N74-14619

A METHOD FOR TRANSFERRING NASTRAN DATA BETWEEN DISSIMILAR COMPUTERS

By James L. Rogers, Jr.

NASA Langley Research Center

INTRODUCTION

The NASTRAN computer program is capable of executing on three different types of computers: namely, the CDC 6000 series, the IBM 360-370 series, and the UNIVAC 1100 series. A typical activity requiring transfer of data between dissimilar computers is the analysis of a large structure such as the Space Shuttle by substructuring. Models of portions of the vehicle which have been analyzed by subcontractors using their computers must be integrated into a model of the complete structure by the prime contractor on his computer. Presently the transfer of NASTRAN matrices or tables between two different types of computers is accomplished by punched cards or a magnetic tape containing card images. These methods of data transfer do not satisfy the requirements for intercomputer data transfer associated with a substructuring activity because (1) accuaracy will be lost due to the precision limitations (10 significant digits) of the NASTRAN Direct Matrix Input (DMI) punched card, and (2) large order matrices make card handling too cumbersome.

To provide a more satisfactory transfer of data, two new programs, RDUSER and WRTUSER, were created (ref. 1). These two programs, used in conjunction with the NASTRAN modules OUTPUT2 and INPUTT2 available in Level 15 and later versions of NASTRAN, allow data to be transferred between computers without loss of accuracy and without handling large decks of punched cards. The purpose of this paper is to describe both the method used for data transfer and the special features of the utility programs RDUSER and WRTUSER. Although data may come from any computer program using the NASTRAN user tape format, examples in this paper will be confined to NASTRAN data since RDUSER and WRTUSER were written with the NASTRAN user in mind.

OVERVIEW OF PROGRAMS

Beginning with Level 15, NASTRAN provided the capability of using FORTRAN WRITE statements to write intermediate data blocks (matrices or tables) on a magnetic tape. This was made possible by the NASTRAN module OUTPUT2 which has the following calling sequence:

```
OUTPUT2   DB1, DB2, DB3, DB4, DB5//V, N, P1/V, N, P2/V, N, P3   $
```

where the DBi are the data blocks to be written in tape, P1 is a parameter for positioning the tape, P2 is the FORTRAN unit number assigned to the tape, and P3 is the FORTRAN User Tape Label (default = XXXXXXXX).

The tape created by OUTPUT2 is a binary tape. Tapes created by programs other than NASTRAN are acceptable as long as the data are output in the OUTPUT2 format. In order to write the header information on the tape, the P1 parameter must be -1 (rewind before writing) the first time OUTPUT2 is called in NASTRAN; otherwise P1 is 0. This binary tape must be converted to a BCD tape before it can be used on a computer of a different type. The conversion is performed by the utility program RDUSER which accepts tables and single-precision or double-precision real or complex matrices. No precision is lost in generating the BCD tape, and the problem of handling large numbers of punched cards is alleviated.

The tape containing the BCD data is transferred to another installation. Before these data can be used as input for NASTRAN at this installation, two tasks must be performed. The first task is to convert the source of the BCD tape written by RDUSER to another source form readable by the computer on which the data will be used. The second task is to convert the BCD tape into an acceptable binary form for the NASTRAN module INPUTT2. The program WRTUSER accomplishes both of these tasks. The calling sequence for the INPUTT2 module has the form

INPUTT2/DB1, DB2, DB3, DB4, DB5/V, N, P1/V, N, P2/V, N, P3 $

where the DBi are the data blocks to be recovered from the binary tape, P1 is a parameter for positioning the tape (P1 must be -1 for the first call to INPUTT2 and 0 for all succeeding calls), P2 is the FORTRAN unit number assigned to the binary tape, and P3 is the FORTRAN User Tape Label (default = XXXXXXXX). A flow chart of the complete tape interface method is shown in figure 1.

SPECIAL FEATURES

The RDUSER program has three special features that will be covered in this section. The first group of cards input to RDUSER is a set of comments written by the user to describe the matrices and tables. These cards are read with a free-field format allowing the user to write any description he desires. These comments are also written on the tape to be transferred to the other installation. WRTUSER reads and prints these comments; this allows the user receiving the tape to have some knowledge of the data written on the tape. The next group of cards input to RDUSER gives the data block name, a code for determining whether the data block is a matrix or a table, and a print option. This group of cards allows the user to omit any data block that is not needed. He does this by simply omitting the card on which the data block name appears. The print option allows the user to print (table 1) or not to print (table 2) elements of a matrix or table. Each of these features proves beneficial when transferring data between dissimilar computers.

VERIFICATION OF PROGRAMS

RDUSER and WRTUSER were executed for four* of the nine possibilities shown in figure 2 and found to possess the desired qualities lacking in DMI punched cards. Card handling for the input to NASTRAN was cut to the minimum. Square, rectangular, and symmetric matrices containing single-precision real, single-precision complex, double-precision real, and double-precision complex elements were used in the test runs. In each case the answers listed on one computer agreed with the answers listed on dissimilar and similar computers: this indicated that no precision was lost in the transfer.

REFERENCES

1. Rogers, James L., Jr.: Intercomputer Transfer in Full Precision of Arbitrary Data on Magnetic Tape Employing the NASTRAN User Tape Format. NASA TM X-2901, 1973.

---

*UNIVAC paths were not tested due to errors in the INPUTT2 and OUTPUT2 NASTRAN modules.

TABLE 1.- MATRIX ELEMENTS LISTED

```
THE TRAILER FOR THE MATRIX X        IS     103      4      4      1      4     16  10000

MATRIX X          IS A COMPLEX    4 COLUMN X    4 ROW  SQUARE  MATRIX

COLUMN       1
 4.6412805170784920960614D-01 -3.6068058625242294112923D-01I  1.8954140247898454418873D-01  5.2344101027640643764016D-02I
 3.2932468138407955393632D-01  6.5028837053801408974393D-03I  3.1227793960030392206306D-02 -1.0134805641292432554224D-02I

COLUMN       2
 2.0952604499531712889393D-01 -2.7694283748157211277885D-01I  5.0788987754953884845577D-02  1.5170666129314280823337D-01I
 1.5524018062987199328973D-01 -3.9557505708258844379088D-01I -1.9984642516332806749801D-02  3.2928693850921320063208D-01I

COLUMN       3
 1.0551629008982885693513D+00  2.4662895099796422471172D-01I  5.2350328286555125600898D-01 -1.1011673933388763657604D+00I
 6.8793338886100130480372D-01  5.5471931195460300045852D-01I  1.2876481422500474227633D-02 -1.0138313408250709812819D+00I

COLUMN       4
 1.4814754137336461070618D-01 -3.7232476733395358792222D-01I  3.4301221849111662720588D-02  4.4791915811022775528727D-01I
 1.1811213256217234501833D-01 -1.2935300900357660225382D-01I  1.7883622910435659214556D-02 -4.9935082651432483036302D-03I

THE NUMBER OF NON-ZERO WORDS IN THE LONGEST RECORD        16

THE DENSITY OF THIS MATRIX IS   100.00 PERCENT

THIS MATRIX IS DOUBLE PRECISION
```

TABLE 2.- MATRIX ELEMENTS OMITTED

```
THE TRAILER FOR THE MATRIX B          IS     102      4      4      1      1      3   5625

MATRIX B          IS A REAL       4 COLUMN X    4 ROW  SQUARE  MATRIX

THE NUMBER OF NON-ZERO WORDS IN THE LONGEST RECORD         3

THE DENSITY OF THIS MATRIX IS    56.25 PERCENT

THIS MATRIX IS SINGLE PRECISION
```

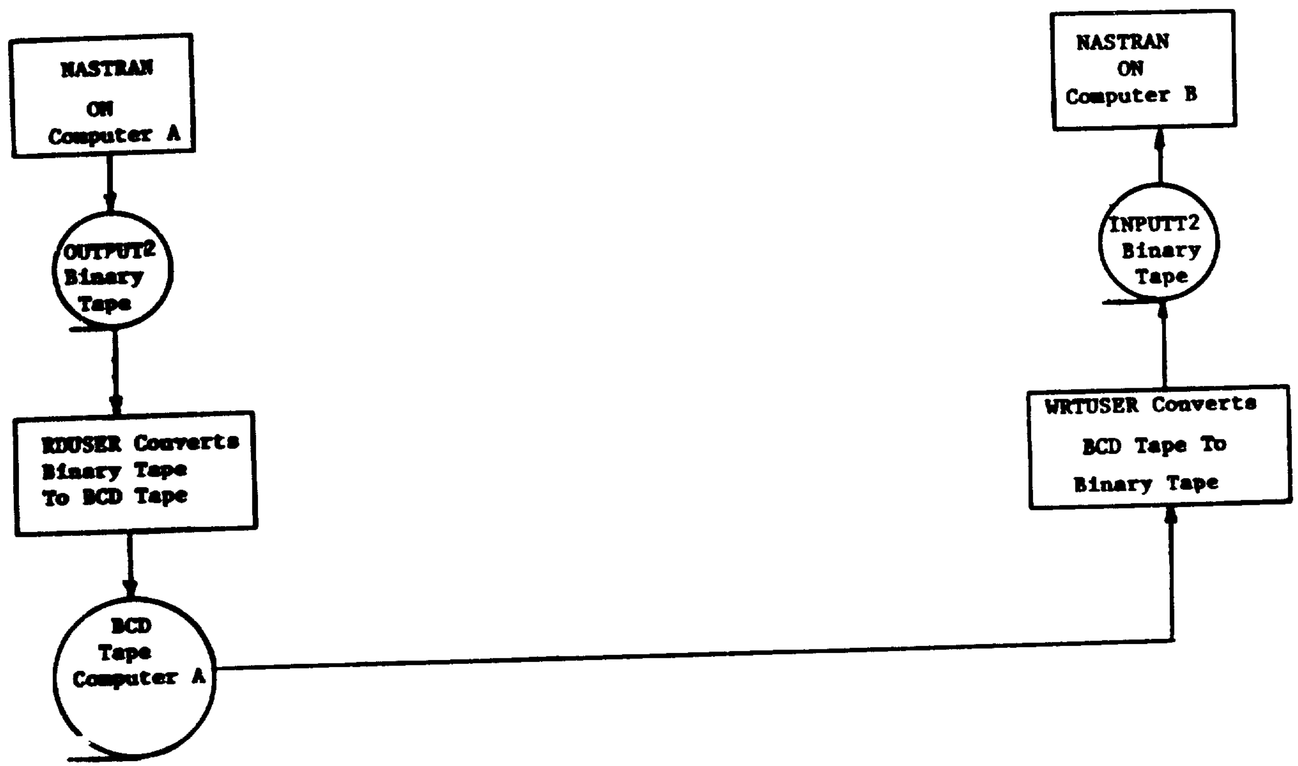

Figure 1. - Flow chart of NASTRAN tape interface method.

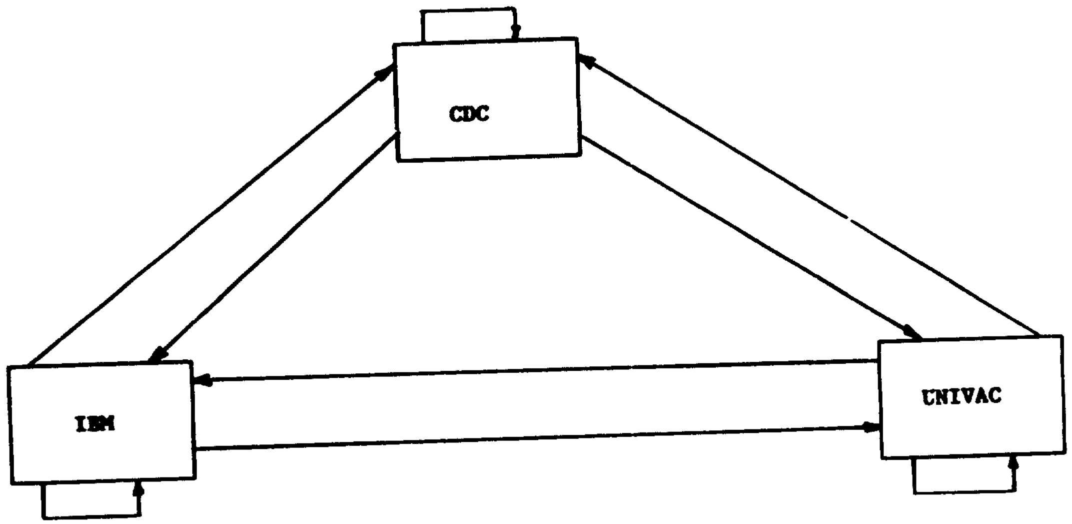

Figure 2. - Paths of data between computers.