NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Technical Memorandum 33-739

Editing of EIA Coded, Numerically Controlled, Machine Tool Tapes

John M. Weiner

JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CALIFORNIA

October 1, 1975

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Technical Memorandum 33-739

Editing of EIA Coded, Numerically Controlled, Machine Tool Tapes

John M. Weiner

JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CALIFORNIA

October 1, 1975

PREFACE

The work described in this report was performed by the Space Sciences Division of the Jet Propulsion Laboratory.

CONTENTS

ABSTRACT

Editing of numerically controlled (N/C) machine tool tapes (8-level paper tape) using an interactive graphic display processor is described in this report. A rapid technique required for correcting production errors in N/C tapes was developed using the interactive text editor on the IMLAC PDS-1D graphic display system and two special programs resident on disk. The correction technique and special programs for processing N/C tapes coded to EIA specifications are discussed.

I. INTRODUCTION

A. PROBLEM DESCRIPTION

Numerically controlled (N/C) machine tool tapes (8-level paper tape) must be monitored for accuracy throughout their development. Errors may result from improper part specification, data transmission, tape preparation, or tape duplication. These errors can ruin several hours of machining as well as waste materials.

The fabrication shops at the Jet Propulsion Laboratory produce N/C tapes for a Monarch lathe, Cintimatic horizontal milling machine, Strippit sheet metal punch, and a Standard 300 wire wrap machine. Interactive cutting path analysis programs (Ref. 4), running on an IMLAC PDS-1D graphics console under the IMLAC disk operating system (DOS-III), are used to simulate the performance of these N/C tapes before they are actually implemented on the machining equipment. As errors are detected and isolated by the user with the aid of these simulation programs, corrected tapes need to be produced. By repeatedly repunching the command tape and simulating its operation, an error free N/C tape can be developed.

Presently, the machine shop personnel use one of two procedures to generate new machine tool tapes depending upon the extent of the corrections needed. When many changes are required in an N/C tape, the master part program resident in the laboratory's UNIVAC 1108 is modified and then executed by the multi-processing system to punch out the new tape. Involved in this method is the allocation of 1108 resources to edit and run the parts program, and to then have the resulting N/C command list punched out via a UNIVAC DCT-500 punch. The time required by this procedure depends heavily upon the load of the computing system and also upon the number of simulation/correction cycles needed to produce the desired tape. As a result of intermittent noise on communication lines, errors will occasionally be introduced to tool tapes via this method.

When few changes need be made in an erroneous tape, or when the corrections are on a smaller scale, a Friden "Flexiwriter" is used to perform local tape editing. The error-laden tape is placed under the read head of the Friden from which a new tape will be punched. In a semi-automatic mode the correct portions of the old tape are copied onto the new

tape. The erroneous characters are manually skipped over and correct ones are inserted. Obvious disadvantages of this procedure include the requirement of large amounts of time to edit and repunch long numerically controlled tapes. A faster more powerful editing system is needed to speed the development of "clean" N/C command tapes for the milling machines.

B. SOLUTION

Two programs were developed to enable EIA (Ref. 3) tapes to be edited using IMLAC PDS-1D disk operating system. The first program, "REIA," inputs the N/C tape in need of correction via a Digitronics photoelectric paper tape reader, converts the EIA code to ASCII, and then writes the ASCII file onto the IMLAC disk. The user can then use the IMLAC text editor, "DFED1," to edit the N/C command disk file. "DFED1" is a very powerful and rich disk-scrolling editor which uses the IMLAC CRT to display the contents of and the result of operations upon IMLAC disk files. After all the needed corrections have been made, the second program, "PEIA," is used to punch the corrected machine tool tape. "PEIA" converts the ASCII command file characters into the EIA coded representation and then punches out the new EIA tape via a Facit 4070 paper tape punch at a rate of 60 characters per second. This is a far more efficient and speedy method for producing corrected EIA N/C tapes than that involving the UNIVAC DCT-500 punch or the Friden "Flexiwriter" punch which output characters at rates of only 30 and 10 characters per second respectively. The EIA and ASCII code dictionaries, used by the "REIA" and "PEIA" programs, are extensible.

C. LANGUAGE AND PROCESSOR

The two programs are written in assembly language for the IMLAC PDS-1D graphic display system (Ref. 1). They are run under the IMLAC DOS-III disk operating system (Ref. 2). The programs should be run on a properly configured IMLAC PDS-1G display system; some program modifications would be required for implementation on an IMLAC PDS-4 system. The minimum processor configuration includes an IMLAC PDS-1D graphic display system with 8192 words of core memory, IMLAC DOS-III disk operating hardware and software, (photoelectric) paper tape reader, paper tape reader interface, and paper tape punch.

II. EDITING PROCEDURE

The following description is divided into three parts: N/C tape input using "REIA," tape editing utilizing "DFEDI," and disk file output via paper tape punch using "PEIA." Before tape editing can commence, the IMLAC operating system must be loaded from disk and the user must log in to the monitor. Under the IMLAC DOS-III system, the user first sets the Address panel switches to octal 40, depresses the stop toggle, and then depresses the start toggle. The user now must log in to the system by entering his "Project, User Number" and Password.

A. N/C TAPE INPUT USING "REIA"

The N/C command list being monitored for accuracy is in an EIA paper tape format. The IMLAC text editor, however, can only operate upon IMLAC disk files (ASCII code); this necessitates the creation of an N/C command disk file by use of "REIA."

(1) Mount the N/C tape in the reader. This procedure is dependent upon the paper tape reader model used. For the Digitronics reader, the following steps are taken:

(a) Turn the reader power switch to "ON".

(b) Open the reader gate (turn gate handle clockwise).

(c) Insert the paper tape to the back guide with the feed holes to the rear.

(d) Position the tape so that the blank leader lies on the read head.

(e) Close the reader gate (turn gate handle counterclockwise) insuring that the tape is in proper position so that the gate will not produce a tear.

The blank leader will be skipped over by "REIA." An incorrectly positioned tape (not aligned with feed hole or first character on read head) will not be fed through the paper tape reader.

(2) Execute the read EIA tape program ("REIA"). Enter by means of the IMLAC keyboard the following:

REIA/<FILE NAME>

and then strike carriage return (CR). <FILE NAME> is the name of the ASCII disk file to be created. Optional project, user number, and protection code may be included in the <FILE NAME> specification (Ref. 2). "REIA" will turn on the paper tape reader and blank the IMLAC CRT screen. When the ASCII disk file has been created, the monitor will once again be displayed.

B. TAPE CONTENT EDITING UTILIZING THE TEXT EDITOR

Correct all errors found in the ASCII command disk file. To enter the tape editing mode, "DFEDI," the fast disk-scrolling text editor must be loaded into core. To accomplish this, enter by means of the keyboard the following:

DF/<FILE NAME> (CR)

where <FILE NAME> is the name of the ASCII disk file created previously. The first thirty lines of the command tape will be displayed.

Since "REIA" uses an EIA table look-up to perform ASCII conversions, erroneous characters appearing on the EIA input tape for which no corresponding entry appears in the table, produce a "?" entry in the ASCII file. The user therefore should first use the text editor to search for occurrences of "?"s in his command code. This is accomplished by entering the following:

CTRL-E then /?/

During the search the screen will be blank. When the file is once again displayed, the cursor will be positioned under the first "?" (undefined character) or under the last character in the data file if a "?" was not found. The above search procedure may be used repeatedly until all undefined inputs have been located.

To reposition the cursor and to scroll the disk file, the left, right, up and down arrow keys are used. To delete a character above the cursor, the "DEL" key is used to insert a character in the file; the user strikes the desired character's key. The user is referred to the "DFED1: TEXT EDITOR" section in the "PDS-1 Disk Operating System Reference Manual" (Ref. 2) for a complete description and discussion of text editor capabilities and use. Through use of "DFED1," entire tape contents can be viewed on the IMLAC screen, and changes can be made and checked before the new paper tape is punched out.

When all errors have been corrected, the user must instruct the text editor to replace the old copy of <FILE NAME> with the corrected one. This is accomplished by entering the following command:

CTRL-F (CR)

The screen will blank and the user will be returned to the monitor when the rewrite is completed.

C. DISK FILE OUTPUT VIA PAPER TAPE PUNCH USING "PEIA"

The ASCII N/C corrected command code is resident on IMLAC disk and can be punched out. As in the "REIA" program, "PEIA" (punch EIA tape program) uses a table lookup method to convert ASCII codes to EIA format. If the user has inserted an incorrect character into the ASCII disk file (i.e., a character for which no conversion was defined), the EIA code output at that position by the paper tape punch will be a "DELETE" character (377).

(1) Prepare the paper tape punch for operation. This procedure is dependent upon the paper tape punch used and the data transmission arrangement for the peripheral devices. For our modified Facit 4070 punch and IMLAC PDS-1D DOS-III system, the following steps are taken:

(a) Patch the TTY output line ("I1" on panel) to the paper tape punch ("PUNCH" on panel).

(b) Set punch rate switch on side of Facit punch to 60 CPS.

(c) Set parity switch to off (center position).

(d) Turn power switches to "ON".

(2) Execute the punch EIA tape program ("PEIA"). Enter by means of the IMLAC keyboard the following:

PEIA/<FILE NAME> (CR)

where <FILE NAME> is the ASCII N/C tape disk file to be punched out.

A header consisting of <File Name> will be produced, followed by leader and the corrected EIA tape.

SUMMARY

The rapid editing of EIA coded, numerically controlled, machine tool tapes is possible using these procedures. By leaving a copy of the command tape on disk instead of deleting the file after the completion of repunching, (user is referred to the "DIR1: Disk Directory System" section in the "PDS-1 Disk Operating System Reference Manual" for a discussion of file purging), subsequent modifications can be made to the N/C disk file without rereading the tape onto the disk each time (i. e., use of "REIA").

These procedures, due to their ease of operation for the machine shop personnel, provide a more efficient method for the very time consuming problem of N/C tape production than the two procedures presently used. Local tape simulation, error detection, and correction as well as tape punching should allow an increase in the throughput of the N/C machine tool tape production staff.

REFERENCES

1. "IMLAC PDS-1D Programming Guide", IMLAC Corporation, Needham, Mass., 1973.

2. "PDS-1 Disk Operating System Reference Manual", IMLAC Corporation, Needham, Mass., 1973.

3. "Character Code for Numerical Machine Control, Perforated Tapes Standard RS-244-A," Electronic Industries Association, Washington D. C., no date.

4. Weiner, John M., Williams, Donald S., and Colley, Stephen R., Interactive Cutting Path Analysis Programs, Technical Memorandum 33-738. Jet Propulsion Laboratory, Pasadena, California, October 1, 1975.

NASA — JPL — Coml., L.A., Calif.