NBDL - 84R002

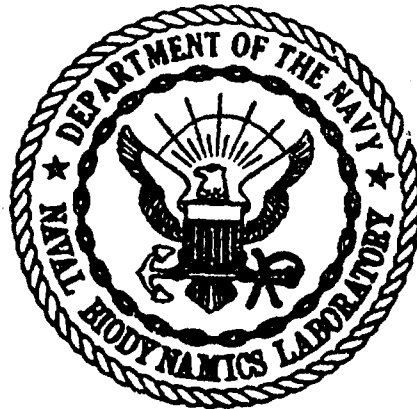# PHOTODIGITIZING PROCEDURES

Patricia D. Kilgore, Naval Biodynamics Laboratory

and

Joseph H. Gottbrath, Q.E.I., Inc.

February 1984

NAVAL BIODYNAMICS LABORATORY
New Orleans, Louisiana

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This report documents procedures and programs for efficiently running the Photo Digitizing System at the Naval Biodynamics Laboratory. Procedures have been tested and have been found to be effective. Any future acquisitions of programs or changes to current programs should be incorporated in these procedures. On-going research programs use high speed instrumentation cameras to record the motion of test subjects during biodynamic experiments. The films are digitized and the 3-dimensional motion is reconstructed and analyzed.

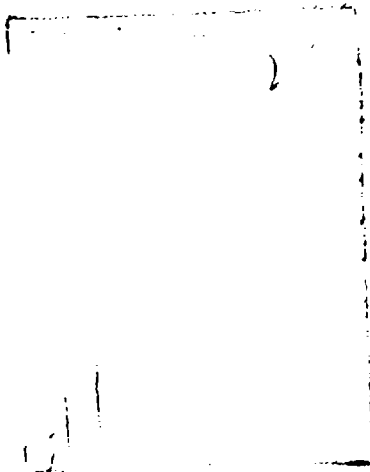DD FORM 1473 EDITION OF 1 NOV 65 IS OBSOLETE
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Experimental research is performed to determine the effects of aircraft crashes, ship motion, vibration, aircraft ejection and parachute opening forces on the health and performance of Navy personnel.

PHOTODIGITIZING PROCEDURES

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February 1984

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Chairman, Editorial Review Board            Commanding Officer

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SUMMARY

THE PROBLEM

Documentation is needed on procedures and programs for efficiently running the Photo Digitizing System.

FINDINGS

Procedures have been tested and have been found to be effective.

RECOMMENDATIONS

Any future acquisitions of programs or changes to current programs should be incorporated in these procedures.


ACKNOWLEDGEMENTS

Special thanks to Miss Mary M. Harbeson for editing the manuscript and Miss Judy B. Johnson for an excellent job of assembling and typing these procedures.

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# PHOTODIGITIZING PROCEDURES

## INTRODUCTION

The Naval Biodynamics Laboratory (NBDL), located in New Orleans, Louisiana, is an internationally recognized laboratory. On-going research programs use high speed instrumentation cameras to record the motion of test subjects during biodynamic experiments. The films are digitized and the 3-dimensional motion is reconstructed and analyzed. Experimental research is performed to determine the effects of aircraft crashes, ship motion, vibration, aircraft ejection and parachute opening forces on the health and performance of Navy personnel.

A major task performed during analysis of the photo data is conversion of the film image to digital information. This report describes the equipment and procedures used in the data conversion.

## BACKGROUND

In a typical experiment the test subject wears standardized instrumentation packages which are rigidly fastened to selected anatomical segments. At least six miniature linear accelerometers and 14 precision photo targets are mounted in each package. The accelerometers produce electrical signals which are digitized and used to reconstruct the 3-dimensional acceleration of the associated anatomical segment. The photo targets are photographed by two high-speed instrumentation cameras mounted in known positions. After the films are developed the x,y coordinates of key targets are digitized for all frames of interest. Data from the two cameras are used to reconstruct the 3-dimensional trajectory of the anatomical segment. Integration of the acceleration information and differentiation of the displacement information produces 3-dimensional velocities measured by the two independent instrumentation systems. Comparison of results from the sensor system with the photo system provides a reliable indication of total system error.

Processing the photo data requires careful execution of a number of related operations, as outlined in Figure 1. The following major functions must be performed:

    a. Calibration of all photo instrumentation used in an experiment must be completed before the photo data may be analyzed. The four components involved are:

        (1) Camera locations: The locations of all cameras must be measured so that the precise location of the film may be determined in a standard laboratory coordinate system.

        (2) Cameras: The optical characteristics for each camera must be measured to determine the relationship between the image in the filmplane and the object (photo targets) being photographed.

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(3) Target locations: Each instrumentation package contains 14 photo targets, as shown in Figure 2. The precise location of the center of each target relative to the standard coordinate system for the package must be measured.

(4) Instrumentation package location: Each instrumentation package is rigidly mounted in a repeatable manner on a selected anatomical segment of a test subject. Stereographic x-rays are used to determine the 3-dimensional location of the instrumentation package relative to a coordinate system defined by the subject's bony anatomical landmarks visible in the x-rays. This relationship permits representation of motion in an anatomical coordinate system which is uniform across subjects, provided only that the motion of the instrument package has been determined.

Each of the above functions involves precise measurements, careful attention to procedural details, and complex calculations using measured data. Wherever possible, computers are used to aid with data collection and reduction, prompt the operator, and cross-check results for internal consistency. After the results of each calibration operation have been verified they are added to the NBDL calibration data base for use in subsequent experiments.

c. Once all the calibration information is available the photographic system may be used to collect data during an experiment. Up to three cameras may be run, with rates up to 1000 frames per second. In addition to photographing motion of the photo targets, the instrumentation film is invaluable in subjective evaluation of operational problems.

d. After the film is developed it is analyzed by a computer-controlled photodigitizing system (PDS). The PDS uses pattern recognition algorithms to automatically scan the image, locating the center of photo targets and deciphering timing information recorded on each frame of film. The control program prompts the system operator for help when problems are encountered. The results of the digitizing process are written to magnetic tape for analysis at a remote computer.

e. After the digitized photo data are received at the remote computer, it is converted to the host format and plotted. The plotted data are examined for errors and appropriate corrections are made.

f. Once the plots are accepted, data from two films and all the supporting calibration information are combined to reconstruct the 3-dimensional motion of each anatomical segment during the experiment. If reduced accelerometer data are available comparison plots of velocities reconstructed from the two systems are plotted for evaluation of total errors of the systems. The three dimensional motions are stored in the NBDL data base, readily available for subsequent analysis. Figure 3 is a representative comparison plot of the angular velocity about the Y axis of the head of a volunteer subject during an impact acceleration test. Motion derived from photo data is shown by the symbol "X", and accelerometer data by the symbol "+". Differences between the two systems less than 1 radian/second are considered acceptable.

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# PHOTODIGITIZING SYSTEM

The photodigitizing system (PDS) is an NAC film analyzer which may be operated under computer control. Figure 4 illustrates the major information paths in the system. The projected film image is directed to two devices: a video camera which is accessible only to the computer, and the operator's screen which is used for manual data entry. Film may be advanced under operator or computer control.

The video camera is a high precision, instrumentation quality videocon. The computer, under program control, must specify an x,y coordinate and read the corresponding gray level. Various pattern recognition algorithms build upon this capability to search for specific high contrast geometric patterns. An oscilloscope displays the path followed by the search algorithms, and is useful for diagnosing problems and monitoring progress.

The image projected on the operator's screen is used primarily for subjective evaluation of the film. If the control program is not able to complete a function the system operator is prompted to intervene. The operator's response is usually based upon a review of the projected image. If requested, the operator may position the x-y crosshairs to the desired point on the image, such as the center of a target, and request the computer to record that x,y coordinate. The foot pedal may be used for a "no hands" signal from the operator to the computer.

The PDS uses the scan converter to store an entire video image for display on a closed circuit TV (CCTV) monitor. The image may be the film image from the video camera on the film analyzer, graphics information generated by the computer, or composite information from both sources. The images in the scan converter are stored and cleared under computer control.

A magnetic tape drive is used to store digitized data for transportation to an off-site computer for analysis. An operator's console with a CRT display and a full keyboard is used for communication between the system operator and the computer.

The operation of the entire system is performed through a control program in the computer. Functions which are supported include:

    a. Calibration of the video camera.
    b. Calibration of the x,y crosshairs.
    c. Definition of film descriptors.
    d. Search for center of photo targets.
    e. Decode timing information.
    f. Display of information on the CCTV monitor.
    g. Accept manual entry of target locations.
    h. Automatic frame advance.
    i. Position tape and write data to tape.

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## OPERATING PROCEDURE FOR PHOTODIGITIZER

The efficiency of the photodigitizing process can be greatly improved by following a well-defined procedure. The procedure outlined in this section is suitable for most of the data film used at NBDL.

1.  EQUIPMENT LIST:

    a.  NAC Film Analyzer.

    b.  PDS Control Unit (PDS is Photo Digitizing System).

    c.  Nova 800® computer.

    d.  Tektronix 4051® operator's console.

    e.  Two 800 CPI Magnetic Tape Units.

    f.  Wavetek® display.

    g.  Operator's film run log.

    h.  Photo digitizer record tape log.

    i.  Run summary records.

2.  SETUP PROCEDURE:

    a.  Turn main POWER switch on (switch is located at the base of main rack).

    b.  Turn on POWER ON switch located on Nova 800® computer.

    c.  Rotate STANDBY switch located on the PDS Control Unit to on position. HV-on indicator should light.

    d.  Turn on POWER ON switch on Mag Tapes Units A and B.

    e.  Turn STANDBY SWITCH on the film analyzer to ON position.

    f.  Turn on Wavetek® display on wall.

    g.  Turn on the Tektronix operator's console (the switch is located under the keyboard on the right hand side).

    h.  Allow machines (PDS camera and control electronics) to warm up 10 minutes.

i.  Press HOME PAGE key on the Tektronix operator's console, then press AUTO LOAD key to load the 4051 communication program from cartridge tape.  The screen will become light green and the following will appear:

PDS Interface

2400 Baud

## 3.  LOADING THE PHOTO DIGITIZING SYSTEMS PROGRAM TAPE INTO THE NOVA:

a.  Select the most current Photo Digitizing Systems program tape.  Be sure the write enable ring has been removed.

b.  There are two tape drives, A and B.  Select the drive with the "0" indicated in the upper right hand corner.  Mount program tape.

c.  After tape is mounted depress load button.

d.  On Nova console set data switches 0, 11 and 14 in up position (M. T. is device number 22).

e.  Raise the RESET control switch on the Nova.

f.  Raise the PROGRAM LOAD control switch momentarily (execute program load routine from ROM to read bootstrap program from tape).

g.  Wait for a # symbol to appear on the operator's console.

h.  Key in "1", return (this loads first program on tape after bootstrap).

i.  After tape motion has stopped depress RESET and REWIND switch on the tape drive.  Depress REWIND again to unload tape.

j.  Remove Photo Digitizing Systems Program tape from drive.

## 4.  TO START EXECUTION OF THE PDS PROGRAM:

a.  Set all Nova data switches to zero (down) except switch 14 (PDS program starts at address 2).

b.  Depress STOP switch momentarily (stops any activity in computer).

c.  Raise RESET switch momentarily.

d.  Raise START switch momentarily.

e.  "SELECT OP CODE" will appear on the operator's console, indicating the program is ready for operator input.

## 5. SYSTEM CALIBRATION:

The calibration procedures must be run every time the program is loaded from tape. This is done as follows:

a. Raise the pressure plate on the film analyzer by turning the pressure plate knob and insert the glass calibration slide which is kept in the drawer below the NOVA 800 and which is VERY DELICATE AND MUST BE HANDLED VERY CAREFULLY. Replacement cost is several hundred dollars.

b. The calibration slide should be inserted with the silver line image up and toward the projector head, with the end of the bar touching the register pin.

c. Turn light intensity to maximum.

d. Lower the pressure plate.

e. Key in "CA" on the operator's console (CA = Calibrate).

f. The PDS will scan the special calibration target and inform the operator if it had difficulty in locating a target, and request action if it is required. Progress can be monitored on the Wavetek display. "INPUT ZERO REF POINT" should appear on the operator's console. If so, continue with paragraph 5i.

g. If the PDS system has trouble locating a target it may give the message "LOST TGT -RETRY?" Check calibration slide to be sure it is positioned correctly. The large circular target should be visible in the center of the PDS screen. If, after making any necessary adjustments to the calibration bar, you wish to retry, key in "Y" for yes and return to paragraph 5f.

h. If you do not wish to retry, key in "N" for no. "INPUT ZERO REF POINT" will appear on Tektronix screen. Continue with paragraph 5i.

i. On the lower left hand side of the film analyzer screen is a small target. There is a red button on the front panel of the analyzer to illuminate the target. Depress this red button whenever additional light is needed.

j. Set the cross hairs in the center of the small target using the X and Y axis hairline dials and joystick.

k. Reset Frame Counter (F), X Axis hairline position counter (X), and Y axis hairline position counter (Y) to zero. Reset button is to the left of each counter.

l. Depress foot switch to allow program to continue.

6

m. "WANT TO USE PREVIOUS FAN CALIBRATION?" will appear on Tektronix screen.

n. Usually the answer is yes, indicating that the X-Y cross hairs do not need to be recalibrated. (However, the X-Y coordinates must be calibrated manually every Monday. See paragraph 5o for manual calibration.) KEY in "Y" for yes.

    (1) "INPUT CENTER TARGET" will appear on screen.

    (2) Put X and Y cross hairs on center of large target in center of screen.

    (3) Depress foot switch to read X - Y coordinate registers.

    (4) "SELECT OP CODE" appears on screen.

    (5) End of Calibration.

    (6) Remove and return calibration slide to storage drawer. Continue with paragraph 6.

o. MANUAL CALIBRATION OF X - Y CROSS HAIRS: (The X-Y coordinates must be calibrated manually every Monday.)

    (1) Depress "N" key.

    (2) "INPUT CENTER TARGET" will appear on screen.

    (3) Put X and Y cross hairs on center of large target in center of screen.

    (4) Depress foot switch to read X - Y coordinate registers.

    (5) "INPUT BOTTOM LEFT TARGET 2, 3" will appear on the screen. The first number represents the row. The second number represents the column.

    (6) Set cross hairs on target (2,3) (see figure 5).

    (7) Depress foot switch to read X -Y coordinate register.

    (8) Tektronix will print X,Y coordinates next to (2, 3) and request target (2, 4.)

    (9) Repeat steps (5)-(8) to target (2, 8). For target (3, 3) move up one line of targets and repeat procedure. Last coordinates to be input are (7, 8) after which "SELECT OP CODE" will appear on the operator's console.

(10) The calibration constants for the x-y cross hairs are stored in program tables. The program must be written to a program tape in order to save the new calibration information. Five program tapes have been created, one for each of the five possible Mondays of a month. A copy of the program is written to tape as follows:

A. Select the program tape corresponding to the most recent Monday.

B. Place a write enable ring in the tape.

C. Mount the tape on drive 0.

D. Press the "LOAD" switch to position tape for processing and place it "ON-LINE".

E. Set all NOVA data switches up except 0 and 15 (core image loader begins at location 77776).

F. Depress STOP switch momentarily.

G. Raise START switch momentarily.

H. Wait for a # symbol to appear on the operator's console.

I. Key in 1 return. (Program with new calibration information will be written as file 1).

J. "NMAX:" appears on the screen.

K. Key in 30000 return. This specifies the last location in memory to be written to tape.

L. After tape motion stops press RESET and REWIND on the tape drive. After motion stops again, press REWIND again to unload the program tape.

M. Remove new copy Photo Digitizing Systems Program tape from the drive.

N. Mark the tape label with the current date, and place tape in storage.

O. To resume PDS operation:

    i. Set all NOVA data switches to zero (down) except switch 14.

    ii. Press STOP switch momentarily.

    iii. Raise RESET switch momentarily.

iv.  Raise START switch momentarily.

v.  "SELECT OP CODE" will appear on the operator's console, indicating the program is ready for operator input.

6.  <u>INSTRUCTIONS FOR MOUNTING AND POSITIONING MAG TAPE FOR DATA OUTPUT</u>:

a.  Put a write ring in a scratch mag tape.

b.  Mount it on tape drive 0 following threading instructions on tape drive.

c.  Depress "LOAD" switch on tape drive.

d.  If the mag tape has been used previously and additional runs are to be placed on the same tape, the tape may be remounted and advanced as follows:

(1)  Key in "ST".

(2)  "ENTER NUMBER OF FILES FOR SPACE FORWARD" will appear.

(3)  Type in number of file (each film digitized is one file).

(4)  Tape will advance to the specified position on the tape.

NOTE:  All data after this postion will be destroyed.

7.  <u>LOADING THE FILM</u>:

NOTE OF CAUTION.  Open top of film can and check to be sure film is on a projector reel.  If it is not on a reel the film will curl and become impossible to handle if you try to remove it.  If necessary, use a split reel.  Open one side by unscrewing it and place it over the film while the film is still in the canister.  Once one side of the reel is placed over the film turn the can over, remove the can and put the other side of the reel on top of it and secure it by tightening the two sides.

a.  Place the loaded reel of film on the back shaft and the empty reel on the front shaft of the NAC film analyzer.

b.  Push the reel clamps down to lock the reels.

c.  Thread the film projector following markings on projector head. Leave a loop on either side of the projector so that film will not be pulled taut when film is advanced.  If operator is not familiar with loading film please seek the aid of an experienced operator.

d.  After the film is threaded check the film feed direction switch.  The selected direction is indicated by a green lamp.  To change direction depress the switch.  Top lamp indicates forward and bottom indicates rewind.

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e.  Set film DIRECTION switch to forward.

f.  Set film AUTO STEP knob to 1.

g.  Depress the AUTO STEP switch and check to see if film is advancing correctly.

h. Advance film to starting location by using the CONTINUOUS film feed knob.

8.  SCAN FILM TO LOCATE STARTING TIME.

a.  Starting time is time of first motion (found on sled run summary sheets) minus 50 milliseconds (.0500 seconds).

b.  Numerals appear on the right hand side of the film image, showing the time each frame was exposed.

c.  Position the film until the time appearing on the screen comes as close as possible to the starting time without going beyond it.

d.  Record time of this frame in the Operator's film run log. (See Figure 2).

9.  PROCEDURE FOR SPECIFYING FILM TIMING INFORMATION:

a.  Select Mode:  Key in "NM" (normal mode).

b.  Specify Test ID.

   (1) "SIX CHARACTER TEST ID" will appear on CRT.

   (2) Type in run number (e.g. "LX0312").

c.  Specify camera site ID.

   (1) "1000 TIMES MACHINE NUMBER/CAMERA NUMBER" will appear on screen.

   (2) Key in 1, 2, or 3 representing site number.  Return.

d.  Specify time between frames.

   (1) "LAST FIVE DIGITS OF TIME STARTING FRAME -1" will appear on screen.

   (2) Key in "00000".  Return.

   (3) "ENTER TIME DIFFERENCE BETWEEN FRAME" will appear.

   (4) Key in "0".  Return

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e.  Specify time of first frame.

(1) "FIVE DIGITS OF TIME" will appear.

(2) Key in the first five LED digits (Set 1 in the following figure). Return.  (These digits are on the right hand side of the film image).

f.  Procedure for enabling automatic LED time code input option.  The "LED?"  message asks the operator if the LED digits are to be read by the program.  Usually all the LEDs are visible and can be read.  Advance the film and review it for any LED problems.  Problems can occur when boxing in LED timing if a digit has been rotated on the filmplane.  If the LEDs are not visible or are obscured in any way, key in "N" to avoid reading LED digits ("TARGETS" will appear on Tektronix screen), and continue with paragraph 10.

Otherwise:

(1) Key in "Y" for yes.

(2) The program responds with "# OF LED DIGITS".

(3) Key in "5" Carriage Return to define the digits in set 2.



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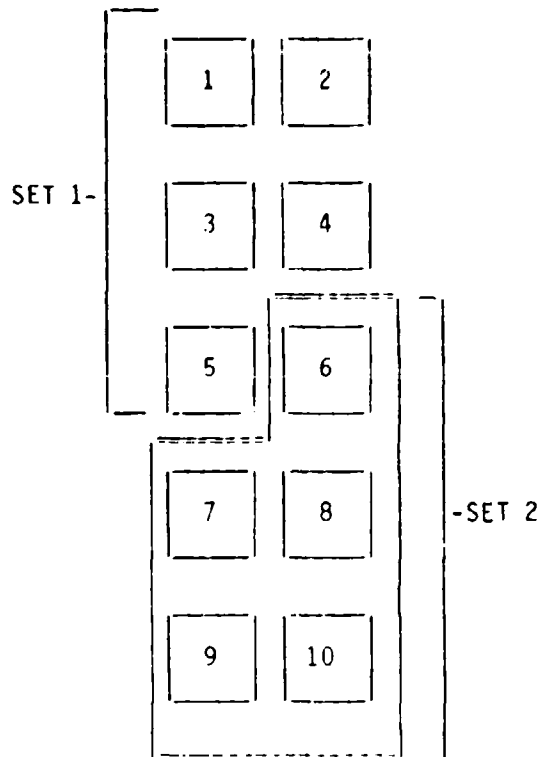
g. Procedure for identifying missing segments resulting from camera's malfunction:

(1) "MISSING SEGMENT" will appear on screen.

(2) If all LED segments are visible type "N" and continue with step h.
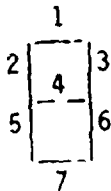
(3) If some of the segments are missing, key in "Y".

(4) "LED POSITION NUMBER" will appear.

(5) Key in 1, 2, 3, 4 or 5 to specify the position of the digit in set 2 that has the missing segment.

(6) "MISSING SEGMENT #" will appear. The segments are numbered as follows:

```
      1
    ____
 2 |    | 3
   | 4  |
   |____|
 5 |    | 6
   |____|
      7
```

Key in the number of the missing segment.

(7) Repeat steps (1)-(6) until all missing segments are recorded.

h. Procedure for Defining Location of Each LED Digit.

(1) "INPUT DIGIT 1 LOWER LEFT" will appear on screen. This refers to the first digit of set 2 (digit 6).

(2) Position X-Y cross hairs at the lower left corner of digit 6.

(3) Then press foot switch to record position.

(4) "INPUT DIGIT 1 UPPER RIGHT" will appear on screen.

(5) Position cross hair at the upper right corner of digit 6.

(6) Press foot switch.

(7) Repeat steps 1 - 6 for digit positions 2 - 5 of set 2.

i. Specify shape of LED for automatic processing.

(1) "INPUT FAN LOW LEFT" will appear on screen. When this appears on screer it is best to find a figure 8. An 8 is necessary because it has all the segments of the LED's.

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example:

If an eight is not available in the first frame move the film slowly either forward or backward to locate an 8 in the last five digits of time.

       (2) Put the cross hairs at the lower left hand corner of the digit 8, as shown in the following figure defining the points used to specify the shape of LED digits.

       (3) Depress foot switch.

       (4) "INPUT TOP RIGHT" will appear. (It is critical that the upper right corner be above points #1 and #2. It may be necessary to move the cross hairs slightly up above the actual upper right corner to accomplish this but it is absolutely necessary for correct reading of the LED Timing.)

       (5) Position the cross hairs at top right corner of the digit 8, as shown in the figure.

       (6) Depress foot switch.

i.e.: 16 INPUT POINTS
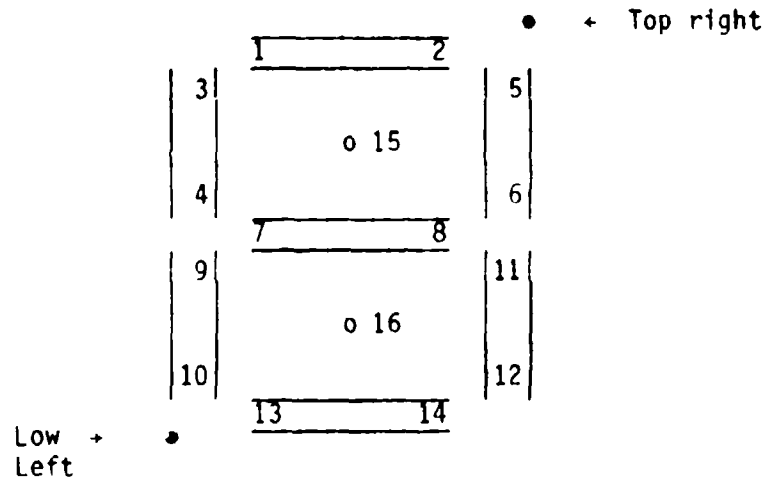
POINTS USED TO SPECIFY SHAPE OF LED DIGITS

(7) "INPUT POINT #1" will appear on screen.

(8) Put cross hairs on position 1. Make sure cross hairs are on center of segment. Depress foot pedal.

(9) Repeat steps 7-8 for points 2-16. After the 16th point is entered "TARGETS" will appear on screen.

10. PROCEDURE FOR SPECIFYING PHOTO TARGET INFORMATION:

At this time it is necessary to decide what targets are going to be digitized during the run. The target numbering convention is:

100 is the sled target (stationary target used as a reference)

1nn is target nn at the neck

2nn is target nn at the mouth

3nn is target nn at the top of the head

4nn is target nn at the pelvis

500 series for any other target package

900 is the lower left film sprocket hole

Target numbers nn for a standard instrumentation mount (T-plate) are shown in figure 2.

There are 14 targets on the T-plate and there are 2 T-plates.

There can be as many as 28 targets (but not all visible at the same time). Targets on at T-plate are in four clusters, as follows:

Targets 1, 2, 6, 13 are in cluster 1.

Targets 4, 8, 12, 14 are in cluster 2.

Targets 5, 10, 11 are in cluster 3.

Targets 3, 7, 9 are in cluster 4.

Only one target in each cluster should be digitized in a frame of film. However, each target to be digitized in the entire film must be identified during the initialization process in order to assign space for the x,y location data. Therefore, it is necessary to scan the film to determine all targets that must be tracked during the run.

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As an example, on a front view camera you may initially see targets 2, 4, 3 and 9 at the mouth. However, once motion starts one or more of these targets may turn away from the camera and disappear. When the PDS program advises it has lost a target the operator must select another target in that cluster.

It is also important for the operator to keep track of the sequence in which the targets are specified. The program will always refer to the target by its sequence number. For example, it may indicate "LOST TARGET 4". In order to respond you must know which target was entered 4th. Make a list of the targets you plan to track. As each target is inserted note next to each target the order in which it was inserted.

 a. "TARGETS" appears on the operator's console.

 b. Key in number of targets to be digitized. Return. Using the example above of front view of the mouth mount you would indicate 6 targets (i.e. sprocket hole, chair, 2, 4, 3 and 9.)

 c. "INPUT TARGET 1" will appear on screen.

 d. Normally, the first target will be the lower left sprocket hole. Since the program has no algorithm for searching for a sprocket hole, the operation must remove it from the search list. Depress RUB OUT button on the operator's console.

 e. "ENTER MOUNT TARGET # appears.

Key in 900 (900 is identification # for sprocket hole). Return.

 f. "INPUT TARGET 2" appears. This is normally the sled reference target.

 g. Line cross hairs on chair target and press foot switch. The Wavetek monitor shows the system searching for the center of the target.

 h. "ENTER MOUNT TARGET #" appears. Chair target is always 100 return.

 i. "INPUT TARGET 3" appears. If the target is to be tracked beginning with the first frame, move the cross hairs to the center of the target and press the foot pedal. If the target will not be used until later in the film, press "RUB OUT", return on the operator's console. If "UTL" appears on console it means computer was "unable to locate" targets. Reset cross hairs on target and press foot pedal.

 j. When "ENTER MOUNT TARGET #" appears key in mount number for which you are reserving space, using the naming convention defined above.

 k. Repeat steps i. through j. defined above for the rest of targets.

## 11. PROCEDURE FOR SPECIFYING CAMERA FIDUCIAL MARKS:

a. "FIDS" will appear at the operator's console. Camera fiducial marks are special markings on the film for the purpose of determining the location of the film in the camera.

b. Key in "N" (Normally camera fiducial marks are not used). Continue with step 12.

c. On occasions when fiducial marks are used key in "Y".

d. "VTO POL W/B - POLARITY BLACK OR WHITE" will appear on the screen.

e. Enter either a "B" for black or a "W" for white. We are not using this portion of the program at this time but we must enter a letter to make the program go on to the next step.

f. "FID 1 - FAN" will appear on the screen.

g. Hit RUB OUT key (we are not using this portion of the program at this time).

## 12. CONCLUSION OF INITIALIZATION:

a. Date of digitization.

"ENTER JULIAN DATE - 4 DIGITS" will appear. Key in (dddy) return. (Example: 0013 = January 1, 1983)

b. Specify number of frames to be processed.

(1) "FRAME" indicates number of frames to be digitized, normally 250.

(2) Key in 250 return.

c. Initialization procedure is concluded when the "READY" message appears. Make the following checks:

(1) Make sure the film is positioned to the first frame to be digitized.

(2) Check the film DIRECTION switch to be sure the film is in forward position (upper green light lit on switch).

(3) Be sure the film advance AUTO STEP switch is set at 1.

(4) If frame counter is not at zero, reset the frame counter (be sure you reset only the frame counter) by depressing button in front of frame counter display.

## 13. DIGITIZE DATA, FRAME BY FRAME:

Sprocket hole information is needed during 10 of the first 25 frames.  After the PDS begins processing the film automatically the operator must make a request to track 10 frames manually.  Note:  T..e PDS system will not prompt the operator to enter the sprocket hole locations.  It is necessary to get the sprocket hole readings before the 25th frame so it is best to do as early as possible to avoid skipping it by mistake.

    a.  Key in "Y" to start data collection.

    b.  System begins processing film automatically, frame by frame.

    c.  As soon as you hear the first frame advance you must immediately depress the CONTROL and A keys simultaneously.  This will interrupt the system and allow operator input.

    d.  "SELECT OP CODE" appears on the operator's console.

    e.  Key in MT (MT = Manual Target is to be specified).

    f.  "ENTER TARGET NUMBER FOR MANUAL-AUTO CHANGE" appears.

    g.  Key in 1 (sprocket hole is always target 1).

    h.  "SELECT OP CODE" appears.

    i.  Key in CR (CR = Continue Run).

    j.  "T1" appears.

    k. Set cross hairs at the top right corner of the lower left hand sprocket hole.

    l.  Depress foot switch to enter x,y value of cross hairs.

    m. The coordinates will appear next to the "T1".  After the frame advances another "T1" will appear on the next line.  Repeat step k-1 for 10 frames.

    n. As the last of approximately 10 frames advances press CONTROL and A keys at the keyboard.

    o.  "SELECT OP CODE" appears.

    p. Key in DT (DT = Delete Target).

    q. "TARGET #" appears.

    r. Key in "T1".

s. "SELECT OP CODE" appears.

t. Key in CR (CR = Continue Run).

u. The program locates all targets, reads the LED digitial timing and advances film 1 frame. The program will continue to process the rest of the 250 frames automatically. Manual intervention by the operator may be necessary to correct problems. Definition of specific actions are covered in section 16.

"TYPE IN LAST 5 DIGITS OF TIME" will appear on the screen.

v. Operator must key in the time of last frame being digitized (last five digits of LEDs), return. (At this point the computer will compare the time it read from the film with the time the operator is keying in to be sure both numbers are the same.

w. After processing of the film is complete, all information is written to the magnetic tape. "SELECT OP CODE" appears, allowing the operator to start a new film.

## 14. FINAL DOCUMENTATION OF FILM:

All runs digitized are logged in. The run number, number of cameras, data digitized and date tape is sent to Data Processing are recorded.

## 15. REMOVING THE MAG TAPE:

After data for the last film is written to tape, the following steps should be taken:

a. Depress RESET switch on the disk drive. ON-LINE light will turn off.

b. Depress REWIND switch. Tape will rewind until LOAD light comes on. Depress REWIND switch again.

c. Remove tape from tape drive.

d. Remove write ring.

e. Identify data on tape. On a label write each run and camera site on the tape. Date it and place the label on the tape reel.

f. Give tape to the individual in the Data Systems Department responsible for converting the digitized data.

g. Post the Photo Digitizing Tape Log with the date the mag tape was sent to the Data Processing Department, the run IDs, camera sites, the number of frames digitized and any other pertinent comments.

16. OPERATOR INTERVENTION DURING DIGITIZING:

    a.  Screen full.

If at any time during these procedures the letter "F" appears flashing at upper left side of Tektronix screen it is an indication that the CRT screen page is full and the HOME PAGE key must be depressed to clear the screen. The terminal will save all messages to be displayed in its own memory, so information will not be lost while the screen is full.

    b.  Reinsert LEDs. Key in RL.

    c.  Terminate diagnostic printout. (Used during NMP, DMP, & MMP):

In Diagnostic Mode A will terminate diagnostic printout and CR (Continue Run) puts program in Normal Mode.

    d.  Delete Target:

        SELECT OP CODE - Key in DT

        TGT#? - Key in the letter T and target number.

        TN - FAN N is number of target deleted.

        SELECT OP CODE - Key in CR or another operation.

    e.  Insert Target:

        SELECT OP CODE - Key in IT

        TGT#? - Key in letter T and target number.

        TN - FAN N is number of target inserted.

        SELECT OP CODE - Key in CR or another operation.

    f.  Delete LEDS:

        SELECT OP CODE - Key in DL

        SELECT OP CODE - Key in CR or another operation.

    g.  Insert LEDS:

        SELECT OP CODE - Key in IL

        SELECT OP CODE - Key in CR or another operation.

h. Continue Run:

SELECT OP CODE - Key in CR (Return run to normal or manual mode.)

i. Terminate Run:

SELECT OP CODE - Key in TR Terminate run with normal end of run

MAG TAPE RECORDS - NNN

SELECT OP CODE.

j. Abort Run:

SELECT OP CODE - Key in AR (Returns program to selection table and rewinds MAG TAPE to beginning of aborted run.)

k. Change Auto to Manual or Vice Versa:

SELECT OP CODE - Key in CS (Change system mode from normal to manual or vice versa.)

SELECT OP CODE - Key in CR continue run.

l. Change Auto - Manual Status on a Target:

SELECT OP CODE - Key in MT

ENTER TARGET NO. FOR MANUAL - AUTO CHANGE

Key in number of target for which status is being changed.

SELECT OP CODE - Key in MT - (for additional auto-manual status change), or CR - (continue run)

m. UTL - Reset cross hairs on target and depress foot pedal.

n. Manual Mode:

SELECT OP CODE -Key in MM (the input data related to the manual mode are the same under the normal mode)

For each frame in the manual mode the CRT output format is:

FRAME - frame number.

T1-FAN manual input for target 1. Repeat for each target.

o.  Verify Tape:

SELECT OP CODE -Key in VT.  Tape rewinds and reads records until a bad record is read or until 2 EOFs are read.

As EOFs are found they display on the CRT.  The option ends with:

CK (if no errors were found), or

***FAULT (if an error occurred).  The operator is prompted with SELECT OP CODE.

## PROBLEMS

If an operator should experience machine malfunctions or has any problems while attempting to digitize film he/she should contact the supervisor or maintenance personnel.

If problems arise and the operator wishes to terminate the run he/she should press CTRL key and A key on operator console.  Then power down the system.

a.  Turn off the main power switch.
b.  Turn off power on switch on NOVA 800.
c.  Turn off PDS control unit.
d.  Turn off power switches on mag tape units A and B.
e.  Turn off film analyzer.
f.  Turn off Wavetek®.

## CONCLUSION

The photo digitizing operation is a vital, labor-intensive step in the successful use of photo data.  This report describes the equipment used and the procedures followed.  It is intended that this document provides both a description of the processing of photo data, and reference material for the operator of the photo digitizing system.

# ABBREVIATIONS

NBDL = Naval Biodynamics Laboratory
PDS  = Photo Digitizing System
NAC  = (NAC, Incorporated; name of Japanese firm)
CRT  = Cathode Ray Tubes
CCTV   Closed Circuit Television
CPI  = Characters Per Inch (tape density)
MT   = (Mag Tape (unit)
ROM  = Read Only Memory
OP   = Operator
CA   = Calibrate
TGT  = Target
NM   = Normal Mode
LED  = Light Emitting Diode
CR   = Continue Run
MT   = Manual Target
MM   = Manual Mode
AR   = Abort Run
FID  = Fiducial
T1   = Target 1
DT   = Delete Target
IT   = Insert Target
DL   = Delete LED's
IL   = Insert LED's
TR   = Terminate Run
CS   = Change System
UTL  = Unable To Locate
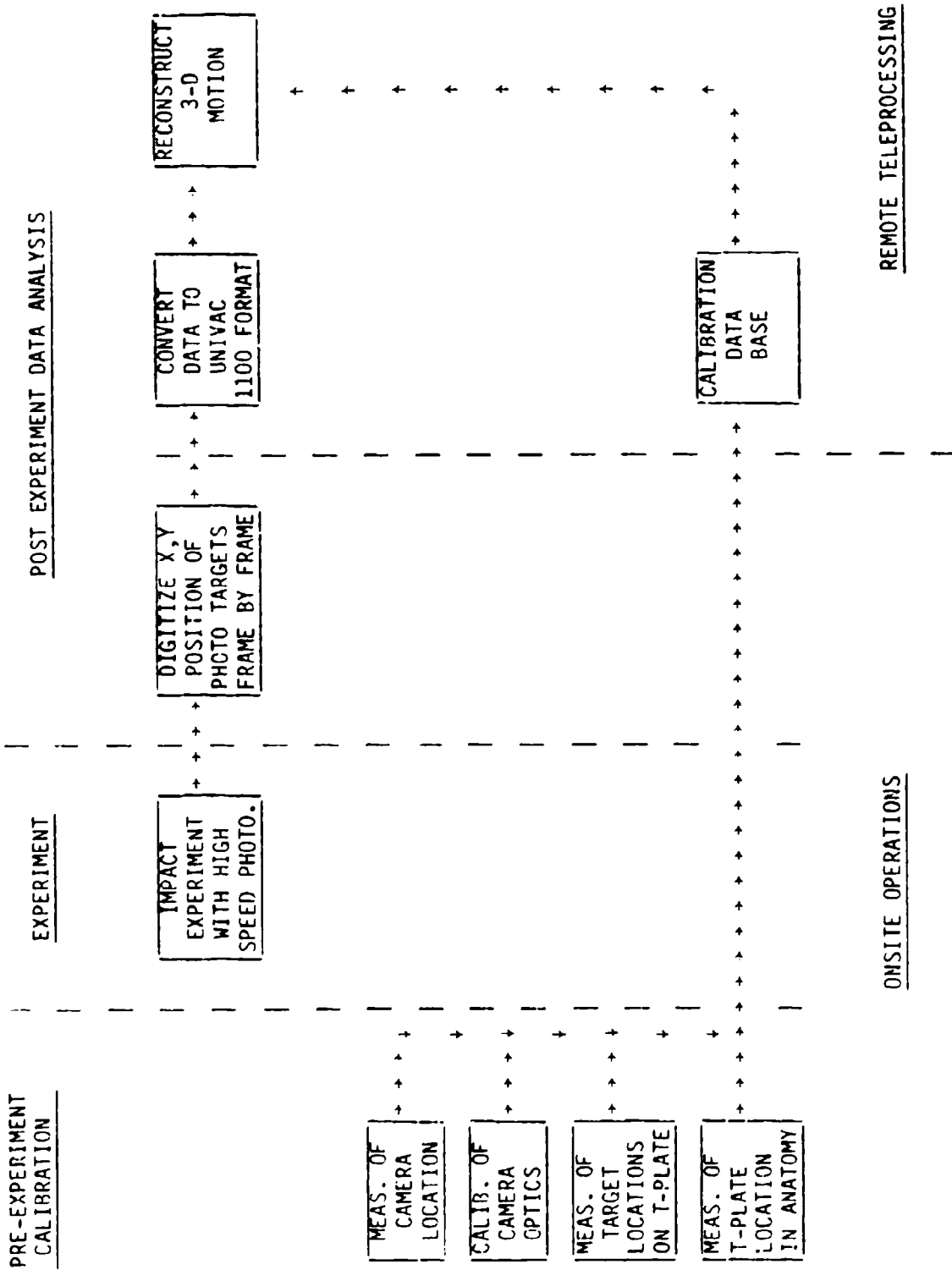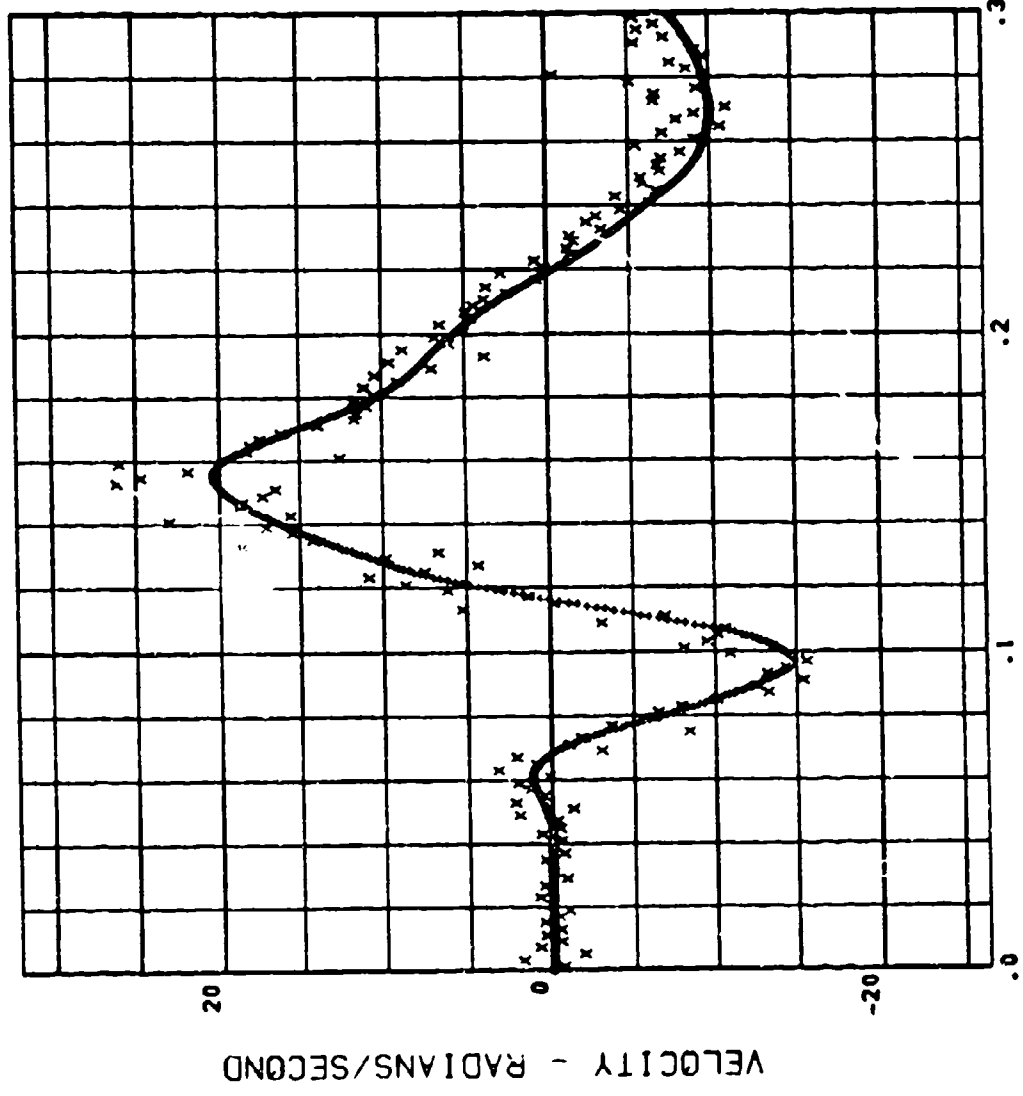VT   = Verify Tape

FIGURE 1. PROCEDURE FOR PROCESSING PHOTO DATA

FIGURE 2. 14 TARGETS FOR ... IN CONFIGURATION PACKAGE

LX4648  H00145    .0969    112.8    10224.

(+) = RHBOXS  ·B    (X) = RHBOXP

22 DEC 83

TIME - SECONDS

VELOCITY - RADIANS/SECOND

FIGURE 3.  COMPARISON PLOT OF ANGULAR VELOCITY ABOUT THE Y AXIS
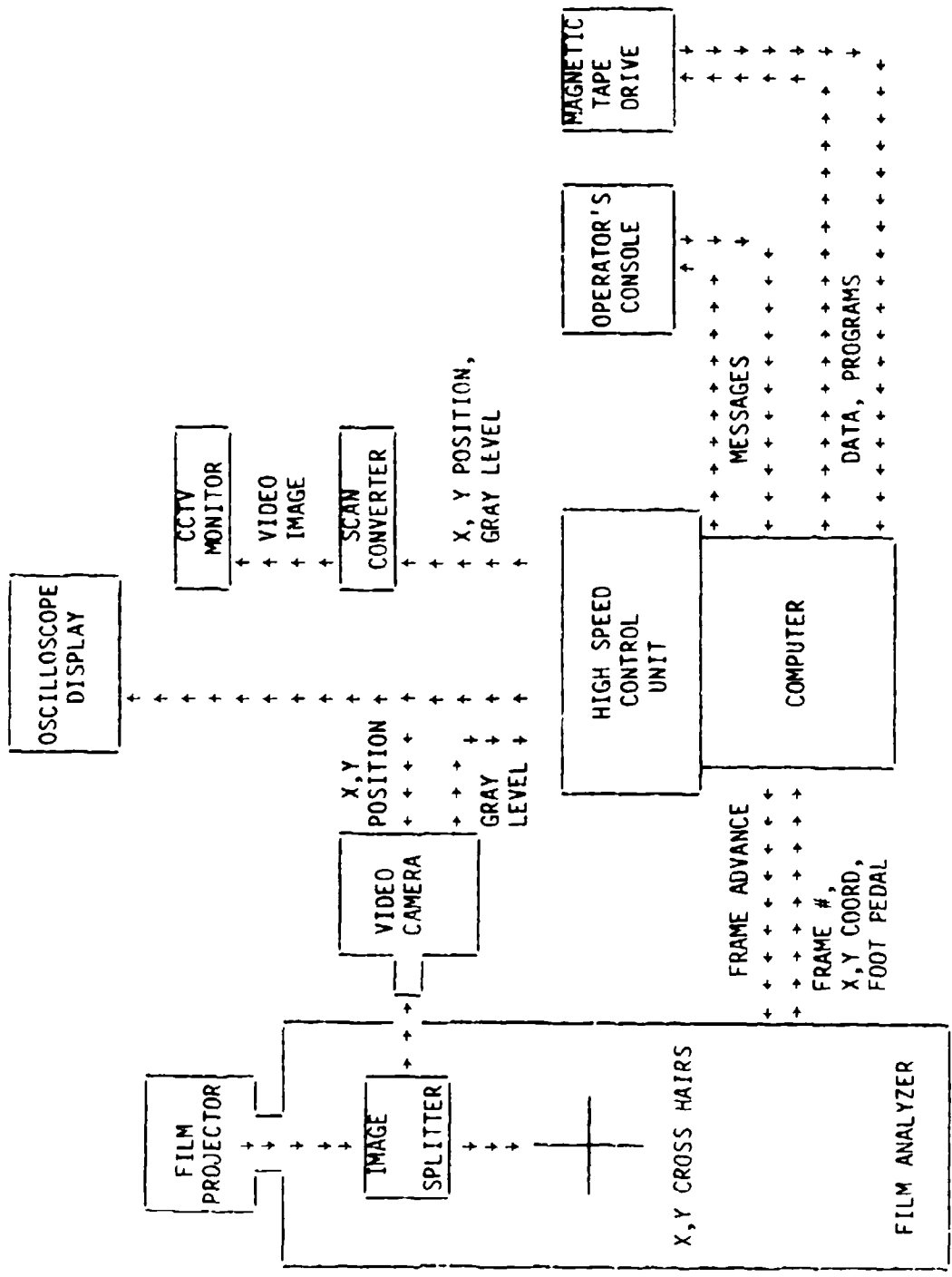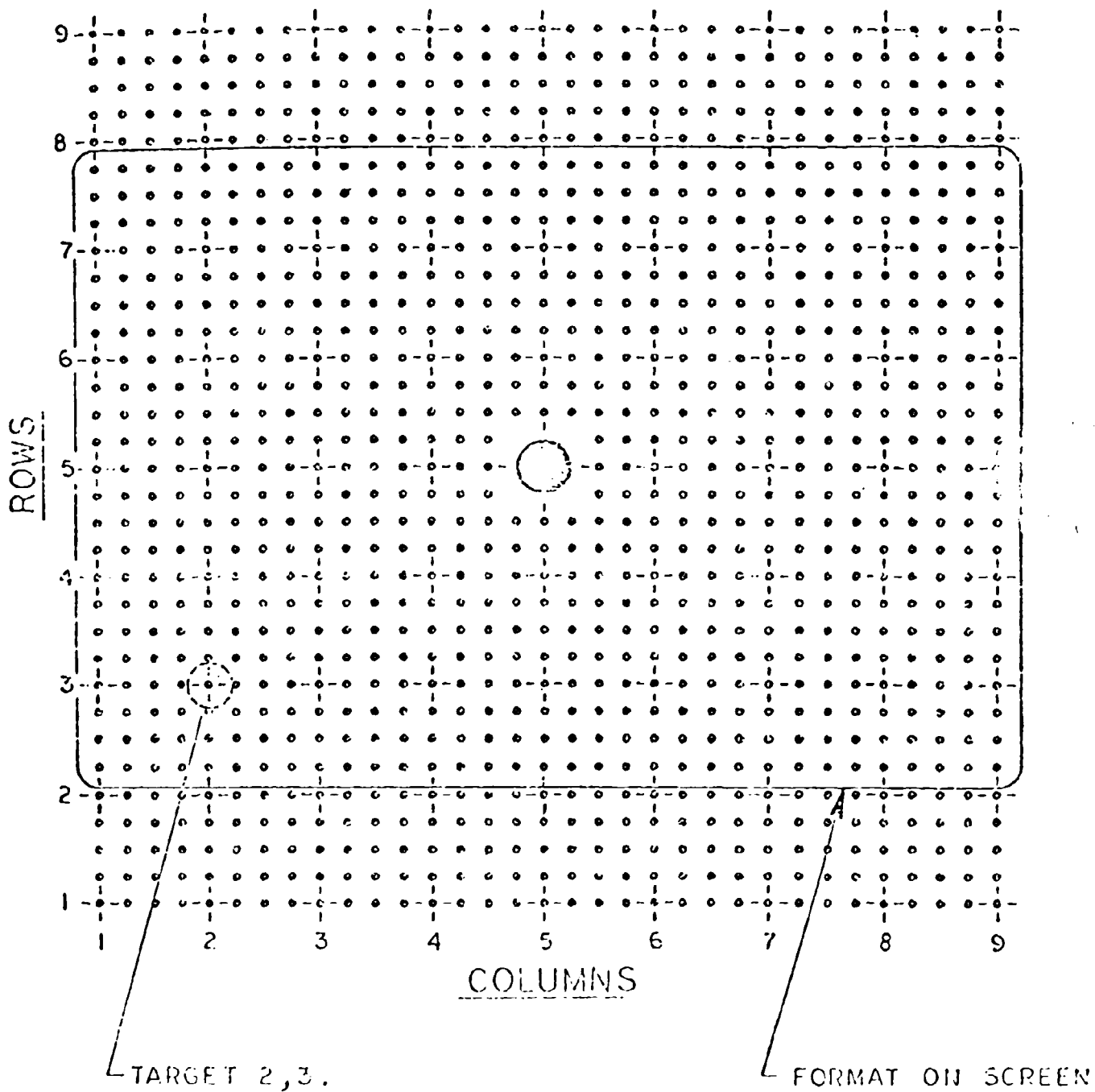OF THE HEAD

FIGURE 4. INFORMATION FLOW IN POS

FIGURE 5.    TARGETS IN CALIBRATION SLIDE