X-RAY ANTHROPOMETRY DIGITIZATION PROGRAM
FOR THE HEWLETT-PACKARD 9000/835 COMPUTER

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Software Documentation
May 1991

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**Title and Subtitle**

X-Ray Anthropometry Digitization Program for the Hewlett-Packard 9000/835 Computer

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**Abstract**

This publication provides documentation of the X-ray anthropometry digitization program used on a Hewlett-Packard 9000/835 computer at the Naval Biodynamics Laboratory in New Orleans, LA.

**Subject Terms**

Anthropometry, digitization, computer software.

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X-RAY ANTHROPOMETRY DIGITIZATION PROGRAM
FOR THE HEWLETT-PACKARD 9000/835 COMPUTER

1. INTRODUCTION

The Naval Biodynamics Laboratory (NAVBIODYNLAB), located in New Orleans, Louisiana, is a research facility under the cognizance of the Naval Medical Research and Development Command. The NAVBIODYNLAB is the principal Navy laboratory conducting biomedical research on the effects of mechanical forces (motion and impact) encountered by Navy personnel. Among its goals are the establishment of human tolerance limits and the development of appropriate methods of avoiding and treating the deleterious effects of such forces. Ongoing research programs at the laboratory acquire accelerometer and photographic impact data from NAVBIODYNLAB horizontal and vertical accelerators.

The proper analysis of data from NAVBIODYNLAB's impact experiments requires that two anatomical coordinate systems be defined, one on the head and one at the base of the neck on the first thoracic vertebra (T-1); these are depicted in Figures 1 and 2. The methodology for defining and obtaining these has been previously reported [1]. Motion data collected from inertial instrumentation packages on the head and T-1 are referenced to their own coordinate systems; thus knowledge of the transformation matrices from the instrument to the anatomical coordinate systems is also required.

This information is obtained from both anterior-posterior and lateral X-rays of the subject with instrument mounts in place. X-rays are taken for both T-1 and head mounts, and a set of calibration X-rays that utilize a plexiglass target containing an array of radio-opaque BBs located at known positions. When the X-rays are developed, tracings are made showing the locations of the BBs. Using BBs from the background plexiglass plate to determine the origin and reference axes for the X-rays, the locations of the other BBs on the X-ray are digitized. The digitized points are used to determine the instrumentation origin and the instrument-to-anatomy transformation matrices.

This report describes a computer program developed by NAVBIODYNLAB to calculate the required transformation matrices. Operational requirements for its use on the Hewlett-Packard 9000/835 computer interfaced with an HP9872T plotter/digitizer [2] are also described.
2. X-RAYS

There are six X-ray views that may be digitized:

1. Anterior-posterior X-ray of the head.
2. Lateral X-ray of the head.
3. Anterior-posterior X-ray of the neck.
4. Lateral X-ray of the neck.
5. Anterior-posterior calibration X-ray.

The program allows the operator to select any of the six X-ray views for digitization, to print the results, and to plot the data back on the paper to confirm the results.
3. FUNCTION

The following program and subroutines are supplied:

- **XXRAY** — Main program, which allows the operator to select major options.
- **XINIT** — Allows the operator to define new subject identification.
- **APHED** — Digitizes anterior-posterior X-rays of the head.
- **LTHED** — Digitizes lateral X-rays of the head.
- **APNEC** — Digitizes anterior-posterior X-rays of the neck.
- **LTNEC** — Digitizes lateral X-rays of the neck.
- **APCAL** — Digitizes anterior-posterior calibration X-rays.
- **LTCAL** — Digitizes lateral calibration X-rays.

![Diagram](image)

**Figure 2.** The Head Anatomical Coordinate System.
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HPDIG — Digitizes a single point.
CAPPR — Writes to data files digitized data for the anterior-posterior calibration X-rays.
CLTPR — Writes to data files digitized data for the lateral calibration X-rays.
HEDPR — Writes to data files digitized data for the anterior-posterior and lateral X-rays of the head.
NECPR — Writes to data files digitized data of the anterior-posterior and lateral X-rays of the neck.
XRYCM — BLOCK DATA subroutine, which defines and initializes named common HDR.
XRYDG — Prompts operator during digitization of a series of points from X-ray.
XRYPL — Plots digitized results on HP9872T plotter.

The following utility subroutines are also supplied:

BELL — Sounds the bell on the terminal.
CONVERT — Converts a 20-byte character string to three integer variables.
DEC2I — Decodes 2-byte character string to integer variable.
ERASE — Clears the display screen on the terminal.
KWAIT — Waits for a response from the keyboard.
PLTIO — Input/Output subroutine package in the C programming language for the HP-9872T plotter.

4. MAIN PROGRAM

4.1 XXRAY

XXRAY is an interactive program for digitizing X-ray anthropometry data. The results may be written to a file for later printing or plotted for verification.

The operator may select the following options:

-1: Exit program.
0: Set up for new subject.
1: Digitize calibration A-P.
2: Digitize calibration lateral.
3: Digitize head A-P.
4: Digitize head lateral.
5: Digitize neck A-P.
6: Digitize neck lateral.

After an option has been selected, the appropriate subroutine is executed. For printed results, the print option of the specific subroutine must be executed.
**4.2 COMPILED**

All the subroutines needed to execute the program are stored in the file ‘libxrayant.a,’ which is in the directory /7933/prod/source/anthropometry.

The program was compiled with the following command:

```
fc xxray.f libxrayant.a -o xxray
```

**4.3 EXECUTION**

The executable code is stored in a file named ‘xxray.’ To execute the program, type the file name and press the RETURN key. The program will instruct you to select one of the above options. To get printed results, execute the ‘lp’ command using the file ‘xrayprint.’

---

**5. SUBROUTINE DESCRIPTIONS**

**5.1 XINIT**

The XINIT routine allows the operator to define subject identification, mount identification, date, and general comments.

The call is:

```
CALL XINIT
```

**5.2 APHED**

The APHED routine digitizes anterior-posterior head X-rays. The operator may digitize points in standard sequence, redigitize selected points, print results, verify results by plotting the points, and exit from the subroutine.

The call is:

```
CALL APHED
```

The options are as follows:

-3: Exit subroutine.
-2: Plot results.
-1: Print results.
0: Digitize points in standard sequence.
1: Digitize only ORG: X,Y origin.
2: Digitize only AX: point on Y axis.
3: Digitize only RAM: right auditory meatus.
4: Digitize only LAM: left auditory meatus.
5: Digitize only RON: right orbital notch.
6: Digitize only LON: left orbital notch.
7: Digitize only CTP: center of T-plate.
5.3 LTHED

The LTHED routine digitizes lateral head X-rays. The operator may digitize points in standard sequence, redigitize selected points, print results, verify results by plotting the points, and exit from the subroutine as desired.

The call is:

CALL LTHED

The options are as follows:

-3: Exit subroutine.
-2: Plot results.
-1: Print results.
0: Digitize points in standard sequence.
1: Digitize only ORG: X,Y origin.
2: Digitize only Y AX: point on Y axis.
3: Digitize only RAM: right auditory meatus.
4: Digitize only LAM: left auditory meatus.
5: Digitize only RON: right orbital notch.
6: Digitize only LON: left orbital notch.
7: Digitize only CTP: center of T-plate.
8: Digitize only RTP: right T-plate.
9: Digitize only LTP: left T-plate.

5.4 APNEC

The APNEC routine digitizes anterior-posterior neck X-rays. The operator may digitize points in standard sequence, redigitize selected points, print results, verify results by plotting the points, and exit from the subroutine as desired.

The call is:

CALL APNEC

The options are as follows:

-3: Exit subroutine.
-2: Plot results.
-1: Print results.
0: Digitize points in standard sequence.
1: Digitize only ORG: X,Y origin.
2: Digitize only Y AX: point on Y axis.
3: Digitize only PSP: posterior spinous process.
X-Ray Anthropometry Digitization Program

4: Digitize only SSN: suprasternal notch.
5: Digitize only CTP: center of T-plate.
6: Digitize only RTP: right T-plate.
7: Digitize only LTP: left T-plate.
8: Digitize only RAF: right articular facet.
9: Digitize only LAF: left articular facet.

5.5 LTNEC
The LTNEC routine digitizes lateral neck X-rays. The operator may digitize points in standard sequence, redigitize selected points, print results, verify results by plotting the points, and exit from the subroutine as desired.
The call is:

CALL LTNEC

The options are as follows:

-3: Exit subroutine.
-2: Plot results.
-1: Print results.
0: Digitize points in standard sequence.
1: Digitize only ORG: X,Y origin.
2: Digitize only Y AX: point on Y axis.
3: Digitize only PSP: posterior spinous process.
4: Digitize only SSN: suprasternal notch.
5: Digitize only CTP: center of T-plate.
6: Digitize only RTP: right T-plate.
7: Digitize only LTP: left T-plate.
8: Digitize only ASC: anterior-superior corner.
9: Digitize only LSP: lower spinous process.
10: Digitize only USP: upper spinous process.

5.6 APCAL
The APCAL routine digitizes anterior-posterior calibration X-rays. The operator may digitize points in standard sequence, redigitize selected points, print results, verify results by plotting the points, and exit from the subroutine as desired.
The call is:

CALL APCAL

The options are as follows:

-3: Exit subroutine.
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-2: Plot results.
-1: Print results.
0: Digitize points in standard sequence.
1: Digitize only ORG: X,Y origin.
2: Digitize only Y AX: point on Y axis.
3: Digitize only 3: 3.
4: Digitize only 13: 13.
5: Digitize only 4: 4.
6: Digitize only 11: 11.
7: Digitize only 10: 10.
8: Digitize only 9: 9.
9: Digitize only 2: 2.
10: Digitize only 12: 12.
11: Digitize only 1: 1.

5.7 LTCAL
The LTCAL routine digitizes lateral calibration X-rays. The operator may digitize points in standard sequence, redigitize selected points, print results, verify results by plotting the points, and exit from the subroutine as desired.

The call is:

CALL LTCAL

The options are as follows:

-3: Exit subroutine.
-2: Plot results.
-1: Print results.
0: Digitize points in standard sequence.
1: Digitize only ORG: X,Y origin.
2: Digitize only Y AX: point on Y axis.
3: Digitize only 5: 5.
4: Digitize only 13: 13.
5: Digitize only 8: 8.
6: Digitize only 11: 11.
7: Digitize only 10: 10.
8: Digitize only 9: 9.
9: Digitize only 6: 6.
10: Digitize only 12: 12.
11: Digitize only 7: 7.

5.8 HPDIG
The HPDIG routine digitizes a single point. This routine allows the operator to enter X,Y position of the digitizing sight.
X-Ray Anthropometry Digitization Program

The call is:

CALL HPDIG (X,Y)

where

\[ X = \text{X value of digitizing sight position.}\]
\[ Y = \text{Y value of digitizing sight position.}\]

5.9 CAPPR

The CAPPR routine documents the results of the digitizing operation. CAPPR is the anterior-posterior X-ray calibration write routine. The argument list defines the X-ray origin (first entry), a point on the +Y axis (second entry), and points of anatomical interest (third through ninth entries).

Each anatomical point is transformed from digitizer raster units to inches in the X-ray film coordinate system. The results are printed and identified using the 32 character label. The results are also written to data files.

The call is:

CALL CAPPR(X,Y,PNT, NPNT)

where

\[ X = \text{Array of X coordinates to be printed.}\]
\[ Y = \text{Array of Y coordinates to be printed.}\]
\[ PNT = \text{Array of 32 character labels to be printed.}\]
\[ NPNT = \text{Number of entries in each of the above arrays}\]
\[ \text{(Entry 1 defines the origin of the X-ray coordinate system. Entry 2 defines the direction of the +Y axis).}\]

5.10 CLTPR

The CLTPR routine documents the results of the digitizing operation. LTPR is the lateral X-ray calibration write routine. The argument list defines the X-ray origin (first entry), a point on the +Y axis (second entry), and points of anatomical interest (third through ninth entries).

Each anatomical point is transformed from digitizer raster units to inches in the X-ray film coordinate system. The results are printed and identified using the 32 character label. The results are also written to data files.

The call is:

CALL CLTPR(X,Y,PNT, NPNT)

where
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X = Array of X coordinates to be printed.
Y = Array of Y coordinates to be printed.
PNT = Array of 32 character labels to be printed.
NPNT = Number of entries in each of the above arrays.
    (Entry 1 defines origin of the X-ray coordinate system. Entry 2 defines the direction of the +Y axis).

5.11 HEDPR

The HEDPR routine documents the results of the digitizing operation. HEDPR is the write routine for anterior-posterior and lateral X-rays of the head. The argument list defines the X-ray origin (first entry), a point on the +Y axis (second entry), and points of anatomical interest (third through ninth entries).

Each anatomical point is transformed from digitizer raster units to inches in the X-ray film coordinate system. The results are printed and identified using the 32 character label. The results are also written to data files.

The call is:

\[
\text{CALL HEDPR}(X,Y,PNT,NPNT)
\]

where

X = Array of X coordinates to be printed.
Y = Array of Y coordinates to be printed.
PNT = Array of 32 character labels to be printed.
NPNT = Number of entries in each of the above arrays.
    (Entry 1 defines origin of the X-ray coordinate system. Entry 2 defines the direction of the +Y axis).

5.12 NECPR

The NECPR routine documents the results of the digitizing operation. NECPR is the write routine for anterior-posterior (AP) and lateral X-rays of the neck. The argument list defines the X-ray origin (first entry), a point on the +Y axis (second entry), and points of anatomical interest (third through ninth entries).

Each anatomical point is transformed from digitizer raster units to inches in the X-ray film coordinate system. The results are printed and identified using the 32 character label. The results are also written to data files.

The call is:

\[
\text{CALL NECPR}(X,Y,PNT,NPNT,ITYPE)
\]

where
X-Ray Anthropometry Digitization Program

X = Array of X coordinates to be printed.
Y = Array of Y coordinates to be printed.
PNT = Array of 32 character labels to be printed.
NPNT = Number of entries in each of the above arrays. (Entry 1 defines origin of the X-ray coordinate system. Entry 2 defines the direction of the +Y axis).
ITYPE = Type of X-ray (AP or lateral).
   1 — AP.
   2 — lateral.

5.13 XRVCM
XRVCM is a block data subroutine that defines and initializes the named common HDR.

5.14 XRVDG
The XRVDG routine prompts the operator during digitization of a series of points from an X-ray. The operator is requested to enter specific points according to the type of X-ray being digitized.
The call is:

\[ \text{CALL XRVDG}(X,Y,PNT,NPNT) \]

where

X = Array of X coordinates of points digitized.
Y = Array of Y coordinates of points digitized.
PNT = Array of 32 character labels for each point.
NPNT = Number of entries in each of the above arrays.

5.15 XRVPD
The XRVPD routine plots the digitized results. It is used to verify the X-ray digitization operation. Each X,Y coordinate specified in the argument list is circled and labelled on the plotter.
The call is:

\[ \text{CALL XRVPD}(X,Y,PNT,NPNT) \]

where

X = Array of X coordinates to be plotted.
Y = Array of Y coordinates to be plotted.
PNT = Array of 32 character labels to be plotted.
   (Only the first four characters are drawn).
NPNT = Number of entries in each of the above arrays.
6. UTILITY SUBROUTINES

Several utility subroutines are used in the X-ray anthropometry program and are included in the program file. Therefore, a brief description of each is given in this section.

6.1 BELL
The routine BELL sounds the bell on the terminal.
The call is:

CALL BELL

6.2 CAPS
The routine CAPS enables the "caps" mode on the HP-2627A terminal.
The call is:

CALL CAPS

6.3 CAPOFF
The routine CAPOFF disables the "caps" mode on the HP-2627A terminal.
The call is:

CALL CAPOFF

6.4 CONVERT
The CONVERT routine converts a 20-byte character string to three integer variables. The input string is the character string read from the HP-9872T plotter after the execution of an output digitized point and pen status ("OD"). The X and Y coordinates and pen status (up or down) associated with the last digitized point is returned.
The call is:

CALL CONVERT(STR,IX,IY,IP)

where

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STR</td>
<td>20-byte character string read from HP-9872T plotter.</td>
</tr>
<tr>
<td>IX</td>
<td>X coordinate in absolute plotter units (returned integer).</td>
</tr>
<tr>
<td>IY</td>
<td>Y coordinate in absolute plotter units (returned integer).</td>
</tr>
<tr>
<td>IP</td>
<td>Pen status (0 = pen up, 1 = pen down).</td>
</tr>
</tbody>
</table>

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6.5 DEC2I
The routine DEC2I decodes a 2-byte character string to an integer variable.
The call is:

\[
\text{CALL DEC2I (STR,I)}
\]

where

\[
\begin{align*}
\text{STR} &= \text{2-byte character string.} \\
\text{I} &= \text{Returned integer.}
\end{align*}
\]

6.6 ERASE
The ERASE routine clears the display screen on the terminal.
The call is:

\[
\text{CALL ERASE}
\]

6.7 KWAIT
The KWAIT routine waits for a response from the keyboard.
The call is:

\[
\text{CALL KWAIT}
\]

6.8 PLTIO
PLTIO is an input/output (I/O) subroutine package in the C programming language for the HP-9872T plotter. Most of HP-UX is written in C, and all the HP-UX system calls and subroutines are accessed as C functions. This is due mainly to the portability features of the C programming language. A feature of C is the “# include” file. Machine dependent code and declarations can be segregated in separate files, so that to port the code, you need only change some “# include” statements and supply the appropriate files to be included. HP-UX I/O operations seem to be based on this principle, since most I/O operations have to use the C language standard I/O package ‘stdio.h’.

PLTIO is a machine-dependent code and the various C subroutines are as follows:

\[
\begin{align*}
\text{PLTIO} & \quad \text{— Writes out a status inquiry and sets status.} \\
\text{PLTOPEN} & \quad \text{— Opens the plotter.} \\
\text{PLTOUT} & \quad \text{— Writes a command out to the plotter.} \\
\text{PLTCLOSE} & \quad \text{— Closes the plotter.}
\end{align*}
\]
6.9 USING PLTIO
PLTIO may be called from a FORTRAN program. Assuming there is a FORTRAN program in file ‘main.f’ that uses PLTIO, the commands to compile and link these two files are:

```
cc -c pltio.c
```

This creates the file ‘pltio.o’.

```
fc main.f pltio.o
```

The resulting object file would be in ‘a.out’.

6.10 PLTIO SUBROUTINE DESCRIPTIONS

6.10.1 PLTIO
The PLTIO routine requests and reads output status byte from the HP-9872T plotter. The call is:

```
CALL PLTIO (PLTID,OUTSTR,RESULT)
```

where

- **PLTID** = Plotter device unit number.
- **OUTSTR** = 4-byte character string containing the output status command “OS.”
- **RESULT** = 8-byte character string containing the status information read from the plotter.

6.10.2 PLTOPEN
The PLTOPEN routine opens the HP-9872T plotter by assigning it the logical unit number -1.

The call is:

```
CALL PLTOPEN (DEVICE,PLTID)
```

where

- **DEVICE** = Device name on system.
- **PLTID** = Plotter logical unit number.
X-Ray Anthropometry Digitization Program

6.10.3 PLTOUT
The PLTOUT routine writes a command out to the plotter.
The call is:

\[ \text{CALL PLTOUT (PLTID, OUTSTR)} \]

where

- PLTID = Plotter logical unit number.
- OUTSTR = Four-byte character string containing the command to be written out.

6.10.4 PLTCLOSE
The PLTCLOSE routine closes the plotter down by disconnecting it from the logical unit assigned to it.
The call is:

\[ \text{CALL PLTCLOSE (PLTID)} \]

where PLTID is the plotter logical unit number.

7. PROCEDURE FOR RUNNING THE HP-9000 DIGITIZING PROGRAM

Place the paper to be digitized on the HP9872 plotter bed and tape it to the surface. Place the digitizing sight in the pen holder.
To execute the program, type:

\[ \text{cd \$anthropometry} \]

and

\[ \text{xxray} \]

7.1 SPECIFY SUBJECT IDENTIFICATION AND RELATED INFORMATION
The following messages will appear on the screen:

a. "aaaaaa(Subject ID)" Subject Identification.
   Key in the Subject ID.
b. "nnnn (mouth Mount ID)" Mouth Mount Number.
   Key in mouth mount number.
c. "nnnn (Neck Mount ID)" Neck Mount Number.
   Key in neck mount number.
7.2 SELECT TYPE OF X-RAYS
The following menu of options will be presented to the operator:

-1: Exit Program.
0: Set Up For New Subject.
1: Digitize Calibration A-P.
2: Digitize Calibration Lateral.
3: Digitize Head A-P.
4: Digitize Head Lateral.
5: Digitize Neck A-P.
6: Digitize Neck Lateral.

a. Key in a number from 1 through 6 to go to paragraph 3 and digitize the desired X-ray, or
b. Key in 0 to return to paragraph 1 for a new subject, or
c. Key in -1 to exit from the program when finished.

7.3 DIGITIZE SELECTED X-RAY VIEW
After selecting the desired X-ray view by typing in a number from 1 through 6, a heading descriptive of the selected view will appear on the screen. The operator will be presented with the following menu of options:

-3: Exit Subroutine
-2: Plot Results
-1: Print Results
0: Digitize Points in Standard Sequence
1: 
  .
  .
  . Digitize only a specific point
  .
n:
X-Ray Anthropometry Digitization Program

Select the desired option by keying in the corresponding number:

(-3) X-ray complete, return to main routine. Continue with paragraph 2.
(-2) Plot and label all points digitized for this X-ray. Proceed as specified in paragraph 6.
(-1) Print archival copy of digitized values for this X-ray. Proceed as specified in paragraph 5.
(0) Digitize all data points in this X-ray in a predefined sequence. Proceed as specified in paragraph 4.
(1,2,...,or N) Select a particular data point to be redigitized from the X-ray. Proceed as specified in paragraph 7.

7.4 DIGITIZE POINTS IN A STANDARD SEQUENCE (MENU OPTION 0)

The first point the program will ask for will be the “ORG.” This is the point of origin on the x,y axis and is digitized as follows:

a. Move the digitizing sight to the point by means of four directional buttons (arrows indicate up, down, left, and right).
b. When the digitizing sight is over the desired point on the paper, press the DOWN button until the sight touches the paper.
c. Move the sight until the black dot is directly over the point, then press the ENTER button.
d. The program reads the x,y value and lifts the sight off the paper. Next, the program will ask to digitize the point “Y AX” on the y axis. Repeat steps a, b, c, and d above.

The program continues to ask for points to be entered until all the points on that X-ray have been digitized. Repeat steps a, b, c, and d above for all of the points. After the last point is digitized, the menu at the start of paragraph 3 is displayed.

7.5 PRINT THE RESULTS (MENU OPTION -1)

This option should be executed for each X-ray.

All data associated with this X-ray are printed in the file ‘xrayprint.’ The printed output should be requested a few minutes after exiting the main program and can be produced with the following command:

```
lp xrayprint
```

All data associated with this X-ray is stored in the text file ‘digoutput’ and used for input to the main X-ray anthropometry program. To print this file use the following command:

```
lp digoutput
```
Examine the output for errors and redigitize data if necessary. The printed output should be saved as a permanent record of the digitized results. The program returns to the menu in paragraph 3.

**7.6 PLOT THE RESULTS (MENU OPTION -2)**

a. The following message will appear on the screen:

   MANUALLY REMOVE DIGITIZING SIGHT FROM HOLDER  
   PLACE PEN IN STABLE #1  
   ENTER <BLANK><RETURN> TO CONTINUE  

b. When this is done and you are ready to continue, press the RETURN key.

The plot routine will verify the results by using the plotter to draw a circle around and label each digitized point. Examples are appended at the end of this document.

c. Examine the output for errors and redigitize data if necessary. The program returns to the menu in paragraph 3.

**7.7 RE-DIGITIZE A SPECIFIC POINT**

Select the data point to be redigitized by keying in the number to the left of the data point on the menu.

a. Move the digitizing sight to that point by means of four directional buttons. (Arrows indicate up, down, left, and right.)

b. When the digitizing sight is over the desired point on the paper, press the DOWN button, so that the sight touches the paper.

c. Move the sight until the black dot is directly over the point and press the ENTER button.

d. The program reads the x,y value and lifts the sight off the paper.

e. Program returns to the menu in paragraph 3.
8. DESCRIPTION OF OUTPUT FILES

The output file 'digoutput' is used as input to the main X-ray anthropometry program. The format of the file is as follows:

- **Record 1**: Subject identification number (SubjID), Julian Date, Mouth Mount, Neck Mount, Start Day, Start Year, End Day, End Year.
- **Record 2**: Anterior-posterior calibration X values (13 values).
- **Record 3**: Anterior-posterior calibration Y values (13 values).
- **Record 4**: Lateral (LAT) calibration X values (13 values).
- **Record 5**: Lateral calibration Y values (13 values).
- **Record 6**: AP Head X values (RAM, LAM, RON, LON, CTP, RTP, LTP).
- **Record 7**: AP Head Y values (RAM, LAM, RON, LON, CTP, RTP, LTP).
- **Record 8**: LAT Head X values (RAM, LAM, RON, LON, CTP, TRP, LTP).
- **Record 9**: LAT Head Y values (RAM, LAM, RON, LON, CTP, RTP, LTP).
- **Record 10**: AP Neck X values (PSP, SSN, CTP, RTP, LTP).
- **Record 11**: AP Neck Y values (PSP, SSN, CTP, RTP, LTP).
- **Record 12**: LAT Neck X values (PSP, SSN, CTP, RTP, LTP).
- **Record 13**: LAT Neck Y values (PSP, SSN, CTP, RTP, LTP).
- **Record 14**: RAF X value, RAF Y value, LAF X value, LAF Y value (All AP).
- **Record 15**: ASC X value, ASC Y value, LSP X value, LSP Y value, USP X value, USP Y value.

The print file is 'xrayprint.' Listings of files 'digoutput' and 'xrayprint' follow.
REFERENCES


APPENDIX A

PROGRAM LISTING OF FILE “XRAYPRINT”
X-Ray Anthropometry Digitization Program

---------results of xray digitization--------

---------a-p cal ---------

subject : H00227
xray date : 3/13/90
mount id : 1101
comments : DIGITIZED DATA

point:  3 x:  2.613  y:  7.040 inches :  3
point: 13 x:  6.655  y:  7.348 inches : 13
point:  4 x: 11.052  y:  7.028 inches :  4
point: 11 x:  2.415  y:  2.763 inches : 11
point: 10 x:  6.651  y:  2.705 inches : 10
point:  9 x: 11.496  y:  2.655 inches :  9
point:  2 x:  2.565  y: -1.438 inches :  2
point: 12 x:  6.655  y: -1.933 inches : 12
point:  1 x: 11.048  y: -1.454 inches :  1

---------results of xray digitization--------

---------lat cal ---------

subject : H00227
xray date : 3/13/90
mount id : 1101
comments : DIGITIZED DATA

point:  5 x:  1.830  y:  7.224 inches :  5
point: 13 x:  5.754  y:  8.211 inches : 13
point:  8 x: 10.045  y:  7.231 inches :  8
point: 11 x:  1.156  y:  3.306 inches : 11
point: 10 x:  5.784  y:  3.095 inches : 10
point:  9 x: 10.290  y:  2.979 inches :  9
point:  6 x:  1.467  y: -1.470 inches :  6
point: 12 x:  5.839  y: -1.979 inches : 12
point:  7 x: 10.158  y: -1.442 inches :  7

---------results of xray digitization--------

---------a-p head---------

subject : H00227
xray date : 3/13/90
mount id : 1101
comments : DIGITIZED DATA

point: ram x:  3.200 y:  2.965 inches : right auditory meatus
point: lam x:  8.819 y:  3.173 inches : left auditory meatus
point: ron x:  4.221 y:  4.512 inches : right orbital notch
point: lon x:  7.411 y:  4.474 inches : left orbital notch
point: ctp x:  5.467 y:  5.416 inches : center of t-plate
point: rtp x:  2.434 y:  2.409 inches : right t-plate
point: ltp x:  8.601 y:  2.354 inches : left t-plate

A-1
----------results of xray digitization----------

----------lat head----------

subject : H00227
xray date : 3/13/90
mount id : 1101
comments : DIGITIZED DATA

point: ram x: 5.724 y: 3.548 inches : right auditory meatus
point: lam x: 5.889 y: 3.502 inches : left auditory meatus
point: ron x: 9.621 y: 5.252 inches : right orbital notch
point: lon x: 9.428 y: 4.952 inches : left orbital notch
point: ctp x: 12.878 y: 6.000 inches : center of t-plate
point: rtp x: 11.843 y: 3.087 inches : right

----------results of xray digitization----------

----------a-p neck----------

subject : H00227
xray date : 3/13/90
mount id : 2101
comments : DIGITIZED DATA

point: psp x: 5.915 y: 3.427 inches : posterior spinous process
point: ssn x: 5.867 y: 5.585 inches : suprasternal notch
point: ctp x: 6.015 y: 4.338 inches : center of t-plate
point: rtp x: 3.052 y: 4.740 inches : right t-plate
point: ltp x: 8.589 y: 4.922 inches : left t-plate
point: raf x: 3.922 y: 3.934 inches : right articular facet
point: laf x: 7.563 y: 4.082 inches : left articular facet

----------results of xray digitization----------

----------lat neck----------

subject : H00227
xray date : 3/13/90
mount id : 2101
comments : DIGITIZED DATA

point: psp x: 6.053 y: 3.952 inches : posterior spinous process
point: ssn x: 12.331 y: 1.058 inches : suprasternal notch
point: ctp x: .380 y: 5.014 inches : center of t-plate
point: rtp x: 3.283 y: 5.779 inches : right t-plate
point: ltp x: 3.682 y: 5.411 inches : left t-plate
point: asc x: 10.505 y: 3.639 inches : anterior superior corner
point: lsp x: 7.004 y: 4.089 inches : lower spinous process
point: usp x: 7.098 y: 4.376 inches : upper spinous process
APPENDIX B

LISTING OF FILE "DIGOUTPUT"
<table>
<thead>
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<th>H00209</th>
<th>10888</th>
<th>1101</th>
<th>2201</th>
<th>0</th>
<th>0</th>
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<td>999.000</td>
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<td>.860</td>
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</table>
subroutine apcal

function:
interactive subroutine to digitize anterior-posterior
 calibration x-ray film. Operator may digitize points in standard
 sequence, redigitize selected points, print results,
 verify results by plotting points, and exit from the
 subroutine as desired.

By:
W. Campos
QEII Computer And Information System Inc.
New Orleans Division
21 Nov 83
For:
Naval Biodynamics Laboratory
New Orleans, Louisiana
Contract: N00014-83-C-0691
Revised by D. Francis for HP-9000 system 28 Aug 1986

.....named common for header info
 common /hdr/ksubj,kmount,kdate(3),koment(20),kfilm,
  *idate, isday, isyear, ieday, ieyear

.....organize data storage
 character*6 ksubj
 real x(11),y(11)
 integer pnt(8,11)
 data pnt/
 1. 'org','x','y or','igin','
 2. 'y ax','po','int','on y','axi's','
 3. '3','3','3',
 4. '13','13',
 5. '4','4','4',
 6. '11','11',
 7. '10','10',
 8. '9','9',
 9. '2','2',
 10. '*','12','12',
 11. '*','1','1',

 data npnt/11/
data idsp/6/,ikey/5/,iprt/1/,iplt/2/

c
c.....identify subroutine
call erase
call bell
write(idsp,900) (i,(pnt(j,i),j=1,8),i=1,npnt)
900 format('',---digitize a-p calibration x-ray---''//
1. ' place digitizing sight in hp-9872 plotter''/
2. ' place pen in station #1''/
3. '-3: exit subroutine''/
4. '-2: plot results''/
56 ' -1: print results'
57 ' 0: digitize points in standard sequence'
58 11(i4,'1: digitize only ',8a1') /
59 8 ' select option')
60 read(ikey,*,err=100,end=100) iopt
61 c
62 c.....execute option requested
63 if(iopt.eq.-3) return
64 c
65 c.....plot results
66 if(iopt.eq.-2) then
67 call xrypl(x,y,pnt,npnt)
68 c
69 c.....print and save results
70 else if(iopt.eq.-1) then
71 call cappr(x,y,pnt,npnt)
72 c
73 c.....digitize points in standard sequence
74 else if(iopt.eq.0) then
75 call xrydg(x,y,pnt,npnt)
76 c
77 c.....digitize specific point
78 else if(iopt.ge.1 .and. iopt.le.npnt) then
79 call xrydg(x(iopt),y(iopt),pnt(1,iopt),1)
80 c
81 c.....out of options
82 endif
83 go to 100
84 c
85 950 format(a6,1x,i5,1x,a5,1x,i1,1x,2(i1,1x),20(f7.3,1x))
86 955 format(a6,1x,i5,1x,a5,1x,i1,1x,2(i7,1x),20(f7.3,1x))
87 end
X-Ray Anthropometry Digitization Program

FORTRAN 77/UX   HP92430A.07.04   COPYRIGHT HEWLETT-PACKARD CO. 1983   Thu Jul 26
14:15:57 1990

1 subroutine aphed
2 c
3 c  function:
4 c  interactive subroutine to digitize anterior-posterior
5 c  head x-rays. Operator may digitize points in standard
6 c  sequence, redigitize selected points, print results,
7 c  verify results by plotting points, and exit from the
8 c  subroutine as desired.
9 c
10 c By:
11 c  W. Anderson
12 c  Naval Biodynamics Laboratory
13 c  28 Oct 83
14 c
15 c Revised by D. Francis for HP-9000 system 28 Aug 1986
16 c
17 c.....named common for header info
18 c common /hdr/ksbj,kmount,kdate(3),koment(20),kfilm,
19 c  *date,isday,isyear,ieday,iyear
20 c
21 c.....organize data storage
22 c character*6 ksubj
23 c real x(9),y(9)
24 c integer pnt(8,9)
25 c data pnt/
26 c 1 'org ',': x', 'y or', 'gin', ',', ',', ',', ',', ',',
27 c 2 'y ax', ': po', 'int', 'on y', 'axi', 's', ',', ',',
28 c 3 'ram ', ': ri', 'ght', 'audi', 'tory', 'mea', 'tus', ','
29 c 4 'lam ', ': le', 'ft a', 'udit', 'ory', 'meat', 'use', ',
30 c 5 'ron ', ': ri', 'ght', 'orbi', 'tal', 'notc', 'h',
31 c 6 'lon ', ': le', 'ft o', 'rbit', 'al n', 'otch', '
32 c 7 'ctp ', ': ce', 'nter', ' of ', 't-pl','ate ', ',
33 c 8 'rtp ', ': ri', 'ght', 't-pl', 'ate ', ',
34 c 9 'ltp ', ': le', 'ft t', 'pla', 'te', ',
35 c data npnt/9/   
36 c data idsp/6/,ikey/5/,iprt/1/,iplt/2/
37 c
38 c.....identify subroutine
39 c 100 call bell
40 c  call bell
41 c write(idsp.900) (i,(pnt(j,i),j=1,8)),i=1,npnt
42 c 900 format( 'digitize a-p head x-ray--''/
43 c 1 'place digitizing sight in hp-9872 plotter''/
44 c 2 'place pen in station #1''/
45 c 3 ' -3: exit subroutine''/
46 c 4 ' -2: plot results''/
47 c 5 ' -1: print and save results''/
48 c 6 ' 0: digitize points in standard sequence''/
49 c 7 ' 9(14,': digitize only ',8a4/)''/
50 c 8 'select option'')
51 c read(ikey,*),err=100,end=100) iopt
52 c
53 c.....execute option requested

C-3
if(iopt.eq.-3) return

if(iopt.eq.-2) then
  call xrypl(x,y,pnt,npnt)
else if(iopt.eq.-1) then
  call hedpr(x,y,pnt,npnt)
else if(iopt.eq.0) then
  call xrydg(x,y,pnt,npnt)
else if(iopt.ge.1 .and. iopt.le.npnt) then
  call xrydg(x(iopt),y(iopt),pnt(1,iopt),1)
endif

950 format(a6,1x,i5,1x,a5,1x,i1,1x,2(i1,1x),20(f7.3,1x))
955 format(a6,1x,i5,1x,a5,1x,i1,1x,2(i7,1x),20(f7.3,1x))
end

NUMBER OF ERRORS = 0     NUMBER OF WARNINGS = 0
X-Ray Anthropometry Digitization Program


subroutine apnec
  function:
  interactive subroutine to digitize anterior-posterior neck x-rays. Operator may digitize points in standard sequence, redigitize selected points, print results, verify results by plotting points, and exit from the subroutine as desired.

By:
W. Campos
QEI Computer And Information System Inc.
New Orleans Division
For:
Naval Biodynamics Laboratory
New Orleans, Louisiana
Contract: N00014-83-C-0691

Revised by D. Francis for HP-9000 system 28 Aug 1986

c......named common for header info
  common /hdr/ksubj,kmount,kdate(3),koment(20),kfilm,
    *date,isday,iyear,iyear,ieday,iyear
  c......organize data storage
  character*_6 ksubj
  real  x(9),y(9)
  integer pnt(8,9)
  data pnt/
    1 'org '': x,'',y or',''gin',''  '',  '',  '',  '',  ''
    2 'y ax '': po,'',int '','' on y','' axi','' s  '',  '').
    3 'pap '': po,'',ster ',''ior ',''spin ',''ous ','' proc ',''ess ','
    4 'snn '': su,'',pras '',''tern ',''al n ',''otch ',''
    5 'ctp '': ce ',''nter ','' of ',''t-pl ',''ate ',''
    6 'tp '': ri ',''ght ',''t-pl ',''ate ',''
    7 'lp '': le ',''ft t ',''pla ',''te ',''
    8 'raf '': ri ',''ght ',''arti ',''cula ',''r fa ','' cet ','
    9 'laf '': le ',''ft a ',''rtic ',''ular ','' fac ',''et ','
  data npnt/9/
  data idsp/6/,ikey/5/,iprt/1/,iplt/2/

identify subroutine
  call erase
  call bell
  write(idsp,900) (i,(pnt(j,i),j=1,8),i=1,npnt)
  format(' ---digitize a-p neck x-ray---')
  1 ' place digitizing sight in hp-9872 plotter' /
  2 ' place pen in station #1' /
  3 ' -3: exit subroutine' /
  4 ' -2: plot results' /
  5 ' -1: print results' /
  6 ' 0: digitize points in standard sequence' /
NAVAL BIODYNAMICS LABORATORY SOFTWARE DOCUMENTATION

56 7 '9(i4,: digitize only ',8a4/)' /
57 8 'select option'
58  read(ikey,*,err=100,end=100) iopt
59 c
60 c.....execute option requested
61  if(iopt.eq.-3) return
62 c
63 c.....plot results
64  if(iopt.eq.-2) then
65  call xrypl(x,y,pnt,npnt)
66 c
67 c.....print and save results
68  else if(iopt.eq.-1) then
69  call necpr(x,y,pnt,npnt,1)
70 c
71 c.....digitize points in standard sequence
72  else if(iopt.eq.0) then
73  call xrydg(x,y,pnt,npnt)
74 c
75 c.....digitize specific point
76  else if(iopt.ge.1 .and. iopt.le.npnt) then
77  call xrydg(x(iopt),y(iopt),pnt(1,iopt),1)
78 c
79 c.....out of options
80  endif
81  go to 100
82 c
83 950 format(a6,1x,i5,1x,a5,1x,i1,1x,2(i1,1x),20(f7.3,1x))
84 955 format(a6,1x,i5,1x,a5,1x,i1,1x,2(i7,1x),20(f5.3,1x))
85 c
86  end

NUMBER OF ERRORS = 0        NUMBER OF WARNINGS = 0

C-6
X-Ray Anthropometry Digitization Program

subroutine bell

FUNCTION:
sounds the bell

BY:
D. Francis
Naval Biodynamics Laboratory
New Orleans, Louisiana
4 May 1987

equivalence (BEL, IB)
character*2 BEL
data IBELL/o'007'/
call mvbits(IBELL,0,16,IB,16)
write(6,10) BEL
format(a2)
return
end

NUMBER OF ERRORS = 0
NUMBER OF WARNINGS = 0
subroutine capoff

FUNCTION:
Disables the 'caps' mode on the HP-2627A terminal.

BY:
D. Francis
Naval Biodynamics Laboratory
New Orleans, Louisiana
28 June 1988

equivalence (ESCA,IEA),(AK0,IK0),(PP,IPP)
character*2 ESCA,AK0,PP
data IESCA/015446'/,K0/065460'/,IPSP/050040'/
call mvbits(IESCA,0,16,IEA,16)
call mvbits(K0,0,16,IK0,16)
call mvbits(IPSP,0,16,IPP,16)
write(6,10) ESCA,AK0,PP
format(6a2)
return
end

NUMBER OF ERRORS = 0    NUMBER OF WARNINGS = 0
subroutine cappr(x,y,pnt,npnt)
  real x(npnt),y(npnt),pnt(8,npnt),xx(13),yy(13)
  integer index(9)
  WHERE:
  x : array of x coordinates to be printed
  y : array of y coordinates to be printed
  pnt : array of 32 character labels to be printed
  npnt: no. of entries in each of the above arrays
  (entry 1 defines origin of the x-ray coord sys)
  (entry 2 defines the direction of the +y axis)

  FUNCTION:
  This subroutine documents the results of the digitizing
  operation. The argument list defines the x-ray origin
  (first entry), a point on the +y axis (second entry), and
  points of anatomical interest (third - npnth entries).
  Each anatomical point is transformed from digitizer raster
  units to inches in the x-ray film coordinate system. The
  results are printed and identified using the 32 character label.

  BY:
  W. Anderson
  Naval Biodynamics Laboratory
  31 Oct 83

  Revised by D. Francis for HP-9000 system 28 Aug 1986

  common /hdr/ksbj,kmount,kdate(3),koment(20),kfilm,
  *idate,isday,isyear,ieday,iyear

  character*8 filmid(6)
  character*5 ksubj
  character*14 mtloc
  data filmid/'a-p cal ','lat cal ','a-p head','lat head,'
  1 'a-p neck','lat neck'/
  data idsp/6/,ikey/5/,iprt/1/,iplt/2/
  data index/3,13,4,11,10,9,2,12,1/

  assign a unit number to the printer
  open(1, file='xrayprint')
  open(4, file='digoutput')

  do 10 i=1,13
    xx(i)=999.000
  10   continue

  do 10 i=1,13
    yy(i)=999.000
  10   continue

C-9
c.....print heading information
write(iprt,920) filmid(kfilm),ksubj,
1 (kdate(i),i=1,3),kmount,(koment(i),i=1,20)
920 format(/'//','","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","","",""/
2 ' subject : ',a6/
3 ' xray date : ',i2,'/',i2,'/',i2/
4 ' mount id : ',i4/
5 ' comments : ',20a2/

66 c..calculate sin, cos terms for rotation from digitizer to film
67 sang=sin(atan2(x(2)-x(1),y(2)-y(1)))
68 cang=cos(atan2(x(2)-x(1),y(2)-y(1)))

70 c.....transform each anatomical point to x-ray coordinates& print
71 ii=1
72 do 210 i=3,npnt
73 xxform=((x(i)-x(1)))*cang-(y(i)-y(1))*sang)/400./2.54
74 yxform=((x(i)-x(1)))*sang+(y(i)-y(1))*cang)/400./2.54
75 j=index(ii)
76 xx(j)=xxform
77 yy(j)=yxform
78 ii=ii+1
79 write(iprt,922) pnt(1,i),xxform,yxform,(pnt(j,i),j=2,8)
80 922 format(3x,'point: ',a4,'x:','f7.3','y:','f7.3,
81 1 inches ','?a4)
82 210 continue
83 c
84 c.....write data to output file
85 write(4,220) (xx(k),k=1,13)
86 write(4,220) (yy(k),k=1,13)
87 220 format( 13(f7.3,1x) )
88 c
89 c
90 c
91 end

NUMBER OF ERRORS = 0         NUMBER OF WARNINGS = 0
subroutine caps

FUNCTION:
Enables the 'caps' mode on the HP-2627A terminal.

BY:
D. Francis
Naval Biodynamics Laboratory
New Orleans, Louisiana
28 June 1988

equivalence (ESCA,IEA),(AK1,IK1),(PP,IPP)

character*2 ESCA,AK1,PP
data IESCA/o'015446'/'K1/o'065461'/'IPSP/o'050040'/
call mvbits(IESCA,0,16,IEA,16)
call mvbits(K1,0,16,IK1,16)
call mvbits(IPSP,0,16,IPP,16)
write(6,10) ESCA,AK1,PP
format(6a2)
return
end

NUMBER OF ERRORS = 0     NUMBER OF WARNINGS = 0
subroutine cltp(x,y,pnt, npnt)

real x(npnt), y(npnt), pnt(8, npnt), xx(13), yy(13)
integer index(9)

WHERE:
x : array of x coordinates to be printed
y : array of y coordinates to be printed
pnt : array of 32 character labels to be printed
npnt: no. of entries in each of the above arrays
(entry 1 defines origin of the x-ray coord sys)
(entry 2 defines the direction of the +y axis)

FUNCTION:
This subroutine documents the results of the digitizing
operation. The argument list defines the x-ray origin
(first entry), a point on the +y axis (second entry), and
points of anatomical interest (third - npnth entries).
Each anatomical point is transformed from digitizer raster
units to inches in the x-ray film coordinate system. The
results are printed and identified using the 32 character label.

BY:
W. Anderson
Naval Biodynamics Laboratory
31 Oct 83

Revised by D. Francis for HP-9000 system 28 Aug 1986

......named common for header info
     common /hdr/ksubj, kmount, kdate(3), koment(20), kfim,
           *idate, isday, isyear, ieday, ieyear

......organize data storage
     character*8 filmmid(6)
     character*6 ksubj
     character*14 mtloc
     data filmmid/'a-p cal','lat cal','a-p head','lat head',
     1 'a-p neck','lat neck'/

     data idsp/6/,ikey/5/,iprt/1/,iplt/2/
     data index/5,13,8,11,10,9,6,12,7/

     assign a unit number to the printer
     open(1, file='xrayprint')
     open(4, file='doutput')

......initialize data arrays
do 10 i=1,13
   xx(i)=999.000
10    yy(i)=999.000
X-Ray Anthropometry Digitization Program

56 c.....print heading information
57       write(iprt,920) filmid(kfilm),ksubj,
58 1   (kdate(i),i=1,3),kmount,(koment(i),i=1,20)
59 920  format('////////' results of xray digitization//////////
60 1 ' ' ---------',a8,'----------//
61 2 ' subject :' ',a6/
62 3 ' xray date : ',i2,'/',i2,'/',i2/
63 4 ' mount id : ',i4/
64 5 ' comments : ',20a2/
65 c
66 c...calculate sin, cos terms for rotation from digitizer to film
67       sang=sin(atan2(x(2)-x(1),y(2)-y(1)))
68       cang=cos(atan2(x(2)-x(1),y(2)-y(1)))
69 c
70 c.....transform each anatomical point to x-ray coordinates & print
71       ii=1
72       do 210 i=3,npnt
73       xxform=((x(i)-x(1))*cang-(y(i)-y(1))*sang)/400./2.54
74       yxform=((x(i)-x(1))*sang+(y(i)-y(1))*cang)/400./2.54
75       j=index(ii)
76       xx(j)=xxform
77       yy(j)=yxform
78       ii=ii+1
79       write(iprt,922) pnt(1,i),xxform,yxform,(pnt(j,i),j=2,8)
80 922  format('point: ',a4,'x: ',f7.3,'y: ',f7.3,
81       l ' inches ','7a4)
82 210  continue
83 c
84 c.....write data to output file
85       write(4,220) (xx(k),k=1,13)
86       write(4,220) (yy(k),k=1,13)
87 220  format( 13(f7.3,1x) )
88 c
89 c
90 c
91 end

NUMBER OF ERRORS = 0 NUMBER OF WARNINGS = 0
subroutine convert(str,ix,iy,ip)

function:

This routine converts a 20-byte character string to three integer
variables. The input string is the character string read from the
HP-9872T plotter after the execution of an output digitized point
and pen status instruction "OD". The X and Y coordinates and pen
status (up or down) associated with the last digitized point is
returned.

argument definitions:

str -- 20-byte character string read from HP-9872T plotter
ix -- returned integer - X-coordinate in absolute plotter units
iy -- returned integer - Y-coordinate in absolute plotter units
ip -- returned integer - pen status (0=pen up, 1=pen down)

By:

D. Francis
Naval Biodynamics Laboratory
New Orleans, Louisiana
15 Dec 1986

character*20 str
read(str,10) ix,iy,ip
format(2i6,i1)
return
end

NUMBER OF ERRORS = 0       NUMBER OF WARNINGS = 0

C-14
subroutine dec2i(str,i)
  purpose:
  decode 2-byte character string to integer variable
  argument definitions:
  str -- 2-byte char string
  i -- returned integer
  programmer:  j lambert  23 jul 86
character*2 str
read(str,10)i
format(i2)
return
end

NUMBER OF ERRORS = 0     NUMBER OF WARNINGS = 0
1 subroutine erase
2
3 FUNCTION:
4 clears display screen
5
6 By:
7 D. Francis
8 Naval Biodynamics Laboratory
9 New Orleans, Louisiana
10 4 May 1987
11
12 equivalence (ESCH,IH), (ESCJ,IJ)
13 character*2 ESCH,ESCJ
14
15 data IESCH/o'015510'/, IESCJ/o'015512'/
16
17 call mvbits(IESCH,0,16,IH,16)
18 call mvbits(IESCJ,0,16,IJ,16)
19
20 write(6,10) ESCH,ESCJ
21
22 10 format(3a2)
23
24 return
25 end

NUMBER OF ERRORS = 0       NUMBER OF WARNINGS = 0
subroutine hedpr(x,y,pnt,npnt)
   
   real x(npnt),y(npnt),pnt(8,npnt),xx(7),yy(7)

WHERE:
   x : array of x coordinates to be printed
   y : array of y coordinates to be printed
   pnt : array of 32 character labels to be printed
   npnt: no. of entries in each of the above arrays
   (entry 1 defines origin of the x-ray coord sys)
   (entry 2 defines the direction of the +y axis)

FUNCTION:
   This subroutine documents the results of the digitizing
   operation. The argument list defines the x-ray origin
   (first entry), a point on the +y axis (second entry), and
   points of anatomical interest (third - npnth entries).
   Each anatomical point is transformed from digitizer raster
   units to inches in the x-ray film coordinate system. The
   results are printed and identified using the 32 character label.

BY:
   W. Anderson
   Naval Biodynamics Laboratory
   31 Oct 83
   
   Revised by D. Francis for HP-9000 system 28 Aug 1986

.....named common for header info
   idate,,isday,,isyear,,ieday,,ieyear

.....organize data storage
   character*8 filmid(6)
   character*6 ksubj
   character*14 mtloc
   data filmid,'a-p cal ','lat cal ','a-p head','lat head',
   1 'a-p neck','lat neck'/

data idsp/6,,ikey/5,,iprt/1,,iplt/2/

assign a unit number to the printer
   open(1,file='xrayprint')
   open(4,file='digoutput')

.....print heading information
   write(iprt,920) filmid(kfilm),ksubj,
   1 (kdate(i),i=1,3),kmount,(koment(i),i=1,20)
   920 format('////////'---------results of xray digitization--------'/
   1 ' ' ' ' ' ' '','a8,' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' '/
   2 ' subject : ','a6/
   3 ' xray date : ','i2,' 'i2,' 'i2,' '/','i2/
c...calculate sin, cos terms for rotation from digitizer to film
59  sang=sin(atan2(x(2)-x(1),y(2)-y(1)))
60  cang=cos(atan2(x(2)-x(1),y(2)-y(1)))
62 c
63 c.....transform each anatomical point to x-ray coordinates & print
64  ii=1
65  do 210 i=3,npnt
66  xxform=((x(i)-x(1))*cang-(y(i)-y(1))*sang)/400./2.54
67  yyform=((x(i)-x(1))*sang+(y(i)-y(1))*cang)/400./2.54
68  xx(ii)=xxform
69  yy(ii)=yyform
70  ii=ii+1
71  write(iprt,922) pnt(1,i),xxform,yyform,(pnt(j,i), j=2,8)
72  922  format(7,a4,'x:',f7.3,'y:',f7.3,'1 inches ',f7.4)
74  210  continue
75 c
76 c.....write data to output file
77  write(4,220) (xx(k),k=1,7)
78  write(4,220) (yy(k),k=1,7)
79  220  format(7(f7.3,1x))
80 c
81 return
82 c
83 end

NUMBER OF ERRORS = 0     NUMBER OF WARNINGS = 0
subroutine hpdig(x,y)

WHERE:

x : x value of digitizing sight position
y : y value of digitizing sight position

FUNCTION:

Allows operator to move and enter x,y position of digitizing sight.

BY:

W. Anderson
Naval Biodynamics Laboratory
26 Oct 83

Revised by D. Francis for HP-9000 system 28 Aug 1986

$ALIAS CPLTIN = 'pltio'(%ref,%ref,%ref)
$ALIAS CPLTOPEN = 'pltopen'(%ref,%ref)
$ALIAS CPLOUT = 'pltout'(%ref,%ref)
$ALIAS CPLTCLOSE = 'pltclose'(%ref)

CHARACTER*14 DEVICE
CHARACTER*4 OUTSTR,OUTSTR2,OUTSTR3,OUTSTR4
CHARACTER*20 DIGTZPT
CHARACTER*8 RESULT
INTEGER PLTID

integer ibuf(40)

DEVICE = '/dev/hpib/0a1'//char(0)
OUTSTR = 'DP;'//char(0)
OUTSTR2='OS;'//char(0)
OUTSTR3='OD;'//char(0)
OUTSTR4='PU;'//char(0)

assign a unit number to the plotter

CALL CPLTOPEN(DEVICE,PLTID)

.....send 'digitize point' command

-turns plotter 'enter' light on, indicating that a point may be digitized.
-the operator may position the digitizer to any desired x,y location.
-when the operator presses the 'enter' button, the x,y location of the pen and the pen up/down status are stored by the plotter for retrieval by the 'od' command.
-pressing the 'enter' button also turns off the 'enter' button light, and sets bit position 2 in the output status word.

C-19
56 c      CALL CPLTOUT(PLTID,OUTSTR)
58 c      CALL CPLTIN(PLTID,OUTSTR2,RESULT)
60 c      CALL CPLTIN(PLTID,OUTSTR3,DIGTZPT)
62 c
64 c      call dec2i(RESULT,istat)
66 c      CALL CPLTOUT(PLTID,OUTSTR4)
68 c
70 c      CALL CPLTCLOSE(PLTID)
72 c      return
74 c

NUMBER OF ERRORS = 0      NUMBER OF WARNINGS = 0
X-Ray Anthropometry Digitization Program


1 subroutine kwait
2 c
3 c FUNCTION:
4 c Wait for response from keyboard
5 c
6 c
7 c BY:
8 c W. Anderson
9 c Naval Biodynamics Laboratory
10 c 27 Feb 84
11 c
12 c Revised by D. Francis 4 May 1987
13 c
14 c.....cue operator and wait
15 c call bell
16 write(6,900)
17 900 format(’...enter <blank><return> to continue’)
18 read(5,910,err=100,end=100) ia
19 910 format(a1)
20 100 return
21 end

NUMBER OF ERRORS = 0 NUMBER OF WARNINGS = 0
subroutine ltcalf

interactive subroutine to digitize lateral calibration x-ray film. Operator may digitize points in standard sequence, redigitize selected points, print results, verify results by plotting points, and exit from the subroutine as desired.

By:
W. Campos
QEI Computer And Information System Inc.
New Orleans Division
21 Nov 83
For:
Naval Biodynamics Laboratory
New Orleans, Louisiana
Conrtact: N00014-83-C-0691

Revised by D. Francis for HP-9000 system 28 Aug 1986

......named common for header info
common /hdr/ksubj,kmount,kdate(3),koment(20),kfilm,
*idate,isday,isyear,ieday,iyear

......organize data storage
character*6 ksubj
real x(11),y(11)
integer pnt(0,11)
data pnt/
1 'org': x,'y or','igin',
2 'y ax': po,'int','on y','axi','s',
3 5 : 5
4 13 : 13
5 8 : 8
6 11 : 11
7 10 : 10
8 9 : 9
9 6 : 6
12 : 12
7 : 7
data npnt/11/
data idsp/6,ikey/5,iprt/1,iplt/2/

c
identify subroutine
100 call erase
call bell
write(idsp,900) (i,(pnt(j,i),j=1,8),i=1,npnt)
900 format(' ---digitize lat calibration x-ray---'

1 ' place digitizing sight in hp-9872 plotter''
2 ' place pen in station #1''
3 ' exit subroutine''
4 ' -2: plot results''

C-22
X-Ray Anthropometry Digitization Program

56 5 ' -1: print results'/
57 6 ' 0: digitize points in standard sequence' /
58 7 1(14,': digitize only ',8a4)/ /
59 8 'select option')
60 read(ikey,*,err=100,end=100) iopt
61 c
62 c.....execute option requested
63 if(iopt.eq.-3) return
64 c
65 c.....plot results
66 if(iopt.eq.-2) then
67 call xrypl(x,y,pnt,npnt)
68 c
69 c.....print and save results
70 else if(iopt.eq.-1) then
71 call cltpr(x,y,pnt,npnt)
72 c
73 c.....digitize points in standard sequence
74 else if(iopt.eq.0) then
75 call xrydg(x,y,pnt,npnt)
76 c
77 c.....digitize specific point
78 else if(iopt.ge.1 .and. iopt.le.npnt) then
79 call xrydg(x(iopt),y(iopt),pnt(i,iopt),1)
80 c
81 c.....out of options
82 endif
83 go to 100
84 c
85 950 format(a6,1x,i5,1x,a5,1x,i1,1x,2(i1,1x),20(f7.3,1x))
86 955 format(a6,1x,i5,1x,a5,1x,i1,1x,2(i7,1x),20(f7.3,1x))
87 c
88 end

NUMBER OF ERRORS = 0    NUMBER OF WARNINGS = 0
subroutine lthed

function:
interactive subroutine to digitize lateral
head x-rays. Operator may digitize points in standard
sequence, redigitize selected points, print results,
verify results by plotting points, and exit from the
subroutine as desired.

By:
W. Campos
QEI Computer And Information System Inc.
New Orleans Division
21 Nov 83
For:
Naval Biodynamics Laboratory
New Orleans, Louisiana
Contract: NO0014-83-C-0691
21 Nov 83

Revised by D. Francis for HP-9000 system 28 Aug 1986

named common for header info
common /hdr/ksubj,kmount,kdate(3),koment(20),kfilm,
*idate,isday,isyear,ieday,iyear

organize data storage
character*6 ksubj
real x(9),y(9)
integer pnt(8,9)
data pnt/
1 'org', ': x', 'y or', 'gin', '
2 'y ax', ': po', 'int', ': on y', 'axi', 's',
3 'ram', ': ri', 'ght', ',aoli', 'tory', 'mea', 'tuse',
4 'lam', ': le', 'ft a', 'udit', 'ory', 'meat', 'use',
5 'ron', ': ri', 'ght', ',orbi', 'tal', 'notc', 'h',
6 'lon', ': le', 'ft o', 'ribit', 'al n', 'otch',
7 'ctp', ': ce', 'nter', 'of', 't-pl', 'ate',
8 'rtp', ': ri', 'ght', 't-pl', 'ate',
9 'ltp', ': le', 'ft t', '-pla', 'te',
data npnt/9/
data idsp/6, ikey/5, iprt/1, iplt/2/

c
identify subroutine
call erase
call bell
write(idsp,900) (i, (pnt(j,i), j=1,8), i=1,npnt)
900 format(' --digitize lateral head x-ray--')/
1 ' place digitizing sight in hp-9872 plotter'/
2 ' place pen in station #1'/
3 ' -3: exit subroutine'/
4 ' -2: plot results'/
5 ' -1: print results'/

C-24
X-Ray Anthropometry Digitization Program

6 ' 0: digitize points in standard sequence'
7 9(i4,'': digitize only ','8a4/) /
8 'select option'
9 read(ikey,*),err=100,end=100) iopt
c
c...execute option requested
if(iopt.eq.-3) return
c
c...plot results
if(iopt.eq.-2) then
call xrypl(x,y,pnt,npnt)
c
c...print and save results
else if(iopt.eq.-1) then
call hedpr(x,y,pnt,npnt,xy)
c
c...digitize points in standard sequence
else if(iopt.eq.0) then
call xrydg(x,y,pnt,npnt)
c
c...digitize specific point
else if(iopt.ge.1 .and. iopt.le.npnt) then
call xrydg(x(iopt),y(iopt),pnt(1,iopt),1)
c
c...out of options
endif

go to 100
c
950 format(a6,1x,i5,1x,a5,1x,i1,1x,2(i1,1x),20(f7.3,1x))
955 format(a6,1x,i5,1x,a5,1x,i1,1x,2(i7,1x),20(f7.3,1x))
c
c
end

NUMBER OF ERRORS = 0 NUMBER OF WARNINGS = 0
subroutine ltnec

interactive subroutine to digitize lateral neck x-rays. Operator may digitize points in standard sequence, redigitize selected points, print results, verify results by plotting points, and exit from the subroutine as desired.

By:
W. Campos
QEI Computer And Information System Inc.
New Orleans Division
21 Nov 83

For:
Naval Biodynamics Laboratory
New Orleans, Louisiana
Contract: N00014-83-C-0691

Revised by D. Francis for HP-9000 system 28 Aug 1986

......named common for header info
common /hdr/ksubj,kmount,kdate(3),koment(20),kfilm,
*idate,isday,isyyear,ieday,iyear

......organize data storage
character*6 ksubj
real x(10),y(10)
integer pnt(8,10)
data pnt/

......identify subroutine
100 call erase
call bell
write(idsp,900) (i,(pnt(j,i),j=1,8),i=1,npnt)
900 format(---digitize lateral neck x-ray---'
1 ' place digitizing sight in hp-9872 plotter'/
2 ' place pen in station #1'/'
3 ' -3: exit subroutine'/'
4 ' -2: plot results'/'
5 ' -1: print results'/'
X-Ray Anthropometry Digitization Program

56  6   '  0: digitize points in standard sequence'
57  7   10(i4,': digitize only ',8a4/) /
58  8   'select option')
59   read(ikey,*err=100,end=100) iopt
60  c
61  c.....execute option requested
62   if(iopt.eq.-3) return
63  c
64  c.....plot results
65   if(iopt.eq.-2) then
66      call xrypl(x,y,pnt,npnt)
67  c
68  c.....print and save results
69   else if(iopt.eq.-1) then
70      call necpr(x,y,pnt,npnt,2)
71  c
72  c.....digitize points in standard sequence
73   else if(iopt.eq.0) then
74      call xrydg(x,y,pnt,npnt)
75  c
76  c.....digitize specific point
77   else if(iopt.ge.1 .and. iopt.le.npnt) then
78      call xrydg(x(iopt),y(iopt),pnt(1,iopt),1)
79  c
80  c.....out of options
81   endif
82  go to 100
83  c
84  950  format(a6,1x,i5,1x,a5,1x,i1,1x,2(i1,1x),2(5f7.3,1x))
85  955  format(a6,1x,i5,1x,a5,1x,i1,1x,2(i7,1x),2(5f7.5,1x))
86  c
87  end

NUMBER OF ERRORS = 0  NUMBER OF WARNINGS = 0
subroutine necpr(x,y,pnt,npnt,itype)

real x(npnt),y(npnt),pnt(8,npnt),xx(8),yy(8)

WHERE:

x : array of x coordinates to be printed
y : array of y coordinates to be printed
pnt : array of 32 character labels to be printed
npnt : no. of entries in each of the above arrays
(entry 1 defines origin of the x-ray coord sys)
(entry 2 defines the direction of the +y axis)
itype: type of x-ray (ap or lateral).
1 - ap
2 - lateral

FUNCTION:

This subroutine documents the results of the digitizing operation. The argument list defines the x-ray origin (first entry), a point on the +y axis (second entry), and points of anatomical interest (third - npnt entries).
Each anatomical point is transformed from digitizer raster units to inches in the x-ray film coordinate system. The results are printed and identified using the 32 character label.

BY:
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31 Oct 83

Revised by D. Francis for HP-9000 system 28 Aug 1986

.....named common for header info
common /hdr/ksubj,kmount,kdate(3),koment(20),kfilm,
*idate,isday,isyear,ieday,iyear,artfac(4)

common nmount

.....organize data storage
character*8 filmid(6)
character*6 ksubj
character*14 mtloc
data filmid/'a-p cal','lat cal','a-p head','lat head,'
'l-a-p neck','lat neck'/
data idsp/6/,ikey/5/,iprt/1/,iplt/2/

assign a unit number to the printer
open(l, file='xrayprint')
open(4, file='digoutput')

.....print heading information
write(iprt,920) filmid(kfilm),ksubj,
X-Ray Anthropometry Digitization Program

```plaintext
1 (kdate(i),i=1,3),nmount,(koment(i),i=1,20)
920 format('/'/'/'/'/'--------results of xray digitization--------'/'
1 ' ' ' ' ' ' ' ' ' 'a8,' ' ' ' ' ' ' ' '
2 ' subject : ','a6/
3 ' xray date : ','i2,' '/','i2,' '/','i2/
4 ' mount id : ','i4/
5 ' comments : ','20a2/

C...calculate sin, cos terms for rotation from digitizer to film
sang=sin(atan2(x(2)-x(1),y(2)-y(1)))
cang=cos(atan2(x(2)-x(1),y(2)-y(1)))

C.....transform each anatomical point to x-ray coordinates & print
i=1
do 210 i=3,npnt
xxform=((x(i)-x(1))*cang-(y(i)-y(1))*sang)/400./2.54
yyform=((x(i)-x(1))*sang+(y(i)-y(1))*cang)/400./2.54
xx(ii)=xxform
yy(ii)=yyform
ii=ii+1
write(iprt,922) pnt(1,i),xxform,yyform,(pnt(j,i),j=2,8)
922 format('point: ',a4,'x: ',f7.3,'y: ',f7.3,
1 ' inches ','7a4)
210 continue

C.....write data to output file
write(4,220) (xx(k),k=1,5)
write(4,220) (yy(k),k=1,5)
220 format( 7(f7.3,1x) )

C.....save ap data
if(iptype.eq.2) go to 240
artfac(1)=xx(6)
artfac(2)=yy(6)
artfac(3)=xx(7)
artfac(4)=yy(7)
return
240 write(4,220) (artfac(i),i=1,4)
write(4,220) xx(6),yy(6),xx(7),yy(7),xx(8),yy(8)
return
c end
```

NUMBER OF ERRORS = 0 NUMBER OF WARNINGS = 0
subroutine xinit

function:
allow operator to define subject id, mount id, date, and
general comment

by:
W. Anderson
naval biodynamics laboratory
26 oct 83

Revised by D. Francis for HP-9000 system 28 Aug 1986

character*6 ksubj

....named common for header info
common /hdr/ksubj,kmount,kdate(3),koment(20),kfilm,
*idate,isday,isyyear,ieday,iyear

common nmount

organize data storage
data ikey/5/,idsp/6/,iprt/1/,iplt/2/

assign output file
open(4,file='digoutput')

identify function
call erase
write(idsp,900)
format('---identification info for new subject---'//
1 'please enter the following data'/)

put terminal in 'caps' mode
call caps

subject id
call bell
write(idsp,910)
format('/aaaaaaa (subject id)')
read(ikey,912,err=100,end=100) ksubj
format(a6)

mount id
call bell
write(idsp,920)
format('/nnnn (mount mount id)')
read(ikey,*,err=110,end=110) kmount

neck mount id
call bell
write(idsp,925)
format('/nnnn (neck mount id)')
read(ikey,*,err=115,end=115) nmount
X-Ray Anthropometry Digitization Program

56 c
57 c
58 c.....date of x-ray
59 120 call bell
60 write(idsp,930)
61 930 format(//'dddyy ( Julian date of x-ray) mmddyy ( Date of x-ray)'
62 read(ikey,932,err=120,end=120) idate, (kdate(i),i=1,3)
63 932 format(15,3i2)
64 c
65 c.....start date and end date
66 125 call bell
67 write(idsp,935)
68 935 format(//'nnnnnnn (start date) nnnnnnnn (end date) '
69 read(ikey,937,err=125,end=125) isday,isyear,ieday,ieyear
70 937 format(2(i3,i4))
71 c
72 c.....general comment
73 130 call bell
74 write(idsp,940)
75 940 format(//'aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa'
76 1 ' (general comment)'
77 read(ikey,942,err=130,end=130) (koment(i),i=1,20)
78 942 format(20a2)
79 c
80 c.....write subject data to output file
81 write(4,945) ksubj,idate,kmount,nmount,isday,isyear,ieday,ieyear
82 945 format(a6,1x,i5,1x,2(i4,1x),2(i3,i4))
83 c
84 return
85 end

NUMBER OF ERRORS = 0          NUMBER OF WARNINGS = 0

C-31
block data xrcym

FUNCTION:
Define common blocks for x-ray digitizing program.

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common /hdr/ksubj, kmount, kdate(3), kment(20), kfilm,
*idate, isday, isyear, ieday, ieyear, artfac(4)

.. .set hdr to initial values
  data ksubj/6h/
  data kmount/0/
  data kdate/3*0/
  data artfac/4*0/
  data kment/20*2h/
  data idate/0/
  data isyear/0/
  data ieyear/0/
  data ieday/0/
  data isday/0/

end

NUMBER OF ERRORS = 0         NUMBER OF WARNINGS = 0
X-Ray Anthropometry Digitization Program


1 subroutine xrydg(x,y,pnt,npnt)
2    c
3    real x(npnt),y(npnt),pnt(8,npnt)
4    c
5    WHERE:
6    c x : array of x coordinates of points digitized
7    c y : array of y coordinates of points digitized
8    c pnt : array of 32 characters labels for each point
9    c npnt : no. of entries in each of the above arrays
10    c
11    FUNCTION:
12    c This subroutine is used to prompt the operator and digitize
13    c points from the x-ray film.
14    c
15    c
16    c BY:
17    c W. Anderson
18    c Naval Biodynamics Laboratory
19    c New Orleans, Louisiana
20    c 28 Oct 83
21    c
22    c Revised by D. Francis for HP-9000 system 28 Aug 1986
23    c
24    c......named common for header info
25    c common /hdr/ksubj,kmount,kdate(3),koment(20),kfilm,
26    c       *idade,isday,iyear,ieday,iyear
27    c
28    c......organize data storage
29    c       data idsp/6/,ikey/5/,iplt/2/
30    c
31    c......instructions to operator
32    c
33    c    call erase
34    c    write(idsp,900)
35    900 format(’---digitize x-ray data from the plotter---’/
36     1 ’ carefully place digitized sight in hp 9872 plotter’/
37     2 ’ position sight to request point’/
38     3 ’ press enter when enter lamp is lit’/
39     4 ’ terminal will beep, and’/
40     5 ’ lamp will go out when computer accepts value’/
41    c
42    c......digitize point by point
43    c    do 220 i=1,npnt
44    c    call bell
45    c    write(idsp,932) (pnt(j,i),j=1,8)
46    932 format(’enter ’,8a4)
47    c    call hpdig(x(i),y(i))
48    c
49    220 continue
50    c
51    c return
52    c
53    c end

NUMBER OF ERRORS = 0      NUMBER OF WARNINGS = 0

C-33
subroutine xrypl(x,y,pnt,npnt)
  real x(npnt),y(npnt),pnt(8,npnt)
  WHERE:
  x : array of x coordinates to be plotted
  y : array of y coordinates to be plotted
  pnt : array of 32 character labels to be plotted
   (only the first 4 characters are drawn)
  npnt: no. of entries in each of the above arrays
  FUNCTION:
  This subroutine is used to verify the x-ray digitizing
  operation. Each x,y coordinate specified in the
  argument list is circled and labelled on the plotter.
  BY:
  W. Anderson
  Naval Biodynamics Laboratory
  28 Oct 83

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  INTEGER ETX
  .....named common for header info
  common /hdr/ksubj,kmount,kdate(3),koment(20),kfilm,
     *idate,isday,isyear,iiday,ieyear

  c.....organize data storage
  data idsp/6/,ikey/5/,iplt/2/

  ETX=3
  assign a unit number to the plotter
  open(2,file=/dev/hpib/0a1')

  c.....prompt operator to make plotter ready
  call erase
  write(idsp,910)
  910 format('---prepare to plot, label digitized points---'/
    1 ' manually remove digitized sight from holder'/
    2 ' place pen in stable #1'/)

  c.....wait for return key from operator
  call kwait

  c.....set default parameters, select pen, set char size
  write(iplt,912)
  912 format("DF:SF1:SI.2,.2;")

  c.....plot & label each point
  do 200 i=1,npnt
     ix=x(i)
     iy=y(i)
  200
X-Ray Anthropometry Digitization Program

56 write(iplt, 914) ix, iy, pnt(1, i), ETX
57 914 format('SMO;PU;PA'lf', 'i5', ';SM;CP1.5, 0;LB', 'f4', ', 1R1')
58 200 continue
59 c
60 c.....close the plotter
61 c
62 close(2)
63 c
64 return
65 c
66 end

NUMBER OF ERRORS = 0      NUMBER OF WARNINGS = 0
program xxray

main ..... x-ray digitization program

function

interactive program to digitize x-ray anthropometry

data. Results may be output to the printer and verified
by plotting on plotter.

by:
W. Anderson
Naval Biodynamics Laboratory
28 Oct 83

Revised by D. Francis for HP-9000 system 28 Aug 1986

character*6 ksubj

......named common for header info
common /hdr/ksubj,kmount,kdate(3),koment(20),kfilm,
*idate,isday,isyyear,ieday,ieyear,artfac(4)

......organize data storage
data ids/p/6/,ikey/5/,iprt/1/,iplt/2/

assign unit number to the plotter
open(2,file='dev/hpib/0a1')

......initialize program
 call xinit

display options menu

100 call erase
 call bell
 write(ids/p,900)
900 format('---x ray digitization program---''/

1 ' main options menu '//'
2 ' -1: exit program'/
3 ' 0: set up for new subject'/
4 ' 1: digitize calibration a-p'/
5 ' 2: digitize calibration lateral'/
6 ' 3: digitize head a-p'/
7 ' 4: digitize head lateral'/
8 ' 5: digitize neck a-p'/
9 ' 6: digitize neck lateral'/
z ' select option number'/

read(ikey,*,*err=100) iopt

d.....make the film id available to the subroutines
 if(iopt.ge.1 .and. iopt.le.6) kfilm=iopt

d.....execute option requested
X-Ray Anthropometry Digitization Program

if(iopt.eq.-1) then
  call capoff
  close(1)
  close(4)
write(idsp,920)
format(/'---exit from x-ray digitization program---'/)
c
  call exit
else if(iopt.eq.0) then
  call xinit
else if(iopt.eq.1) then
  call apcal
else if(iopt.eq.2) then
  call ltcal
else if(iopt.eq.3) then
  call aphed
else if(iopt.eq.4) then
  call lthed
else if(iopt.eq.5) then
  call apnc
else if(iopt.eq.6) then
  call ltnec
endif
c
.....select a new option
go to 100
c
end

NUMBER OF ERRORS = 0 NUMBER OF WARNINGS = 0
#include <stdio.h>
#include <string.h>
#define CR '\015'
#define O_RDWR 2

/*
 ** write out a status inquiry and get status
 */

int pltio(pltid, outstr, result)
int *pltid;
char *outstr, *result;
{
    FILE *fp;
    int i;
    char c, buf[80];

    strcpy(buf, outstr);
    недел (i=0; c != CR; i++)
    {
        read(*pltid, &c, 1);
        buf[i] = c;
    }
    buf[i] = '\0';
    strcpy(result, buf);
}

/*
 ** write command out to plotter
 */

int pltout(pltid, outstr)
int *pltid;
char *outstr;
{
    write(*pltid, outstr, strlen(outstr));
}

/*
 ** open plotter device
 */

int pltopen(device, pltid)
char *device;
int *pltid;
{
    char *errbuf = "ERROR device file not found \n";
    if ((*pltid = open(device, O_RDWR)) == -1 )
X-Ray Anthropometry Digitization Program

{
    write(6,errmsg,strlen(errbuf));
    exit(1);
}

int pltclose(pltid)
int *pltid;
{
    close(*pltid);
}
APPENDIX D

SAMPLES OF PLOTTED OUTPUT
Figure D-1. X-ray anthropometry anterior-posterior calibration data.

Figure D-2. X-ray anthropometry lateral calibration data.
Figure D-3. X-ray anthropometry anterior-posterior head data.

Figure D-4. X-ray anthropometry lateral head data.
Figure D-5. X-ray anthropometry anterior-posterior neck data.

Figure D-6. X-ray anthropometry lateral neck data.