C9E C2	1.020E 02	1.870E C2	5.123E-02	1.723E 00	5.157E-02	1.725E 00	9.980E-01	-6.332E-02
3.74TE CC	2.1S7E C1	1.2C9E C2	1.020E 02	1.870E C2	5.915E-02	1.661E 00	5.939E-02	1.663E 00	9.961E-01	-6.166E-02
3.75TE CO	2.1S7E 01	1.2C9E C2	1.020E 02	1.870E C2	6.654E-02	1.594E 00	6.679E-02	1.596E 00	9.942E-01	-5.977E-02
3.76TE CO	2.1S7E 01	1.2C9E C2	1.020E 02	1.870E C2	7.348E-02	1.522E 00	7.373E-02	1.524E 00	9.925E-01	-5.767E-02
3.77TE CO	2.1S7E 01	1.2C9E C2	1.020E C2	1.870E C2	7.997E-02	1.445E 00	8.022E-02	1.446E 00	9.908E-01	-5.537E-02
3.78TE CO	2.1S7E 01	1.2C9E C2	1.020E 02	1.870E 02	8.599E-02	1.363E 00	8.624E-02	1.364E 00	9.892E-01	-5.288E-02
3.79EE CO	2.1S7E 01	1.2C9E C2	1.020E 02	1.870E 02	9.151E-02	1.277E 00	9.176E-02	1.279E 00	9.876E-01	-5.022E-02
3.8C6E CO	2.1S7E C1	1.2C9E C2	1.020E 02	1.870E C2	9.654E-02	1.188E 00	9.680E-02	1.189E 00	9.861E-01	-4.739E-02
3.81BE CO	2.1S7E C1	1.2C9E C2	1.020E C2	1.870E C2	1.011E-01	1.095E 00	1.013E-01	1.097E 00	9.848E-01	-4.443E-02
3.82BE CO	2.1S7E C1	1.2C9E C2	1.020E 02	1.870E 02	1.051E-01	1.000E 00	1.053E-01	1.002E 00	9.835E-01	-4.134E-02
3.83BE CO	2.1S7E C1	1.2C9E C2	1.020E 02	1.870E 02	1.086E-01	9.032E-01	1.088E-01	9.042E-01	9.823E-01	-3.813E-02
3.84EE CO	2.1S7E C1	1.2C9E C2	1.020E 02	1.870E C2	1.115E-01	8.042E-01	1.118E-01	8.052E-01	9.812E-01	-3.483E-02
3.85EE CO	2.1S7E C1	1.2C9E C2	1.020E 02	1.870E C2	1.140E-01	7.030E-01	1.142E-01	7.040E-01	9.802E-01	-3.144E-02
3.86EE CO	2.1S7E C1	1.2C9E C2	1.020E 02	1.870E 02	1.159E-01	6.026E-01	1.161E-01	6.035E-01	9.793E-01	-2.800E-02
3.87BE CO	2.1S7E 01	1.2C9E C2	1.020L 02	1.870E C2	1.173E-01	5.010E-01	1.175E-01	5.018E-01	9.785E-01	-2.450E-02
3.88EE CO	2.1S7E C1	1.2C9E C2	1.020E 02	1.870E C2	1.182E-01	3.993E-01	1.184L-01	4.002E-01	9.778E-01	-2.096E-02
3.89EE CC	2.1S7E C1	1.2C9E C2	1.020E 02	1.870E C2	1.186E-01	2.981E-01	1.188E-01	2.989E-01	9.772E-01	-1.741E-02
3.9CCE CO	2.1S7E 01	1.2C9E C2	1.020E 02	1.870E C2	1.184E-01	1.977E-01	1.187E-01	1.985E-01	9.768E-01	-1.385E-02
3.91BE CO	2.1S7E C1	1.2C9E C2	1.020E 02	1.870E C2	1.178E-01	9.855E-02	1.181E-01	9.925E-02	9.764E-01	-1.031E-02
3.92BE CO	2.1S7E C1	1.2C9E C2	1.020E 02	1.870E 02	1.167E-01	9.982E-04	1.170E-01	1.672E-03	9.761E-01	-6.789E-03
3.93BE CO	2.1S7E 01	1.2C9E C2	1.020E 02	1.870E C2	1.152E-01	-9.457E-02	1.154E-01	-9.392E-02	9.760E-01	-3.309E-03
3.94BE CC	2.1S7E C1	1.2C9E C2	1.020E 02	1.870E C2	1.132E-01	-1.878E-01	1.134E-01	-1.872E-01	9.759E-01	1.176E-04
3.95BE CO	2.1S7E 01	1.2C9E C2	1.020E 02	1.870E C2	1.107E-01	-2.783E-01	1.109E-01	-2.777E-01	9.760E-01	3.478E-03
3.96BE CO	2.1S7E C1	1.2C9E C2	1.020L 02	1.870E 02	1.079E-01	-3.659E-01	1.081E-01	-3.653E-01	9.761E-01	6.759E-03

3.975E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	1.047E-01	-4.501E-01	1.048E-01	-4.495E-01	9.704E-01	9.948E-03
3.985E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	1.010E-01	-5.307E-01	1.012E-01	-5.302E-01	9.767E-01	1.303E-02
3.995E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	9.760E-02	-6.075E-01	9.724E-02	-6.070E-01	9.771E-01	1.601E-02
4.005E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	9.260E-02	-6.801E-01	9.227E-02	-6.796E-01	9.777E-01	1.886E-02
4.015E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	8.821E-02	-7.485E-01	8.837E-02	-7.480E-01	9.785E-01	2.157E-02
4.025E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	8.335E-02	-8.128E-01	8.349E-02	-8.119E-01	9.790E-01	2.415E-02
4.035E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	7.823E-02	-8.715E-01	7.837E-02	-8.710E-01	9.797E-01	2.657E-02
4.045E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	7.269E-02	-9.258E-01	7.302E-02	-9.254E-01	9.805E-01	2.884E-02
4.055E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	6.735E-02	-9.751E-01	6.746E-02	-9.747E-01	9.814E-01	3.095E-02
4.065E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	6.163E-02	-1.019E 00	6.174E-02	-1.019E 00	9.824E-01	3.288E-02
4.075E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	5.578E-02	-1.058E 00	5.587E-02	-1.058E 00	9.834E-01	3.464E-02
4.085E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	4.980E-02	-1.092E 00	4.988E-02	-1.092E 00	9.845E-01	3.623E-02
4.095E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	4.373E-02	-1.121E 00	4.381E-02	-1.120E 00	9.856E-01	3.763E-02
4.105E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	3.760E-02	-1.144E 00	3.766E-02	-1.144E 00	9.867E-01	3.885E-02
4.115E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	3.143E-02	-1.162E 00	3.148E-02	-1.162E 00	9.879E-01	3.989E-02
4.125E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	2.525E-02	-1.175E 00	2.529E-02	-1.174E 00	9.891E-01	4.074E-02
4.135E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	1.908E-02	-1.182E 00	1.911E-02	-1.182E 00	9.903E-01	4.141E-02
4.145E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	1.295E-02	-1.185E 00	1.297E-02	-1.184E 00	9.916E-01	4.189E-02
4.155E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	6.851E-03	-1.182E 00	6.869E-03	-1.182E 00	9.928E-01	4.219E-02
4.165E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	9.198E-04	-1.175E 00	9.132E-04	-1.174E 00	9.941E-01	4.230E-02
4.175E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-4.946E-03	-1.162E 00	-4.959E-03	-1.162E 00	9.954E-01	4.224E-02
4.185E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-1.060E-02	-1.145E 00	-1.070E-02	-1.145E 00	9.966E-01	4.201E-02
4.195E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-1.625E-02	-1.124E 00	-1.629E-02	-1.124E 00	9.979E-01	4.161E-02
4.205E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-2.165E-02	-1.098E 00	-2.169E-02	-1.098E 00	9.991E-01	4.104E-02
4.215E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-2.685E-02	-1.068E 00	-2.690E-02	-1.068E 00	1.000E 00	4.031E-02
4.225E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-3.181E-02	-1.034E 00	-3.187E-02	-1.034E 00	1.001E 00	3.943E-02
4.235E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-3.651E-02	-9.965E-01	-3.658E-02	-9.965E-01	1.003E 00	3.841E-02
4.245E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-4.095E-02	-9.555E-01	-4.103E-02	-9.555E-01	1.004E 00	3.724E-02
4.255E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-4.510E-02	-9.113E-01	-4.518E-02	-9.113E-01	1.005E 00	3.595E-02
4.265E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-4.895E-02	-8.642E-01	-4.905E-02	-8.642E-01	1.006E 00	3.454E-02
4.275E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-5.253E-02	-8.143E-01	-5.262E-02	-8.144E-01	1.007E 00	3.302E-02
4.285E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-5.581E-02	-7.622E-01	-5.590E-02	-7.622E-01	1.008E 00	3.139E-02
4.295E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-5.877E-02	-7.079E-01	-5.887E-02	-7.079E-01	1.008E 00	2.967E-02
4.305E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-6.142E-02	-6.518E-01	-6.153E-02	-6.519E-01	1.009E 00	2.787E-02
4.315E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-6.376E-02	-5.942E-01	-6.386E-02	-5.942E-01	1.010E 00	2.599E-02
4.325E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-6.578E-02	-5.352E-01	-6.589E-02	-5.353E-01	1.011E 00	2.405E-02
4.335E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-6.749E-02	-4.753E-01	-6.760E-02	-4.755E-01	1.011E 00	2.205E-02
4.345E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-6.887E-02	-4.147E-01	-6.898E-02	-4.148E-01	1.012E 00	2.000E-02
4.355E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-6.993E-02	-3.536E-01	-7.006E-02	-3.538E-01	1.013E 00	1.792E-02
4.365E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-7.070E-02	-2.923E-01	-7.082E-02	-2.925E-01	1.013E 00	1.581E-02
4.375E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-7.115E-02	-2.311E-01	-7.127E-02	-2.313E-01	1.013E 00	1.368E-02
4.385E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-7.129E-02	-1.702E-01	-7.141E-02	-1.704E-01	1.014E 00	1.154E-02
4.395E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-7.114E-02	-1.099E-01	-7.125E-02	-1.101E-01	1.014E 00	9.405E-03
4.405E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-7.068E-02	-5.039E-02	-7.080E-02	-5.063E-02	1.014E 00	7.277E-03
4.415E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-6.995E-02	8.782E-03	-7.007E-02	7.835E-03	1.014E 00	5.166E-03
4.425E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-6.894E-02	6.530E-02	-6.905E-02	6.504E-02	1.014E 00	3.082E-03
4.435E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-6.766E-02	1.211E-01	-6.777E-02	1.208E-01	1.014E 00	1.032E-03
4.445E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-6.613E-02	1.751E-01	-6.624E-02	1.748E-01	1.014E 00	-9.757E-04
4.455E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-6.436E-02	2.273E-01	-6.446E-02	2.270E-01	1.014E 00	-2.934E-03
4.465E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-6.236E-02	2.775E-01	-6.246E-02	2.772E-01	1.014E 00	-4.835E-03
4.475E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-6.015E-02	3.255E-01	-6.025E-02	3.252E-01	1.014E 00	-6.674E-03
4.485E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-5.773E-02	3.711E-01	-5.782E-02	3.708E-01	1.014E 00	-8.442E-03
4.495E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-5.512E-02	4.142E-01	-5.521E-02	4.139E-01	1.013E 00	-1.014E-02
4.505E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-5.233E-02	4.547E-01	-5.242E-02	4.544E-01	1.013E 00	-1.175E-02
4.515E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-4.939E-02	4.924E-01	-4.947E-02	4.921E-01	1.013E 00	-1.327E-02
4.525E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-4.629E-02	5.274E-01	-4.636E-02	5.271E-01	1.012E 00	-1.471E-02
4.535E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-4.306E-02	5.594E-01	-4.313E-02	5.591E-01	1.012E 00	-1.605E-02
4.545E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-3.972E-02	5.884E-01	-3.979E-02	5.881E-01	1.011E 00	-1.729E-02
4.555E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-3.627E-02	6.144E-01	-3.633E-02	6.141E-01	1.010E 00	-1.843E-02
4.565E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-3.276E-02	6.372E-01	-3.281E-02	6.369E-01	1.010E 00	-1.947E-02
4.575E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-2.916E-02	6.569E-01	-2.921E-02	6.566E-01	1.009E 00	-2.040E-02

4.58CE CO	2.157E 01	1.20PE 02	1.020E 02	1.870E 02	-2.550C-02	6.775E-01	-2.595E-02	6.732E-01	1.008E 00	-2.122E-02
4.59CE CO	2.157E 01	1.20PE 02	1.020E 02	1.870C 02	-2.182C-02	6.868E-01	-2.186E-02	6.866E-01	1.008E 00	-2.193E-02
4.6CCE CO	2.157E 01	1.2CPE C2	1.C20E 02	1.870E C2	-1.815E-02	6.970E-01	-1.818E-02	6.968E-01	1.007E 00	-2.253E-02
4.61CE CO	2.157E C1	1.2C8E C2	1.C20E 02	1.870C C2	-1.446C-02	7.041E-01	-1.448E-02	7.039E-01	1.006E 00	-2.302E-02
4.62CE CO	2.157E 01	1.20PE C2	1.020E 02	1.870E C2	-1.079E-02	7.081E-01	-1.077E-02	7.079E-01	1.006E 00	-2.340E-02
4.63CE CO	2.157E C1	1.2C8E C2	1.020E 02	1.870E C2	-7.053E-03	7.091E-01	-7.063E-03	7.089E-01	1.005E 00	-2.367E-02
4.63SE CO	2.157E C1	1.2C8E C2	1.C20E 02	1.870E C2	-3.352E-03	7.071E-01	-3.396E-03	7.069E-01	1.004E 00	-2.382E-02
4.64SE CO	2.157E 01	1.2C8E C2	1.C20E 02	1.870E C2	2.118E-04	7.020E-01	2.139E-04	7.018E-01	1.003E 00	-2.387E-02
4.65SE CO	2.157E C1	1.20PE C2	1.020E 02	1.870E C2	3.744E-03	6.941E-01	3.752E-03	6.939E-01	1.003E 00	-2.381E-02
4.66SE CO	2.157E C1	1.2C8E C2	1.C20E 02	1.870E C2	7.153E-03	6.834E-01	7.207E-03	6.832E-01	1.002E 00	-2.365E-02
4.67SE CO	2.157E 01	1.2C8E C2	1.C20E 02	1.870E C2	1.055E-02	6.700E-01	1.057E-02	6.698E-01	1.001E 00	-2.338E-02
4.68SE CO	2.157E 01	1.2C8E C2	1.C20E 02	1.870E C2	1.381E-02	6.540E-01	1.384E-02	6.539E-01	1.000E 00	-2.302E-02
4.69SE CO	2.157E 01	1.20PE C2	1.020E 02	1.870E C2	1.696E-02	6.355E-01	1.699E-02	6.354E-01	9.996E-01	-2.255E-02
4.7CSE CO	2.157E 01	1.2C8E C2	1.020E 02	1.870E C2	1.993E-02	6.146E-01	1.996E-02	6.145E-01	9.989E-01	-2.200E-02
4.71SE CO	2.157E C1	1.2C8E C2	1.C20E C2	1.870E C2	2.272E-02	5.915E-01	2.276E-02	5.914E-01	9.982E-01	-2.136E-02
4.72SE CO	2.157E 01	1.2C8E C2	1.020E 02	1.870E 02	2.534E-02	5.663E-01	2.538E-02	5.662E-01	9.976E-01	-2.064E-02
4.73SE CO	2.157E 01	1.20PE C2	1.020E 02	1.870E C2	2.777E-02	5.392E-01	2.781E-02	5.391E-01	9.970E-01	-1.984E-02
4.74SE CO	2.157E C1	1.2C8E C2	1.020E 02	1.870E C2	3.CC1E-02	5.104E-01	3.006E-02	5.103E-01	9.964E-01	-1.898E-02
4.75SE CO	2.157E C1	1.2C8E C2	1.C20E C2	1.870E C2	3.207E-02	4.800E-01	3.213E-02	4.800E-01	9.959E-01	-1.804E-02
4.76FE CO	2.157E 01	1.2C8E C2	1.C20E 02	1.870E 02	3.355E-02	4.483E-01	3.400E-02	4.483E-01	9.953E-01	-1.705E-02
4.77EE CO	2.157E C1	1.20PE C2	1.020E 02	1.870E 02	3.563E-02	4.154E-01	3.569E-02	4.154E-01	9.948E-01	-1.601E-02
4.78EE CO	2.157E C1	1.2C8E C2	1.020E 02	1.870E 02	3.712E-02	3.815E-01	3.718E-02	3.815E-01	9.944E-01	-1.492E-02
4.79BE CO	2.157E 01	1.2C8E C2	1.C20E C2	1.870E C2	3.842E-02	3.467E-01	3.848E-02	3.467E-01	9.939E-01	-1.378E-02
4.8CBE CO	2.157E 01	1.2CPE C2	1.C20E 02	1.870E C2	3.953E-02	3.112E-01	3.959E-02	3.113E-01	9.935E-01	-1.261E-02
4.81BE CO	2.157E C1	1.20PE C2	1.020E 02	1.870E C2	4.044E-02	2.753E-01	4.051E-02	2.753E-01	9.932E-01	-1.141E-02
4.82BE CO	2.157E C1	1.2C8E C2	1.C20E 02	1.870E C2	4.117E-02	2.389E-01	4.124E-02	2.390E-01	9.928E-01	-1.019E-02
4.83BE CO	2.157E C1	1.2C8E C2	1.020E 02	1.870E C2	4.171E-02	2.024E-01	4.178E-02	2.025E-01	9.926E-01	-8.946E-03
4.84BE CO	2.157E 01	1.20PE C2	1.020E 02	1.870E C2	4.206E-02	1.659E-01	4.213E-02	1.660E-01	9.923E-01	-7.689E-03
4.85BE CO	2.157E 01	1.20PE C2	1.020E 02	1.870E 02	4.223E-02	1.295E-01	4.230E-02	1.296E-01	9.921E-01	-6.424E-03
4.86PE CO	2.157E C1	1.2CPE C2	1.C20E 02	1.870E C2	4.221E-02	9.335E-02	4.228E-02	9.347E-02	9.919E-01	-5.157E-03
4.87BE CO	2.157E C1	1.2C8E C2	1.C20E 02	1.870E C2	4.202E-02	5.763E-02	4.209E-02	5.775E-02	9.918E-01	-3.893E-03
4.88BE CO	2.157E C1	1.2C8E C2	1.020E 02	1.870E C2	4.166E-02	2.246E-02	4.173E-02	2.259E-02	9.917E-01	-2.637E-03
4.89BE CO	2.157E C1	1.20PE C2	1.020E 02	1.870E C2	4.114E-02	-1.201E-02	4.120E-02	-1.187E-02	9.916E-01	-1.394E-03
4.9CBE CO	2.157E C1	1.2CPE C2	1.C20E 02	1.870E C2	4.045E-02	-4.566E-02	4.051E-02	-4.552E-02	9.916E-01	-1.700E-04
4.91BE CO	2.157E 01	1.2CPE C2	1.C20E 02	1.870E C2	3.960E-02	-7.857E-02	3.967E-02	-7.823E-02	9.916E-01	1.031E-03
4.92BE CO	2.157E C1	1.20PE 02	1.C20E 02	1.870E C2	3.861E-02	-1.100E-01	3.867E-02	-1.099E-01	9.916E-01	2.205E-03
4.93BE CO	2.157E C1	1.2CPE C2	1.C20E 02	1.870E C2	3.748E-02	-1.405E-01	3.754E-02	-1.403E-01	9.917E-01	3.347E-03
4.94BE CO	2.157E 01	1.2CPE C2	1.C20E 02	1.870E C2	3.621E-02	-1.697E-01	3.627E-02	-1.696E-01	9.918E-01	4.452E-03
4.95BE CO	2.157E 01	1.2CPE C2	1.C20E 02	1.870E C2	3.482E-02	-1.976E-01	3.488E-02	-1.974E-01	9.920E-01	5.518E-03
4.96PE CO	2.157E C1	1.2CPE C2	1.020E 02	1.870E 02	3.331E-02	-2.240E-01	3.336E-02	-2.238E-01	9.922E-01	6.540E-03
4.97BE CO	2.157E C1	1.2CPE C2	1.C20E 02	1.870E C2	3.169E-02	-2.488E-01	3.174E-02	-2.486E-01	9.924E-01	7.516E-03
4.98BE CO	2.157E C1	1.2CPE C2	1.020E C2	1.870E C2	2.997E-02	-2.721E-01	3.002E-02	-2.719E-01	9.926E-01	8.441E-03
4.99BE CO	2.157E C1	1.2CPE C2	1.020E 02	1.870E C2	2.816E-02	-2.937E-01	2.821E-02	-2.935E-01	9.929E-01	9.313E-03
5.CCBE CO	2.157E C1	1.2CPE 02	1.020E 02	1.870E 02	2.627E-02	-3.135E-01	2.631E-02	-3.134E-01	9.932E-01	1.013E-02
5.C1BE CO	2.157E C1	1.2C8E C2	1.020E 02	1.870E C2	2.430E-02	-3.316E-01	2.435E-02	-3.314E-01	9.935E-01	1.089E-02
5.C2BE CO	2.157E C1	1.2C8E C2	1.020E 02	1.870E C2	2.228E-02	-3.479E-01	2.232E-02	-3.477E-01	9.938E-01	1.159E-02
5.C3BE CO	2.157E C1	1.2CPE C2	1.020E 02	1.870E C2	2.020E-02	-3.623E-01	2.023E-02	-3.622E-01	9.942E-01	1.223E-02
5.C4BE CO	2.157E 01	1.2C8E C2	1.020E 02	1.870E C2	1.808E-02	-3.749E-01	1.811E-02	-3.748E-01	9.945E-01	1.280E-02
5.C5BE CO	2.157E C1	1.2CPE C2	1.020E 02	1.870E C2	1.592E-02	-3.856E-01	1.595E-02	-3.855E-01	9.949E-01	1.331E-02
5.C6BE CO	2.157E C1	1.2CPE C2	1.C20E 02	1.870E C2	1.374E-02	-3.944E-01	1.376E-02	-3.943E-01	9.953E-01	1.375E-02
5.C7BE CO	2.157E C1	1.2CPE C2	1.020E 02	1.870E C2	1.154E-02	-4.013E-01	1.156E-02	-4.012E-01	9.957E-01	1.413E-02
5.C8BE CO	2.157E C1	1.2CPE C2	1.020E 02	1.870E 02	9.340E-03	-4.064E-01	9.356E-03	-4.063E-01	9.962E-01	1.445E-02
5.C9BE CO	2.157E 01	1.2C8E C2	1.C20E 02	1.870E C2	7.143E-03	-4.096E-01	7.155E-03	-4.095E-01	9.966E-01	1.469E-02
5.1CBE CO	2.157E C1	1.2C8E C2	1.C20E 02	1.870E C2	4.958E-03	-4.110E-01	4.966E-03	-4.109E-01	9.970E-01	1.488E-02
5.11BE CO	2.157E 01	1.2CPE C2	1.C20E 02	1.870E C2	2.756E-03	-4.105E-01	2.800E-03	-4.104E-01	9.975E-01	1.499E-02
5.12SE CO	2.157E 01	1.20PE C2	1.020E 02	1.870E C2	6.621E-04	-4.081E-01	6.640E-04	-4.082E-01	9.979E-01	1.504E-02
5.13SE CO	2.157E 01	1.2CPE C2	1.020E 02	1.870E C2	-1.420E-03	-4.044E-01	-1.433E-03	-4.043E-01	9.984E-01	1.503E-02
5.14SE CO	2.157E 01	1.2CPE C2	1.020E 02	1.870E C2	-3.476E-03	-3.988E-01	-3.482E-03	-3.987E-01	9.988E-01	1.496E-02
5.15SE CO	2.157E C1	1.2CPE C2	1.020E 02	1.870E C2	-5.469E-03	-3.916E-01	-5.478E-03	-3.916E-01	9.993E-01	1.483E-02
5.16SE CO	2.157E 01	1.2CPE C2	1.020E 02	1.870E 02	-7.400E-03	-3.829E-01	-7.413E-03	-3.828E-01	9.997E-01	1.463E-02
5.17SE CO	2.157E 01	1.2CPE C2	1.020E 02	1.870E C2	-9.261E-03	-3.726E-01	-9.277E-03	-3.726E-01	1.000E 00	1.438E-02

5.185E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-1.109E-02	-3.609E-01	-1.103E-02	-3.609E-01	1.001E 00	1.408E-02
5.195E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-1.266E-02	-3.479E-01	-1.268E-02	-3.479E-01	1.001E 00	1.372E-02
5.205E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-1.421E-02	-3.337E-01	-1.423E-02	-3.336E-01	1.001E 00	1.332E-02
5.215E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-1.567E-02	-3.189E-01	-1.569E-02	-3.189E-01	1.002E 00	1.287E-02
5.225E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-1.707E-02	-3.039E-01	-1.705E-02	-3.039E-01	1.002E 00	1.238E-02
5.235E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-1.834E-02	-2.845E-01	-1.826E-02	-2.845E-01	1.002E 00	1.185E-02
5.244E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-1.939E-02	-2.663E-01	-1.932E-02	-2.663E-01	1.003E 00	1.129E-02
5.254E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-2.020E-02	-2.479E-01	-2.020E-02	-2.474E-01	1.003E 00	1.069E-02
5.264E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-2.110E-02	-2.279E-01	-2.113E-02	-2.279E-01	1.003E 00	1.007E-02
5.274E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-2.187E-02	-2.079E-01	-2.190E-02	-2.080E-01	1.003E 00	9.429E-03
5.284E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-2.251E-02	-1.876E-01	-2.254E-02	-1.876E-01	1.004E 00	8.763E-03
5.294E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-2.301E-02	-1.669E-01	-2.305E-02	-1.669E-01	1.004E 00	8.080E-03
5.304E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-2.340E-02	-1.460E-01	-2.344E-02	-1.461E-01	1.004E 00	7.384E-03
5.314E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-2.370E-02	-1.251E-01	-2.374E-02	-1.251E-01	1.004E 00	6.677E-03
5.324E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-2.392E-02	-1.041E-01	-2.395E-02	-1.042E-01	1.004E 00	5.962E-03
5.334E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-2.408E-02	-8.324E-02	-2.403E-02	-8.332E-02	1.004E 00	5.243E-03
5.344E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-2.396E-02	-6.249E-02	-2.400E-02	-6.250E-02	1.004E 00	4.523E-03
5.354E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-2.383E-02	-4.201E-02	-2.387E-02	-4.211E-02	1.005E 00	3.806E-03
5.364E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-2.364E-02	-2.191E-02	-2.368E-02	-2.201E-02	1.005E 00	3.094E-03
5.373E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-2.333E-02	-2.179E-03	-2.337E-02	-2.284E-03	1.005E 00	2.389E-03
5.383E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-2.291E-02	1.711E-02	-2.295E-02	1.701E-02	1.005E 00	1.695E-03
5.393E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-2.241E-02	3.585E-02	-2.244E-02	3.573E-02	1.005E 00	1.015E-03
5.403E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-2.184E-02	5.392E-02	-2.187E-02	5.381E-02	1.005E 00	3.508E-04
5.413E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-2.122E-02	7.128E-02	-2.125E-02	7.116E-02	1.005E 00	-2.952E-04
5.423E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-2.058E-02	8.795E-02	-2.059E-02	8.783E-02	1.005E 00	-9.214E-04
5.433E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-1.971E-02	1.039E-01	-1.974E-02	1.038E-01	1.004E 00	-1.525E-03
5.443E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-1.884E-02	1.190E-01	-1.887E-02	1.189E-01	1.004E 00	-2.104E-03
5.453E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-1.792E-02	1.332E-01	-1.795E-02	1.331E-01	1.004E 00	-2.655E-03
5.463E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-1.698E-02	1.464E-01	-1.701E-02	1.463E-01	1.004E 00	-3.179E-03
5.473E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-1.600E-02	1.587E-01	-1.603E-02	1.586E-01	1.004E 00	-3.674E-03
5.483E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-1.494E-02	1.702E-01	-1.497E-02	1.700E-01	1.004E 00	-4.138E-03
5.493E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-1.382E-02	1.806E-01	-1.384E-02	1.805E-01	1.004E 00	-4.570E-03
5.503E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-1.265E-02	1.900E-01	-1.267E-02	1.899E-01	1.003E 00	-4.967E-03
5.513E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-1.147E-02	1.984E-01	-1.148E-02	1.982E-01	1.003E 00	-5.329E-03
5.523E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-1.027E-02	2.056E-01	-1.028E-02	2.055E-01	1.003E 00	-5.655E-03
5.533E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-9.070E-03	2.118E-01	-9.085E-03	2.117E-01	1.003E 00	-5.945E-03
5.543E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-7.885E-03	2.169E-01	-7.898E-03	2.168E-01	1.003E 00	-6.199E-03
5.553E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-6.718E-03	2.209E-01	-6.730E-03	2.208E-01	1.002E 00	-6.418E-03
5.563E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-5.573E-03	2.239E-01	-5.582E-03	2.238E-01	1.002E 00	-6.602E-03
5.573E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-4.353E-03	2.259E-01	-4.399E-03	2.258E-01	1.002E 00	-6.752E-03
5.583E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-3.169E-03	2.271E-01	-3.173E-03	2.270E-01	1.002E 00	-6.866E-03
5.593E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-1.919E-03	2.278E-01	-1.921E-03	2.272E-01	1.001E 00	-6.942E-03
5.603E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	-6.571E-04	2.265E-01	-6.567E-04	2.264E-01	1.001E 00	-6.981E-03
5.613E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	6.059E-04	2.247E-01	6.084E-04	2.246E-01	1.001E 00	-6.981E-03
5.623E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	1.861E-03	2.219E-01	1.865E-03	2.218E-01	1.001E 00	-6.944E-03
5.633E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	3.100E-03	2.181E-01	3.107E-03	2.180E-01	1.000E 00	-6.870E-03
5.643E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	4.319E-03	2.134E-01	4.327E-03	2.133E-01	1.000E 00	-6.759E-03
5.653E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	5.466E-03	2.077E-01	5.475E-03	2.076E-01	9.998E-01	-6.612E-03
5.663E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	6.515E-03	2.010E-01	6.525E-03	2.010E-01	9.996E-01	-6.432E-03
5.673E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	7.471E-03	1.935E-01	7.483E-03	1.935E-01	9.994E-01	-6.222E-03
5.683E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	8.341E-03	1.852E-01	8.354E-03	1.852E-01	9.992E-01	-5.984E-03
5.693E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	9.129E-03	1.763E-01	9.143E-03	1.763E-01	9.990E-01	-5.722E-03
5.703E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	9.838E-03	1.668E-01	9.852E-03	1.668E-01	9.989E-01	-5.437E-03
5.713E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	1.047E-02	1.568E-01	1.049E-02	1.568E-01	9.987E-01	-5.133E-03
5.723E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	1.103E-02	1.464E-01	1.105E-02	1.464E-01	9.985E-01	-4.810E-03
5.733E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	1.152E-02	1.356E-01	1.153E-02	1.356E-01	9.984E-01	-4.471E-03
5.743E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	1.193E-02	1.245E-01	1.195E-02	1.245E-01	9.983E-01	-4.119E-03
5.753E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	1.228E-02	1.132E-01	1.230E-02	1.132E-01	9.981E-01	-3.756E-03
5.763E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	1.257E-02	1.017E-01	1.259E-02	1.017E-01	9.980E-01	-3.383E-03
5.773E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	1.279E-02	9.013E-02	1.281E-02	9.013E-02	9.979E-01	-3.002E-03
5.783E 00	2.197E 01	1.208E 02	1.020E 02	1.870E 02	1.295E-02	7.848E-02	1.297E-02	7.849E-02	9.979E-01	-2.616E-03

5.79CE CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E 02	1.3C4E-02	6.684E-02	1.306E-02	6.685E-02	9.970E-01	-2.226E-03
5.8CCE CO	2.197E 01	1.2C8E C2	1.020E 02	1.870E C2	1.3C8E-02	5.925E-02	1.310E-02	5.526E-02	9.977E-01	-1.834E-03
5.81CE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	1.3C5E-02	4.375E-02	1.307E-02	4.378E-02	9.977E-01	-1.442E-03
5.82CE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E 02	1.297E-02	3.241E-02	1.300E-02	3.243E-02	9.976E-01	-1.052E-03
5.83CE CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E 02	1.284E-02	2.174E-02	1.286E-02	2.128E-02	9.976E-01	-6.643E-04
5.84CE CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	1.266E-02	1.014E-02	1.268E-02	1.037E-02	9.976E-01	-2.817E-04
5.85CE CO	2.197E C1	1.2C8E C2	1.020E C2	1.870E C2	1.242E-02	-3.052E-04	1.244E-02	-2.701E-04	9.976E-01	9.465E-05
5.859E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	1.214E-02	-1.063E-02	1.216E-02	-1.060E-02	9.976E-01	4.632E-04
5.86CE CO	2.197E 01	1.2C8E C2	1.020E 02	1.870E 02	1.181E-02	-2.061E-02	1.183E-02	-2.057E-02	9.976E-01	8.225E-04
5.87CE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	1.144E-02	-3.C41E-02	1.146E-02	-3.017E-02	9.976E-01	1.171E-03
5.879E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	1.103E-02	-3.999E-02	1.104E-02	-3.995E-02	9.977E-01	1.520E-03
5.88CE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	1.058E-02	-4.913E-02	1.059E-02	-4.908E-02	9.977E-01	1.833E-03
5.889E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	1.CC9E-02	-5.740E-02	1.011E-02	-5.635E-02	9.978E-01	2.143E-03
5.89CE CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	9.574E-03	-6.417E-02	9.589E-03	-6.413E-02	9.978E-01	2.434E-03
5.89CE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	9.027E-03	-7.044E-02	9.042E-03	-7.139E-02	9.979E-01	2.717E-03
5.89CE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	8.493E-03	-7.617E-02	8.467E-03	-7.812E-02	9.980E-01	2.979E-03
5.89CE CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	7.956E-03	-8.135E-02	7.869E-03	-8.431E-02	9.981E-01	3.224E-03
5.89CE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	7.228E-03	-8.597E-02	7.25CE-03	-8.993E-02	9.982E-01	3.451E-03
5.89CE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	6.6C2E-03	-9.003E-02	6.613E-03	-9.498E-02	9.983E-01	3.658E-03
5.89CE CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	5.951E-03	-9.350E-02	5.961E-03	-9.946E-02	9.984E-01	3.847E-03
5.89CE CO	2.197E 01	1.2C8E C2	1.020E 02	1.870E C2	5.288E-03	-1.034E-01	5.297E-03	-1.033E-01	9.985E-01	4.015E-03
5.89CE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	4.616E-03	-1.067E-01	4.624E-03	-1.066E-01	9.986E-01	4.164E-03
6.CC8E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	3.939E-03	-1.094E-01	3.945E-03	-1.094E-01	9.987E-01	4.292E-03
6.C19E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	3.259E-03	-1.115E-01	3.264E-03	-1.115E-01	9.989E-01	4.400E-03
6.C28E CO	2.197E 01	1.2C8E C2	1.C20E 02	1.870E C2	2.578E-03	-1.131E-01	2.582E-03	-1.130E-01	9.990E-01	4.487E-03
6.C38E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	1.9C0E-03	-1.140E-01	1.903E-03	-1.140E-01	9.991E-01	4.554E-03
6.C48E CO	2.197E 01	1.2C8E C2	1.C20E 02	1.870E C2	1.229E-03	-1.144E-01	1.231E-03	-1.144E-01	9.993E-01	4.601E-03
6.C58E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	5.637E-04	-1.143E-01	5.646E-04	-1.142E-01	9.994E-01	4.628E-03
6.C68E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E 02	-9.163E-05	-1.136E-01	-9.187E-05	-1.135E-01	9.995E-01	4.635E-03
6.C78E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-7.343E-04	-1.123E-01	-7.356E-04	-1.123E-01	9.997E-01	4.623E-03
6.C88E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E 02	-1.362E-03	-1.106E-01	-1.365E-03	-1.106E-01	9.998E-01	4.591E-03
6.C97E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E 02	-1.973E-03	-1.084E-01	-1.976E-03	-1.084E-01	1.000E 00	4.541E-03
6.1C7E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-2.554E-03	-1.056E-01	-2.558E-03	-1.056E-01	1.000E 00	4.473E-03
6.117E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-3.083E-03	-1.024E-01	-3.087E-03	-1.024E-01	1.000E 00	4.388E-03
6.127E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E 02	-3.564E-03	-9.878E-02	-3.569E-03	-9.877E-02	1.000E 00	4.288E-03
6.137E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-4.002E-03	-9.475E-02	-4.007E-03	-9.474E-02	1.000E 00	4.174E-03
6.147E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-4.404E-03	-9.04CE-02	-4.409E-03	-9.039E-02	1.000E 00	4.048E-03
6.157E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-4.773E-03	-8.575E-02	-4.779E-03	-8.575E-02	1.001E 00	3.910E-03
6.167E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-5.113E-03	-8.086E-02	-5.120E-03	-8.086E-02	1.001E 00	3.762E-03
6.177E CO	2.197E 01	1.2C8E C2	1.020E 02	1.870E 02	-5.429E-03	-7.575E-02	-5.436E-03	-7.575E-02	1.001E 00	3.604E-03
6.187E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-5.723E-03	-7.044E-02	-5.731E-03	-7.046E-02	1.001E 00	3.436E-03
6.197E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-5.998E-03	-6.498E-02	-6.006E-03	-6.499E-02	1.001E 00	3.261E-03
6.2C7E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-6.242E-03	-5.934E-02	-6.250E-03	-5.936E-02	1.001E 00	3.077E-03
6.217E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E 02	-6.454E-03	-5.349E-02	-6.402E-03	-5.351E-02	1.001E 00	2.887E-03
6.227E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-6.463E-03	-4.749E-02	-6.470E-03	-4.752E-02	1.001E 00	2.694E-03
6.237E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-6.465E-03	-4.146E-02	-6.471E-03	-4.149E-02	1.001E 00	2.500E-03
6.247E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E 02	-6.411E-03	-3.546E-02	-6.418E-03	-3.549E-02	1.001E 00	2.307E-03
6.257E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E 02	-6.315E-03	-2.956E-02	-6.322E-03	-2.959E-02	1.001E 00	2.116E-03
6.267E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E 02	-6.186E-03	-2.378E-02	-6.192E-03	-2.382E-02	1.001E 00	1.928E-03
6.277E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-6.031E-03	-1.819E-02	-6.037E-03	-1.823E-02	1.001E 00	1.745E-03
6.287E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-5.857E-03	-1.279E-02	-5.863E-03	-1.283E-02	1.001E 00	1.566E-03
6.297E CO	2.197E 01	1.2C8E C2	1.C20E 02	1.870E C2	-5.670E-03	-7.606E-03	-5.676E-03	-7.657E-03	1.001E 00	1.393E-03
6.3C7E CO	2.197E C1	1.2C8E C2	1.029E 02	1.870E C2	-5.475E-03	-2.697E-03	-5.480E-03	-2.711E-03	1.001E 00	1.226E-03
6.317E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-5.274E-03	2.051E-03	-5.280E-03	1.995E-03	1.001E 00	1.065E-03
6.327E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E 02	-5.073E-03	6.517E-03	-5.078E-03	6.458E-03	1.001E 00	9.096E-04
6.337E CO	2.197E 01	1.2C8E C2	1.020E 02	1.870E C2	-4.872E-03	1.074E-02	-4.877E-03	1.068E-02	1.001E 00	7.604E-04
6.347E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-4.674E-03	1.472E-02	-4.679E-03	1.465E-02	1.001E 00	6.172E-04
6.357E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-4.480E-03	1.846E-02	-4.485E-03	1.840E-02	1.001E 00	4.799E-04
6.367E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-4.292E-03	2.197E-02	-4.297E-03	2.191E-02	1.001E 00	3.483E-04
6.377E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-4.111E-03	2.526E-02	-4.116E-03	2.519E-02	1.001E 00	2.222E-04
6.387E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-3.937E-03	2.833E-02	-3.942E-03	2.827E-02	1.001E 00	1.015E-04

6.395E CO	2.197E 01	1.2C8E C2	1.020E 02	1.870E C2	-3.771E-03	3.720E-02	-3.776E-03	3.113E-02	1.001E 00	-1.413E-05
6.405E CO	2.197E 01	1.2C8E C2	1.020E 02	1.870E C2	-3.613E-03	3.787E-02	-3.617E-03	3.180E-02	1.001E 00	-1.249E-04
6.415E CO	2.197E 01	1.2C8E C2	1.020E 02	1.870E C2	-3.459E-03	3.856E-02	-3.463E-03	3.629E-02	1.001E 00	-2.310E-04
6.425E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-3.246E-03	3.928E-02	-3.250E-03	3.871E-02	1.001E 00	-3.318E-04
6.435E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-2.967E-03	4.107E-02	-2.970E-03	4.100E-02	1.001E 00	-4.252E-04
6.445E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-2.626E-03	4.317E-02	-2.638E-03	4.309E-02	1.001E 00	-5.094E-04
6.455E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-2.269E-03	4.502E-02	-2.267E-03	4.495E-02	1.001E 00	-5.830E-04
6.464E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-1.869E-03	4.658E-02	-1.866E-03	4.651E-02	1.000E 00	-6.451E-04
6.474E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-1.444E-03	4.782E-02	-1.445E-03	4.775E-02	1.000E 00	-6.948E-04
6.484E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-1.009E-03	4.873E-02	-1.009E-03	4.866E-02	1.000E 00	-7.317E-04
6.494E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-5.661E-04	4.928E-02	-5.659E-04	4.921E-02	1.000E 00	-7.554E-04
6.504E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-1.201E-04	4.947E-02	-1.199E-04	4.940E-02	1.000E 00	-7.657E-04
6.514E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	3.239E-04	4.929E-02	3.244E-04	4.923E-02	1.000E CO	-7.627E-04
6.524E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	7.161E-04	4.869E-02	7.167E-04	4.863E-02	1.000E 00	-7.470E-04
6.534E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	1.046E-03	4.770E-02	1.046E-03	4.764E-02	9.999E-01	-7.204E-04
6.544E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	1.322E-03	4.638E-02	1.322E-03	4.632E-02	9.999E-01	-6.848E-04
6.554E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	1.552E-03	4.481E-02	1.552E-03	4.475E-02	9.999E-01	-6.417E-04
6.564E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	1.743E-03	4.302E-02	1.743E-03	4.297E-02	9.999E-01	-5.922E-04
6.574E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	1.897E-03	4.106E-02	1.898E-03	4.101E-02	9.999E-01	-5.375E-04
6.583E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	2.019E-03	3.897E-02	2.019E-03	3.893E-02	9.998E-01	-4.787E-04
6.593E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	2.113E-03	3.678E-02	2.114E-03	3.674E-02	9.998E-01	-4.167E-04
6.603E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	2.184E-03	3.452E-02	2.185E-03	3.448E-02	9.998E-01	-3.521E-04
6.613E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	2.232E-03	3.222E-02	2.232E-03	3.218E-02	9.998E-01	-2.859E-04
6.623E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	2.258E-03	2.988E-02	2.259E-03	2.985E-02	9.998E-01	-2.185E-04
6.633E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	2.268E-03	2.755E-02	2.269E-03	2.752E-02	9.998E-01	-1.506E-04
6.643E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	2.260E-03	2.522E-02	2.262E-03	2.520E-02	9.998E-01	-9.260E-05
6.653E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	2.239E-03	2.293E-02	2.241E-03	2.290E-02	9.998E-01	-1.508E-05
6.663E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	2.204E-03	2.067E-02	2.206E-03	2.065E-02	9.998E-01	5.161E-05
6.673E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	2.156E-03	1.846E-02	2.158E-03	1.845E-02	9.998E-01	1.170E-04
6.683E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	2.098E-03	1.632E-02	2.100E-03	1.631E-02	9.998E-01	1.809E-04
6.693E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	2.031E-03	1.425E-02	2.033E-03	1.424E-02	9.998E-01	2.429E-04
6.702E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	1.954E-03	1.226E-02	1.956E-03	1.225E-02	9.998E-01	3.027E-04
6.712E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	1.869E-03	1.035E-02	1.871E-03	1.034E-02	9.998E-01	3.600E-04
6.722E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	1.776E-03	8.541E-03	1.781E-03	8.533E-03	9.998E-01	4.148E-04
6.732E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	1.676E-03	6.824E-03	1.682E-03	6.817E-03	9.998E-01	4.667E-04
6.742E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	1.576E-03	5.208E-03	1.578E-03	5.202E-03	9.998E-01	5.156E-04
6.752E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	1.467E-03	3.698E-03	1.469E-03	3.693E-03	9.998E-01	5.612E-04
6.762E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	1.355E-03	2.300E-03	1.357E-03	2.296E-03	9.998E-01	6.036E-04
6.772E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	1.239E-03	1.009E-03	1.241E-03	1.006E-03	9.998E-01	6.425E-04
6.782E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	1.119E-03	-1.711E-04	1.120E-03	-1.741E-04	9.998E-01	6.779E-04
6.792E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	9.953E-04	-1.231E-03	9.965E-04	-1.240E-03	9.998E-01	7.096E-04
6.802E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	8.710E-04	-2.187E-03	8.720E-04	-2.189E-03	9.998E-01	7.376E-04
6.812E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	7.468E-04	-3.020E-03	7.478E-04	-3.022E-03	9.998E-01	7.619E-04
6.821E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	6.239E-04	-3.736E-03	6.247E-04	-3.738E-03	9.998E-01	7.824E-04
6.831E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	5.027E-04	-4.339E-03	5.033E-04	-4.341E-03	1.000E 00	7.993E-04
6.841E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	3.800E-04	-4.836E-03	3.804E-04	-4.838E-03	1.000E 00	8.126E-04
6.851E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	2.600E-04	-5.220E-03	2.611E-04	-5.222E-03	1.000E 00	8.222E-04
6.861E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	1.611E-04	-5.474E-03	1.614E-04	-5.475E-03	1.000E 00	8.285E-04
6.871E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E 02	7.930E-05	-5.618E-03	7.956E-05	-5.619E-03	1.000E 00	8.320E-04
6.881E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	1.264E-05	-5.672E-03	1.304E-05	-5.674E-03	1.000E CO	8.334E-04
6.891E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-4.664E-05	-5.655E-03	-4.049E-05	-5.656E-03	1.000E 00	8.329E-04
6.901E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-8.310E-05	-5.579E-03	-8.301E-05	-5.581E-03	1.000E CO	8.310E-04
6.911E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E 02	-1.163E-04	-5.457E-03	-1.162E-04	-5.460E-03	1.000E 00	8.280E-04
6.921E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-1.416E-04	-5.301E-03	-1.417E-04	-5.303E-03	1.000E 00	8.241E-04
6.931E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-1.604E-04	-5.117E-03	-1.605E-04	-5.120E-03	1.000E 00	8.196E-04
6.941E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-1.728E-04	-4.914E-03	-1.739E-04	-4.918E-03	1.000E 00	8.145E-04
6.950E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-1.826E-04	-4.698E-03	-1.828E-04	-4.702E-03	1.000E 00	8.092E-04
6.960E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-1.877E-04	-4.474E-03	-1.879E-04	-4.477E-03	1.000E 00	8.036E-04
6.970E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-1.897E-04	-4.245E-03	-1.900E-04	-4.249E-03	1.000E 00	7.979E-04
6.980E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-1.893E-04	-4.015E-03	-1.896E-04	-4.019E-03	1.000E 00	7.922E-04
6.990E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-1.869E-04	-3.787E-03	-1.872E-04	-3.791E-03	1.000E 00	7.866E-04

7.CCCE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-1.820E-04	-3.964E-03	-1.833E-04	-3.567E-03	1.000E 00	7.81CE-04
7.C1CE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-1.778E-04	-3.865E-03	-1.782E-04	-3.349E-03	1.000E 00	7.756E-04
7.C2CE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-1.737E-04	-3.134E-03	-1.721E-04	-3.137E-03	1.000E 00	7.703E-04
7.C3CE CO	2.197E C1	1.2C8E C2	1.C20E C2	1.870E C2	-1.695E-04	-2.930E-03	-1.654E-04	-2.933E-03	1.000E 00	7.653E-04
7.C4CE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-1.578E-04	-2.734E-03	-1.582E-04	-2.738E-03	1.000E 00	7.604E-04
7.C5CE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E 02	-1.563E-04	-2.548E-03	-1.507E-04	-2.551E-03	1.000E 00	7.558E-04
7.C6CE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E 02	-1.427E-04	-2.371E-03	-1.430E-04	-2.374E-03	1.000E 00	7.514E-04
7.C6SE CO	2.197E C1	1.2C8E C2	1.C20E C2	1 .870E C2	-1.350E-04	-2.203E-03	-1.353E-04	-2.206E-03	1.000E 00	7.472E-04
7.C7SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-1.273E-04	-2.044E-03	-1.277E-04	-2.047E-03	1.000E 00	7.432E-04
7.C8SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-1.198E-04	-1.894E-03	-1.202E-04	-1.897E-03	1.000E 00	7.395E-04
7.C9SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-1.125E-04	-1.754E-03	-1.128E-04	-1.756E-03	1.000E 00	7.360E-04
7.C9SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-1.054E-04	-1.622E-03	-1.057E-04	-1.624E-03	1.000E 00	7.327E-04
7.1CSE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-9.857E-05	-1.498E-03	-9.887E-05	-1.501E-03	1.000E 00	7.297E-04
7.11SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-9.201E-05	-1.383E-03	-9.229E-05	-1.385E-03	1.000E 00	7.268E-04
7.12SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-8.575E-05	-1.275E-03	-8.602E-05	-1.277E-03	1.000E 00	7.241E-04
7.13SE CO	2.197E C1	1.2C8E C2	1.C20E C2	1.870E C2	-7.979E-05	-1.175E-03	-8.004E-05	-1.177E-03	1.000E 00	7.216E-04
7.14SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-7.414E-05	-1.082E-03	-7.438E-05	-1.084E-03	1.000E 00	7.193E-04
7.15SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-6.880E-05	-9.956E-04	-6.903E-05	-9.972E-04	1.000E 00	7.172E-04
7.16SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-6.377E-05	-9.154E-04	-6.399E-05	-9.168E-04	1.000E 00	7.152E-04
7.17SE CO	2.197E C1	1.2C8E C2	1.C20E C2	1.870E C2	-5.904E-05	-8.411E-04	-5.924E-05	-8.424E-04	1.000E 00	7.133E-04
7.18SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-5.461E-05	-7.723E-04	-5.480E-05	-7.735E-04	1.000E 00	7.116E-04
7.19SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-5.046E-05	-7.087E-04	-5.063E-05	-7.098E-04	1.000E 00	7.100E-04
7.2CSE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-4.658E-05	-6.500E-04	-4.674E-05	-6.510E-04	1.000E 00	7.085E-04
7.21SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-4.296E-05	-5.959E-04	-4.311E-05	-5.968E-04	1.000E 00	7.072E-04
7.22SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-3.959E-05	-5.459E-04	-3.972E-05	-5.467E-04	1.000E 00	7.059E-04
7.23SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-3.645E-05	-4.999E-04	-3.658E-05	-5.007E-04	1.000E 00	7.048E-04
7.24SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-3.354E-05	-4.576E-04	-3.366E-05	-4.582E-04	1.000E 00	7.037E-04
7.25SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-3.084E-05	-4.186E-04	-3.095E-05	-4.192E-04	1.000E 00	7.028E-04
7.26SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-2.833E-05	-3.828E-04	-2.844E-05	-3.833E-04	1.000E 00	7.019E-04
7.27SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-2.602E-05	-3.499E-04	-2.611E-05	-3.504E-04	1.000E 00	7.012E-04
7.28SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-2.390E-05	-3.197E-04	-2.398E-05	-3.201E-04	1.000E 00	7.005E-04
7.29SE CO	2.197E C1	1.2C8E C2	1.C20E C2	1.870E C2	-2.195E-05	-2.922E-04	-2.198E-05	-2.924E-04	1.000E 00	6.999E-04
7.3CSE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-2.016E-05	-2.669E-04	-2.015E-05	-2.669E-04	1.000E 00	6.989E-04
7.31SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-1.852E-05	-2.438E-04	-1.846E-05	-2.436E-04	1.000E 00	6.984E-04
7.32SE CO	2.197E C1	1.2C8E C2	1.C20E C2	1.870E C2	-1.702E-05	-2.228E-04	-1.690E-05	-2.223E-04	1.000E 00	6.978E-04
7.33SE CO	2.197E C1	1.2C8E C2	1.C20E C2	1.870E C2	-1.564E-05	-2.035E-04	-1.547E-05	-2.027E-04	1.000E 00	6.973E-04
7.34SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-1.437E-05	-1.859E-04	-1.419E-05	-1.848E-04	1.000E 00	6.969E-04
7.35SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-1.320E-05	-1.698E-04	-1.294E-05	-1.685E-04	1.000E 00	6.965E-04
7.36SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-1.212E-05	-1.550E-04	-1.183E-05	-1.535E-04	1.000E 00	6.961E-04
7.37SE CO	2.197E C1	1.2C8E C2	1.C20E C2	1.870E C2	-1.113E-05	-1.414E-04	-1.081E-05	-1.390E-04	1.000E 00	6.957E-04
7.38SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-9.843E-06	-1.289E-04	-9.875E-06	-1.273E-04	1.000E 00	6.954E-04
7.39SE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-8.987E-06	-1.175E-04	-9.017E-06	-1.159E-04	1.000E 00	6.951E-04
7.4C7E CO	2.197E C1	1.2C8E C2	1.C20E C2	1.870E C2	-8.203E-06	-1.055E-04	-8.229E-06	-1.055E-04	1.000E 00	6.948E-04
7.41TE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-7.489E-06	-9.598E-05	-7.508E-06	-9.602E-05	1.000E 00	6.946E-04
7.42TE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-6.827E-06	-8.732E-05	-6.848E-06	-8.735E-05	1.000E 00	6.944E-04
7.43TE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-6.225E-06	-7.943E-05	-6.244E-06	-7.945E-05	1.000E 00	6.942E-04
7.44TE CO	2.197E C1	1.2C8E C2	1.C20E C2	1.870E C2	-5.674E-06	-7.223E-05	-5.691E-06	-7.224E-05	1.000E 00	6.940E-04
7.45TE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-5.171E-06	-6.567E-05	-5.186E-06	-6.567E-05	1.000E 00	6.938E-04
7.46TE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-4.711E-06	-5.969E-05	-4.724E-06	-5.969E-05	1.000E 00	6.936E-04
7.47TE CO	2.197E 01	1.2C8E C2	1.C20E 02	1.870E C2	-4.295E-06	-5.425E-05	-4.302E-06	-5.424E-05	1.000E 00	6.935E-04
7.48TE CO	2.197E C1	1.2C8E C2	1.C20E C2	1.870E C2	-3.916E-06	-4.929E-05	-3.917E-06	-4.927E-05	1.000E 00	6.934E-04
7.49TE CO	2.197E C1	1.2C8E C2	1.C20E C2	1.870E C2	-3.569E-06	-4.477E-05	-3.569E-06	-4.475E-05	1.000E 00	6.933E-04
7.5C6E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-3.253E-06	-4.066E-05	-3.244E-06	-4.064E-05	1.000E 00	6.931E-04
7.51GE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-2.964E-06	-3.693E-05	-2.951E-06	-3.690E-05	1.000E 00	6.930E-04
7.52GE CO	2.197E C1	1.2C8E C2	1.C20E C2	1.870E C2	-2.698E-06	-3.352E-05	-2.684E-06	-3.350E-05	1.000E 00	6.929E-04
7.53GE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-2.455E-06	-3.043E-05	-2.441E-06	-3.040E-05	1.000E 00	6.928E-04
7.54GE CO	2.197E C1	1.2C8E C2	1.C20E C2	1.870E C2	-2.234E-06	-2.762E-05	-2.219E-06	-2.759E-05	1.000E 00	6.928E-04
7.55GE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-2.033E-06	-2.507E-05	-2.017E-06	-2.503E-05	1.000E 00	6.927E-04
7.56GE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-1.850E-06	-2.274E-05	-1.833E-06	-2.271E-05	1.000E 00	6.926E-04
7.57GE CO	2.197E C1	1.2C8E C2	1.C20E C2	1.870E C2	-1.683E-06	-2.062E-05	-1.665E-06	-2.059E-05	1.000E 00	6.926E-04
7.58GE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-1.530E-06	-1.871E-05	-1.512E-06	-1.867E-05	1.000E 00	6.925E-04
7.59GE CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-1.391E-06	-1.697E-05	-1.374E-06	-1.694E-05	1.000E 00	6.925E-04

7.6C5E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-1.371E-06	-1.606E-05	-1.373E-06	-1.603E-05	1.0C0E 00	6.925E-04
7.615E CO	2.197E C1	1.2C8E C2	1.020E C2	1.870E C2	-1.245E-06	-1.538E-05	-1.247E-06	-1.535E-05	1.0C0E 00	6.924E-04
7.625E 00	2.197E C1	1.2C8E C2	1.020E C2	1.870E C2	-1.130E-06	-1.394E-05	-1.132E-06	-1.391E-05	1.0C0E 00	6.924E-04
7.635E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-1.026E-06	-1.264E-05	-1.027E-06	-1.261E-05	1.0C0E 00	6.923E-04
7.645E CO	2.197E 01	1.2C8E C2	1.020E 02	1.870E C2	-9.312E-07	-1.145E-05	-9.322E-07	-1.143E-05	1.0C0E 00	6.923E-04
7.655E CO	2.197E 01	1.2C8E C2	1.020E 02	1.870E C2	-8.450E-07	-1.038E-05	-8.458E-07	-1.035E-05	1.0C0E 00	6.922E-04
7.665E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-7.677E-07	-9.406E-06	-7.673E-07	-9.379E-06	1.0C0E 00	6.922E-04
7.674E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-6.995E-07	-8.521E-06	-6.995E-07	-8.496E-06	1.000E 00	6.922E-04
7.684E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-6.380E-07	-7.719E-06	-6.381E-07	-7.695E-06	1.0C0E 00	6.921E-04
7.694E CO	2.197E 01	1.2C8E C2	1.C20E 02	1.870E C2	-5.721E-07	-6.991E-06	-5.723E-07	-6.968E-06	1.0C0E 00	6.921E-04
7.704E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-5.187E-07	-6.332E-06	-5.188E-07	-6.309E-06	1.0C0E 00	6.921E-04
7.714E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-4.703E-07	-5.733E-06	-4.703E-07	-5.712E-06	1.000E 00	6.921E-04
7.724E CO	2.197E 01	1.2C8E C2	1.C20E 02	1.870E C2	-4.263E-07	-5.191E-06	-4.262E-07	-5.171E-06	1.0C0E 00	6.920E-04
7.734E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-3.862E-07	-4.700E-06	-3.862E-07	-4.680E-06	1.0C0E 00	6.920E-04
7.744E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-3.500E-07	-4.254E-06	-3.500E-07	-4.236E-06	1.000E 00	6.920E-04
7.754E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-3.172E-07	-3.851E-06	-3.170E-07	-3.833E-06	1.0C0E 00	6.920E-04
7.764E 00	2.197E C1	1.2C8E C2	1.020E 02	1.870E 02	-2.874E-07	-3.485E-06	-2.872E-07	-3.468E-06	1.0C0E 00	6.919E-04
7.774E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-2.604E-07	-3.154E-06	-2.601E-07	-3.138E-06	1.0C0E 00	6.919E-04
7.784E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-2.359E-07	-2.853E-06	-2.355E-07	-2.839E-06	1.000E 00	6.919E-04
7.794E CO	2.197E 01	1.2C8E C2	1.020E 02	1.870E C2	-2.136E-07	-2.582E-06	-2.133E-07	-2.568E-06	1.0C0E 00	6.919E-04
7.803E CO	2.197E 01	1.2C8E C2	1.C20E 02	1.870E C2	-1.934E-07	-2.339E-06	-1.931E-07	-2.322E-06	1.0C0E 00	6.918E-04
7.813E CO	2.197E C1	1.2C8E C2	1.C20E C2	1.870E C2	-1.751E-07	-2.112E-06	-1.748E-07	-2.100E-06	1.000E 00	6.918E-04
7.823E CO	2.197E 01	1.2C8E C2	1.C20E 02	1.870E C2	-1.585E-07	-1.911E-06	-1.582E-07	-1.899E-06	1.000E 00	6.918E-04
7.833E CO	2.197E 01	1.2C8E C2	1.C20E 02	1.870E C2	-1.435E-07	-1.728E-06	-1.432E-07	-1.717E-06	1.0C0E 00	6.918E-04
7.843E CO	2.197E 01	1.2C8E C2	1.020E 02	1.870E C2	-1.299E-07	-1.563E-06	-1.296E-07	-1.552E-06	1.0C0E 00	6.918E-04
7.853E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-1.175E-07	-1.413E-06	-1.172E-07	-1.403E-06	1.0C0E 00	6.917E-04
7.863E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-1.064E-07	-1.277E-06	-1.061E-07	-1.268E-06	1.000E 00	6.917E-04
7.873E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-9.624E-08	-1.155E-06	-9.595E-08	-1.146E-06	1.0C0E 00	6.917E-04
7.883E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-8.707E-08	-1.044E-06	-8.679E-08	-1.036E-06	1.0C0E 00	6.917E-04
7.893E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-7.877E-08	-9.437E-07	-7.849E-08	-9.363E-07	1.0C0E 00	6.916E-04
7.903E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-7.125E-08	-8.529E-07	-7.098E-08	-8.460E-07	1.0C0E 00	6.916E-04
7.912E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-6.444E-08	-7.709E-07	-6.419E-08	-7.644E-07	1.0C0E 00	6.916E-04
7.922E CO	2.197E C1	1.2C8E C2	1.020E 02	1.870E C2	-5.828E-08	-6.966E-07	-5.804E-08	-6.906E-07	1.0C0E 00	6.916E-04
7.932E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-5.270E-08	-6.295E-07	-5.247E-08	-6.239E-07	1.0C0E 00	6.916E-04
7.942E CO	2.197E C1	1.2C8E C2	1.C20E 02	1.870E C2	-4.766E-08	-5.688E-07	-4.743E-08	-5.636E-07	1.000E 00	6.916E-04