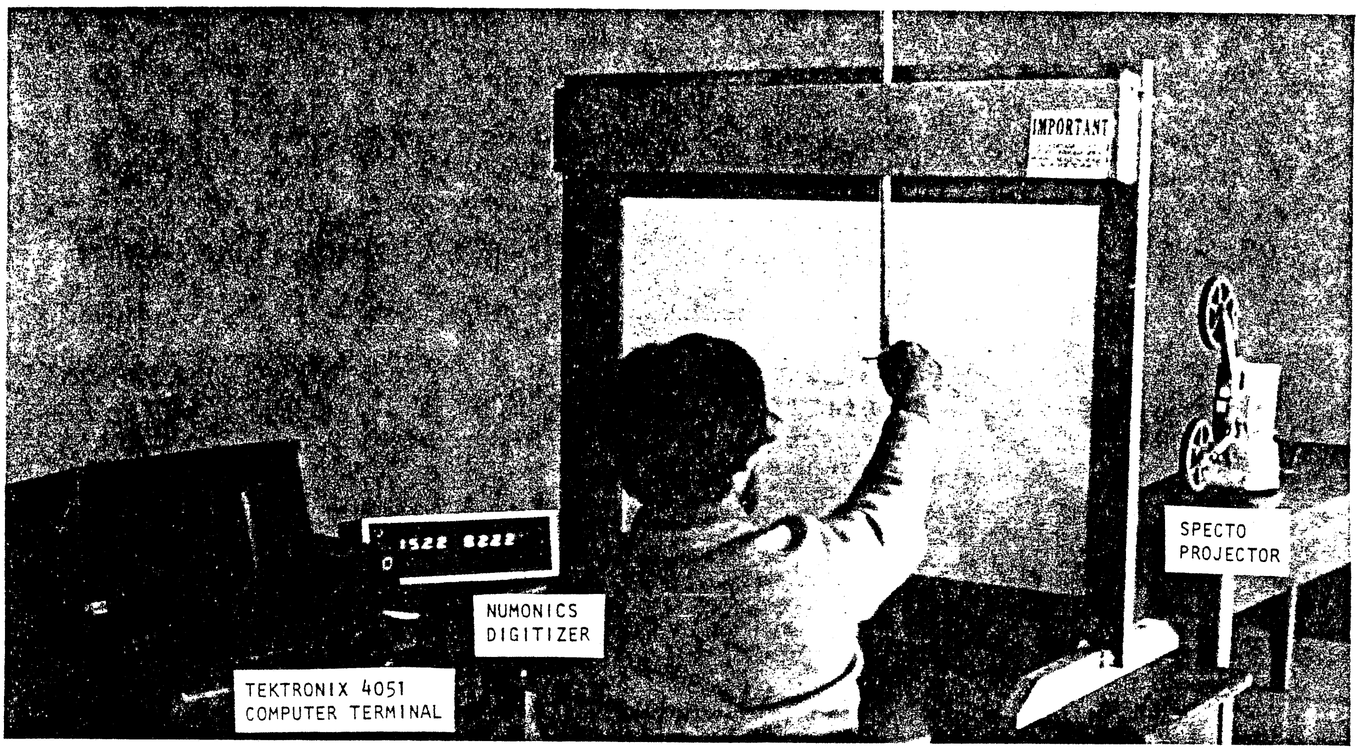
Teknigues

The 4051 Applications Library Newsletter February 1, 1979 Vol. 3 No. 1



A researcher at the University of Western Australia digitizes body positions of player during volleyball recovery technique. Analyzing the digitized film with the 4051 allows the researchers to compare speed, accuracy, and injury in diving versus rolling.
(Courtesy of University of Western Australia)

Using the 4051 in High Speed Film Analysis

by G. Keith McElroy
University of Western Australia

Computer Graphics. Often when that term arises, we think of a graphic representation of data from computer memory—graphics from the inside out. This is a valid means of making the data easier to see. But how about applying the analytical powers of the 4051 Graphic System to real world phenomena, extracting the data from the movement of objects as they really do move? At the University of Western Australia, the Department of Physical Education has undertaken such an application of computer graphics; their system includes the 4051 Graphic System to perform the analysis. The pilot study for their high-speed film and computer analysis project investigated two emergency recovery techniques in volleyball: diving versus rolling.

In this application, researchers film subjects, then digitize and analyze the film, a method of graphics from the outside in. The aim of their pilot study has been to investigate the technique of high-speed film analysis, to provide an introduction to the system equipment and to analysis techniques, and to obtain direction for future research.

High-speed film analysis can be used as a systematic study to provide information about the details of movement that occur too quickly for the human eye to see. In volleyball, like many sports, coaches must offer advice to players based on the coaches' own intuitive judgment and past experience. The film analysis system opens the way for precise measurements that can support the coaches' judgment. It may also provide new information that can alter coaching decisions. High-speed film analysis can provide a scientific basis for coaching decisions about

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alternate playing techniques, beyond simple recording and displaying an action.

The university volleyball coaching texts deal briefly with the diving technique for recovering the ball in an emergency playing situation. The texts, however, present little evidence for the superiority of any one technique over another (diving versus rolling, for instance) or the variations of techniques. Variables to consider include speed, accuracy, and injury prevention. Possible variations in techniques may occur as well: players may use one hand or two, for instance. Analyzing high-speed film with the 4051 enables all of these variables to be studied in a systematic manner.

Study Procedures and Techniques

The first step in the study was to select three highly-skilled subjects. Each subject represented a different height category—short, medium, and tall. The subjects performed emergency recoveries using both the dive technique and the roll technique, from distances of 3.0, 3.5, and 4.0 metres. The volleyball was suspended 30 cm above the polished wood gymnasium floor. This stationary ball position was chosen because there was not enough time available to devise an apparatus that could consistently deliver the ball with appropriate velocity and placement.

The player subjects were marked on selected body joint positions, and were permitted to warm up in their own manner. The players were told that they were to respond as in an emergency situation. Therefore, the greatest possible speed was required, both to the ball and back onto the feet. They were instructed to "dig" the ball vertically, with the intention of recovering ball height for further play. As the subjects performed their emergency recoveries, the high-speed cameras filmed the action for analysis.

Figure 1 shows the location of the filming equipment. Two Photosonics 16mm high-speed cameras were used to film the action; one was located directly in front of the action, the other filmed perpendicular to the direction of motion. The front camera filmed at a rate of 100 frames per second, while the side camera filmed at the 200 frames per second rate. A standard scale was positioned for reference at the point of ball contact, and was filmed by each camera. A sweep-hand timing clock in the camera field of view allowed the camera frame rate accuracy to be verified.

The processed film was then run through the film analysis system, which consists of a Spectro Mark III Motion Analysis Projector, a film table, and a Numonics 224 Digitizer interfaced directly to the 4051 Graphic System. Programming efforts were guided by Robert McIntosh, a university technical officer. The 4051 uses the input data to analyze the various techniques. The cover photo shows the analysis system equipment.

The following procedure obtained usable data from the film:

1. The scale factor was calculated by comparing the apparent length of the hurdle with the known two-metre reference scale.

2. The time interval between frames was calculated, using the known frame rate of the cameras corrected to the filmed time clock.

3. The location of selected body parts, and the volleyball, were input to the 4051 by means of the digitizer. This allowed basic kinematic analysis to be performed; further software development will allow calculation of more detailed kinetic factors.

4. Selected hand tracings were made of the critical positions and sequences, from the 4051 display. (A

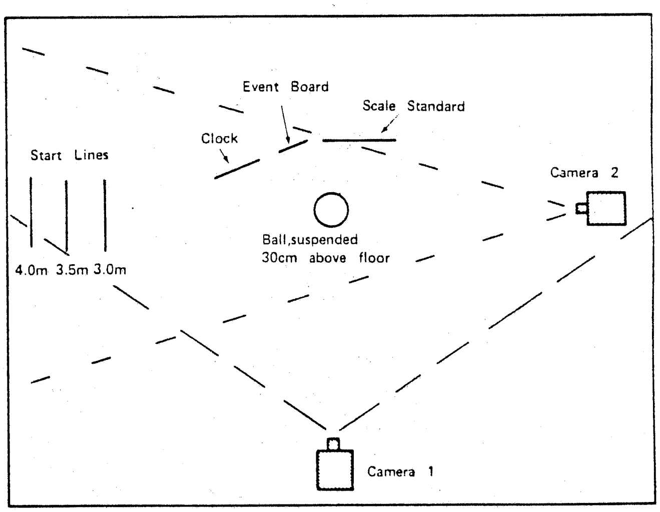

Fig. 1. Location of Equipment

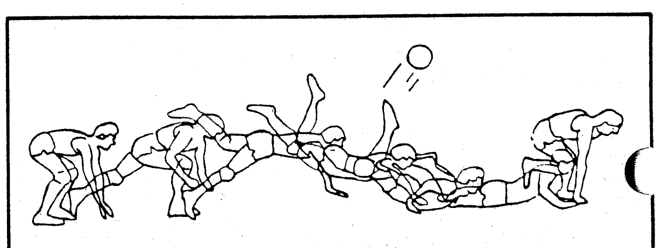

Fig. 2. Dive Sequence: From 3.0 Metres J.H.1

TEKniques, the 4051 Applications Library Newsletter, is published by the Information Display Group of Tektronix, Inc., Group 451, P.O. Box 500, Beaverton, Oregon 97077. It is distributed to TEKTRONIX 4051 users and members of the 4051 Applications Library.

Publishing Manager	Ken Cramer
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Circulation	Rory Gugliotta

hard copy unit or a plotter will be added to the system in the future, to provide the drawings.)

The results of the above analysis are described in the remainder of this article.

Study Results

Figure 2 shows the graphic representation of the typical diving recovery technique. One surprising result occurred in the test: only one trial out of nine dives resulted in the subject becoming truly airborne before ball contact: this was subject T.N. over the longest distance. Figure 3 illustrates a typical rolling technique for recovery. Tables 1 and 2 are summaries of the primary measurements taken.

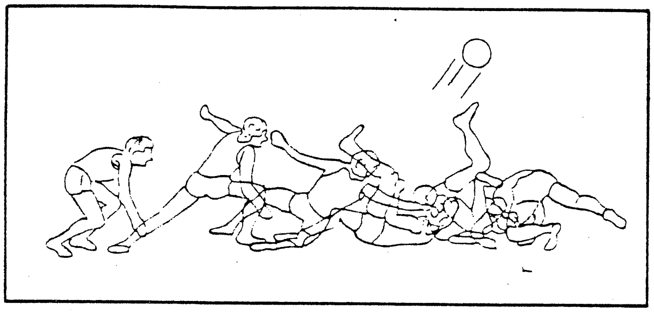


Fig. 3. Roll Sequence: From 3.0 Metres G.M.1

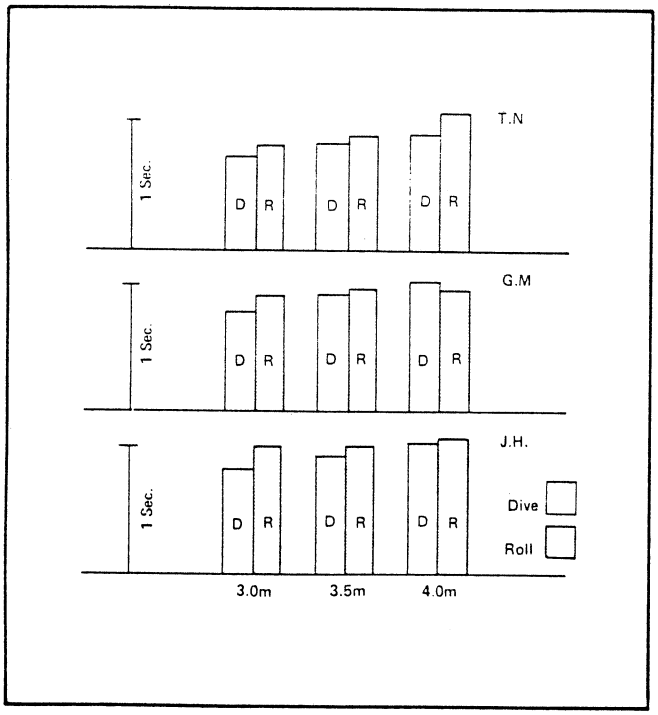


Fig. 4. Comparison of Time to Ball Contact Dive Vs. Roll

In emergency situations requiring the use of these ball recovery techniques, the time taken to contact the ball is the first priority. The dive was clearly faster than the roll, with increasing distances requiring longer times. This information has been extracted from the tables and displayed graphically in Figure 4.

	Subject T N			Subject G M			Subject J H		
DISTANCE (metres)	3	3 5	4	3	3 5	4	3	3 5	4
Time to ball contact (secs)	75	85	91	80	97	1 03	86	96	1 06
Time contact to recovery	1 34	1 41	1 44	N/A	1 25	1 23	93	97	1 16
Time between feet re-position	26	35	45	N/A	00	00	04	05	15
Time step 1	27	09	18	19	25	47	25	20	13
step 2		33	33	30	31	30		30	32
Distance (metres) step 1	1 39	21	74	46	79	1 34	1 36	77	89
step 2		1 79	1 92	1 59	2 07	2 59		2 01	2 58
Distance remaining to contact	1 61	1 71	2 08	1 41	1 43	1 41	1 64	1 49	1 42
Time ball contact to hand on floor	22	19	15	N A	23	22	21	22	19
Time between hands contact	01	005	00	N/A	00	01	045	14	02
Trunk slide. duration	41	41	41	N/A	50	45	35	37	39
Trunk slide distance	1 14	1 21	1 38	N A	1 79	1 59	1 11	1 33	1 34
Airborne at contact?	N	N	Y	N	N	N	N	N	SIMULT
Time	− 09	− 06	+ 02	N/A	− 05	− 02	− 02	− 08	0 00
Ball velocity (metres/sec)	14 2	15 4	13 1	N/A	15 1	14 7	18 2	15 3	17 7
Ball direction. side (degrees)	−66	−57	−47	N/A	−59	−51	−61	+66	−78
Ball direction front (degrees)	+75	+77	+68	−86	−75	−77	−73	−78	−64
Error of direction. absolute (degrees)	27	34	45	N A	33	40	32	26	28

N.A = film damaged during analysis

Table 1. Dive Statistics.

	Subject T N			Subject G M			Subject J H		
DISTANCE (metres)	3	3 5	4	3	3 5	4	3	3 5	4
Time to ball contact (secs)	84	91	1 11	89	99	1 00	1 02	1 05	1 11
Time contact to recovery	82	80	N A	N A	85	82	1 00	87	70
Time stutter	05			02	01		05	05	03
step 1	38	24	35	20	20	24	20	29	36
step 2		38	43	39	39	28	44	44	41
step 3						35			
Distance (metres) stutter	− 09			42	− 15		− 24	− 15	− 15
step 1	1 89	1 08	1 44	37	71	68	73	97	1 44
step 2		2 47	2 87	1 30	1 65	1 32	2 52	2 70	2 88
step 3						1 94			
Distance remaining to contact	1 11	1 03	1 13	1 70	1 85	2 06	48	80	1 12
Trunk roll duration	59	56	N/A	N A	51	48	47	41	46
Recovery position (est o clock)	9	8	N A	N A	8	8	7	8	8
Airborne at contact?	N	N	N	N	N	N	N	N	N
Ball velocity (metres sec)	11 8	16 6	10 6	14 3	12 2	15 0	14 4	13 7	12 7
Ball direction side (degrees)	−78	−55	−78	−68	−69	−66	−78	−82	−46
Ball direction front (degrees)	−75	−82	−74	−88	−88	90	−87	−87	−81
Error of direction absolute (degrees)	19	35	19	22	21	24	12	8	44

Table 2. Roll Statistics

However, the second playing priority is recovery to a playing position with both soles on the floor. This was accomplished faster with the use of the roll technique than with the dive (Figure 5), so the roll technique could be an advantage for the player to take part in further play. It may even be possible to develop a combination technique, using the best features of the dive and the roll techniques.

The typical body alignment from the side view is displayed in Figure 6. Note that the body had not yet become airborne, and that the non-contact hand was at the same height as the contact hand. Subject T.N., over the longest distance, displayed the only occurrence of airborne ball contact, as shown in Figure 7; again the contact and non-contact hands were at a similar height. The tables show that the subjects had approximately 0.2 seconds to place hands on the floor after ball contact; time between each hand's contact was very small. This makes it apparent that there was time for both hands to take part in ball contact, which may be desirable: two-handed contact may give more control. It was noted that the non-contact hand was generally held a little wider for balance, and perhaps for safety assurance for the two subjects who made palm-up ball contact and hence needed to rotate the hand before landing. (Single-handed ball contact may allow for last-minute position or direction adjustment.)

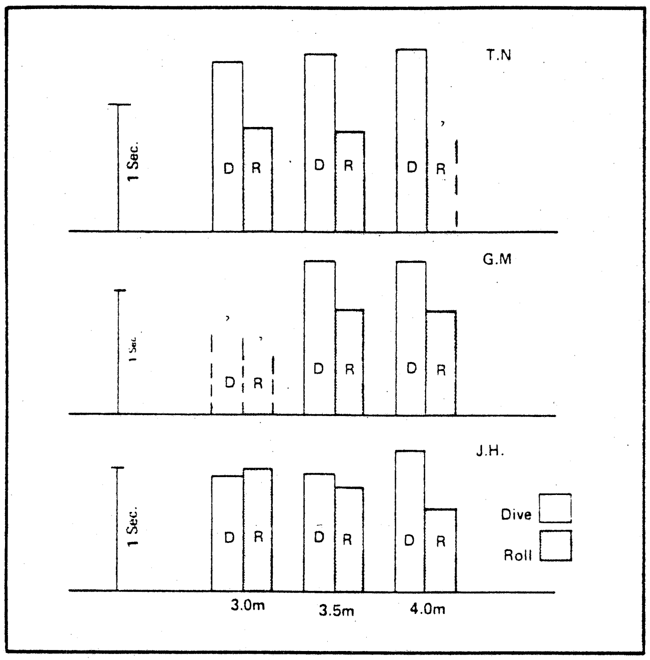


Fig. 5. Comparison of Time from Ball Contact to Recovery: Dive Vs. Roll

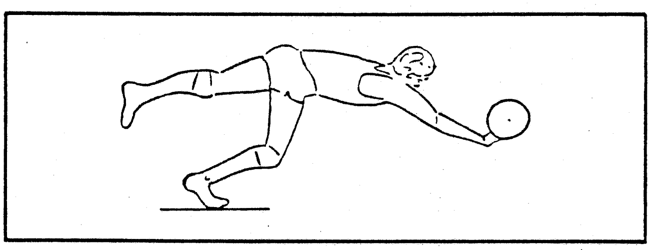


Fig. 6. Body Position at Ball Contact: Dive T.N.1

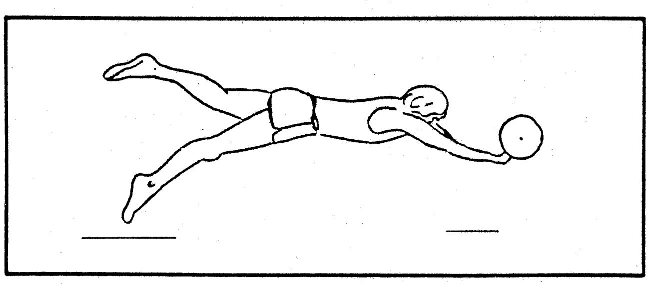


Fig. 7. Body Position at Ball Contact: Dive T.N.3

Film analysis also showed that subjects made ball contact with the palm up during the rolls. Errors with the roll were generally less than with the dive. Errors viewed from the front varied to either side of the subject; errors viewed from the side were forward of the vertical in all except one subject's trial. Figure 8 represents the absolute errors from the vertical, calculated in 3-dimensional space.

The fact that two subjects used palm up orientation during ball contact in the dive runs counter to the general volleyball texts in use at the University. In their cases errors (viewed from the front) were to the subject left. The remaining subject, T.N., used a palm down hand orientation at ball contact; all his errors were to the subject right. As with the rolls, dive errors (viewed from the side) were forward of the vertical, with one solitary exception.

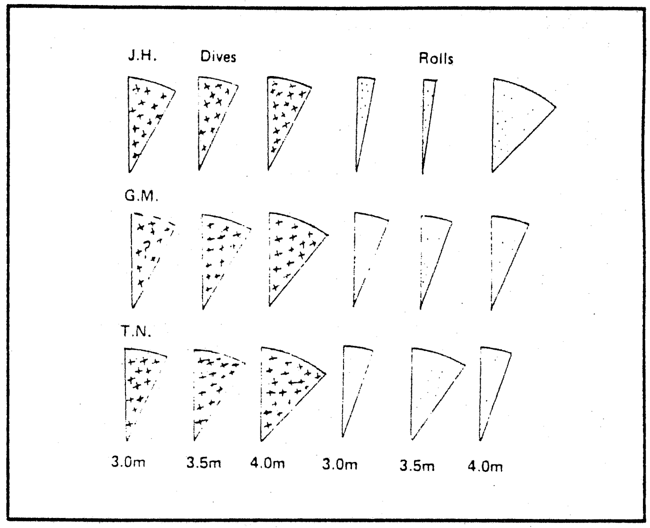


Fig. 8. Absolute Error of Ball Direction After Contact

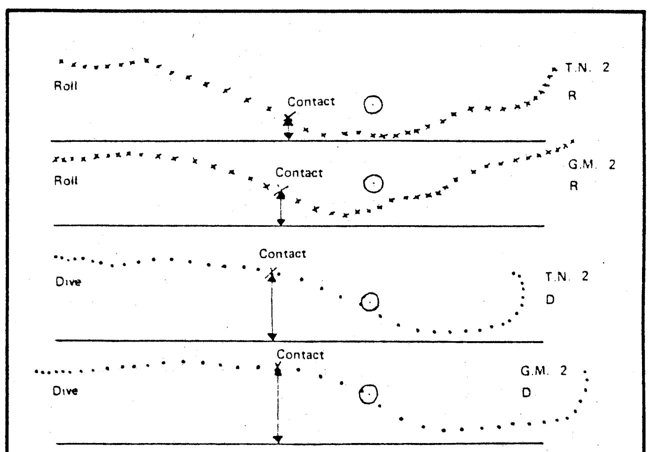


Fig. 9. Example Centre of Gravity: Roll Vs. Dive

In the filmed experiments, subjects moved directly forward toward the ball from a position facing the net. The palm up orientation may leave more scope for hooking a ball back into play, if it requires a side deflection. Use of the palm down may give reassurance of landing safely. Some subjects had a knee in contact with the floor at ball contact, which also seemed to add further stability from which to hit the ball.

Figure 9 displays examples of the centre of gravity (c. of g.) pathways calculated for the roll and the dive technique. Analysis of each technique showed marked similarity between subjects, but there were consistent differences between techniques. During the dive the c. of g. remained quite high until near the point of ball contact, and then dropped moderately quickly. This indicated the need for more shock absorption, compared with the roll, where the c. of g. started a gradual downward path much earlier. The considerably lower elevation of the c. of g. at the moment of ball contact during the roll is also indicated in Figure 9. Another indication of the greater shock absorption required in the dive was also shown by the film analysis. The time of trunk contact during each slide was less than for the corresponding roll, thus indicating more rapid absorption of shock required during the slide.

Thus the risk of injury was greater during the dive, particularly since the dive required the lumbar curvature of the spine to increase, rather than the safer decrease of lumbar curvature required during the roll. The use of arm strength before trunk contact during the dive was necessary to prevent injury. A very important aspect of injury prevention and technique involved the continued motion of thighs, legs and feet forward, toward the back of the head. This allowed more gradual dissipation of momentum, to prevent injury. Faster recovery onto the feet was permitted by allowing the trunk to stop quickly while the total c. of g. continued to move forward due to the movement of thighs and legs.

A graphic comparison of c. of g. velocities confirms the above. The horizontal, or X, component of the c. of g. velocities showed consistency from subject to subject for a given technique, but differed between the rolls and dives. The X velocities were of a similar order of magnitude, but the "drop off" was slightly faster for the dive, mainly due to the shorter trunk contact time during the slide.

Likewise the vertical or Y component of the c. of g. velocities showed consistency from subject to subject for a technique, but differed between the rolls and dives. The negative Y values show that downward velocities for the dive exceeded those for the roll. This indicates a slightly more violent meeting with the floor. Determining these velocity values can be highly beneficial for reduction of playing injuries.

Summary

Based on this pilot study, the researchers at University of Western Australia were able to draw several conclusions:

1. The dive technique is faster to the point of ball contact.
2. The roll technique allows a faster recovery after ball contact.
3. The roll technique is more accurate.
4. The dive technique allows time for both arms to take part in ball contact if this is considered desirable.
5. A combination of diving contact with rolling recovery may be possible, and offers some theoretical advantage. This is as yet untested.
6. Computer-aided film analysis is a useful investigative technique, and further co-operation between coach and researcher appears desirable, in volleyball and other sports. In fact, the same techniques are being investigated for applications in Australian football, golf, cricket, swimming and gymnastics.

Researchers are in the process of adding further refinements to the system. Additional data is being integrated into the computations, coming from accelerometers, force platforms, and electromyographic (muscle eletrical activity) recordings taken as the subject is filmed. So exploration into this 4051 application is continuing, adding another growing realm to the 4051 Graphic System experience.

Article and photograph made available through assistance of Herman D'Hondt, Tektronix Sales Engineer, North Ryde, N.S.W., Australia.

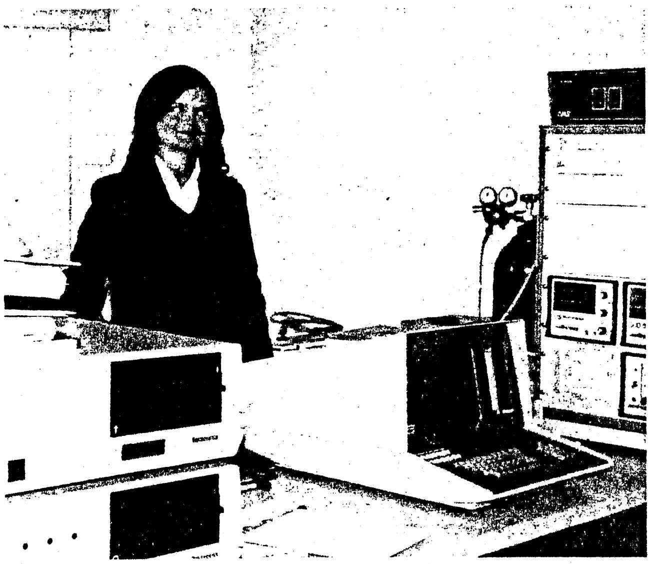
4051 Speeds Up Pulmonary Testing

The muffled sound of jackhammers and saws periodically intrudes into the modern laboratory as construction continues on the new United Hospitals, Inc., in St. Paul, MN. An automated pulmonary testing system, as up to date as the building itself, stands in a newly completed wing.

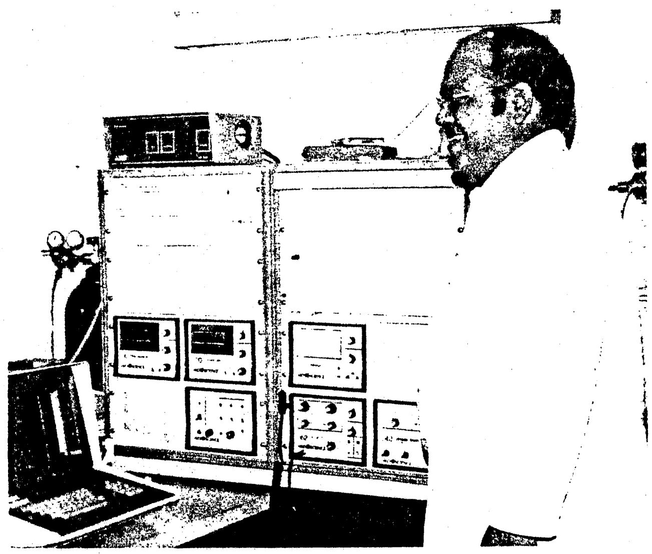
Lab technician Jim Day is completing a pulmonary functions test; it has taken approximately one minute. Depending on the type of test, the time saved over older methods varies from 45 minutes to two hours. At the heart of the system is a TEKTRONIX 4051 Graphic System busily calculating, interpreting and plotting the data.

Pulmonary Functions

One of the body's exchange points is in the lungs, where the blood drops off carbon dioxide and picks up oxygen. Volume and flow are two indicators of how well the lungs are functioning. Carbon Monoxide Diffusion Capacity measures the ability of the lungs to transfer gases (oxygen) from the lungs into the blood. These tests along with others can warn of disease such as emphysema, asthma, bronchitis or chronic obstructive lung disease as well as giving the doctor an indication of drug side effects.



Kye Anderson describes the configuration of the System 1000 which performs all pulmonary functions testing at United Hospitals, Inc. in St. Paul, Minn.



Pulmonary Lab Director Jim Day interprets the flow-volume loop graphed on the 4051.

The Test

During the test the patient breathes into a spirometer. First the patient takes a couple of normal breaths then inhales deeply and blows out as far and hard as possible. An AMS Model 704 interface converts the analog data of the spirometer into digital format, and sends it on the IEEE 488 General Purpose Interface Bus (GPIB) to the 4051. The program running on the 4051 looks for the peak and minimum values of the exhaled air. These values multiplied by a calibration factor calculate the vital capacity of the lungs (Figure 1).

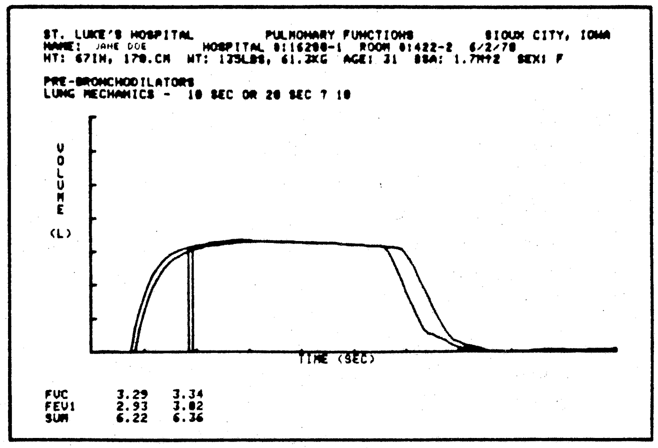


Fig. 1. Volume is one indicator of how well the lungs are functioning.

A second test produces a flow-volume loop. The patient takes a deep breath and blows into the spirometer as fast and hard as possible until he or she can't blow any more. Then the patient rapidly inhales the air. The flow data is plotted along the Y-axis and the volume on the X-axis. As volume and flow increase then decrease it results in a loop. The flow rate at 25, 50, and 75% of the volume is picked off for comparison with normal flow rates. The 4051 plots the curve of this data against a normal curve, which readily shows if something is amiss (Figure 2).

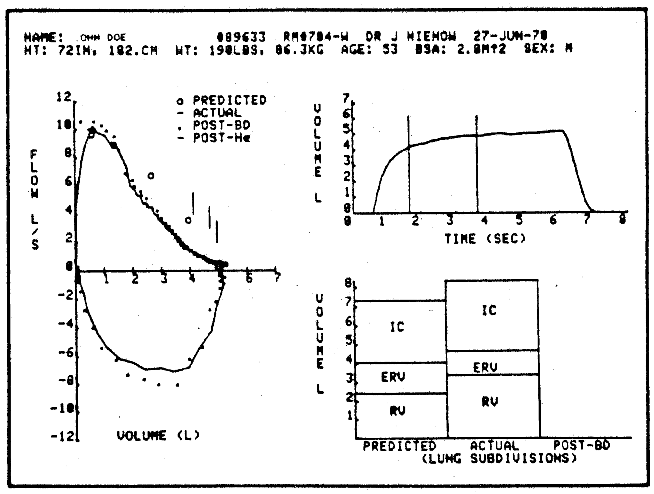


Fig. 2. The flow-volume loop is one method of detecting abnormalities of the lung.

Applying the Results

Kye Anderson of Medical Graphics Corporation, who configured the system, explains why the tests are helpful and what they might indicate.

The early detection of abnormal lung functions aid the diagnosis and speeds up initial treatment of the disease. Abnormalities of the lung mechanics could indicate such diseases as emphysema, chronic bronchitis or bronchial asthma.

Kye said certain medications such as those used in the treatment of cancer can decrease the capacity of the lung to diffuse gas into the blood, therefore the periodic testing of such lung tests is a necessity in the treatment of such diseases.

The Occupational Safety and Health Act resulted in stringent rules for working environments. Therefore some lung tests are mandatory for employees working with asbestos or other harmful lung pollutants.

However, prior to the Medical Graphics Pulmonary System that includes the 4051, the AMS 704, and a TEKTRONIX 4631 Hard Copy Unit, the time required to reduce, interpret and graph the data made it difficult to do routine screening of a large population. Now this system is a useful tool in everyday life at hospitals, clinics, and industrial screening processes.

Other Uses

Other pulmonary function tests include Functional Residual Capacity. When all the respiratory muscles are relaxed and there is no air moving in or out of the lungs (as is the situation at the end of a normal expiration), there is still a volume of air in the lungs. This volume of gas in the lungs is called Functional Residual Capacity. When this parameter is measured the total lung capacity can be calculated allowing the physician to differentiate between Restricitive diseases (as pulmonary fibrosis) or Obstructive diseases (as asthma or emphysema).

A Blood Gas Analysis and Interpretation test plots gas exchange before, during and after exercise or different concentrations of oxygen.

A pulmonary exercise program measures certain parameters of lung function during exercise and provides information regarding the patients capacity or incapacity to exercise.

At United Hospitals, Inc., the Medical Graphics Corporation system is interfaced to a Med-Science Spirometer and gas analyzers. When the 4051 is not involved in testing, its stand-alone features allow it to maintain patient records, bookkeeping functions, departmental statistics and other business details.

Interview arranged by Dick Pula, Tektronix Sales Engineer, St. Paul, Minn.

Editor's Note: Medical Graphics Corporation, 14253 St. Croix Trail North, Stillwater, Minnesota 55082, can provide more details of the AMS Model 704 interface and the software.

Modified RS-232 Interface Expands BASIC I/O Mode to Half Duplex

by Pat Kelley

The 4050 Option 1 MOD AA RS-232 Data Communications Interface expands BASIC I/O mode to half duplex allowing its use on high speed modems.

The BASIC I/O keywords PRINT, LIST, SAVE, TLIST, INPUT, OLD and APPEND drive the RS-232 data link by specifying primary address 40. This enables RS-232 input/output under program control or through the keyboard. However, on the standard 4051 Option 1 this mode can only be used on full duplex communications and most full duplex modems have a limited baud rate, usually 300. To allow BASIC I/O to be used on higher speed modems which are characteristically half duplex, the modified interface expands BASIC I/O to half duplex.

The other features of the 4051 Option 1, which equips your 4051 to communicate with host computers, terminals, and other RS-232 equipment as a terminal, by tape or through BASIC I/O, remain essentially the same.

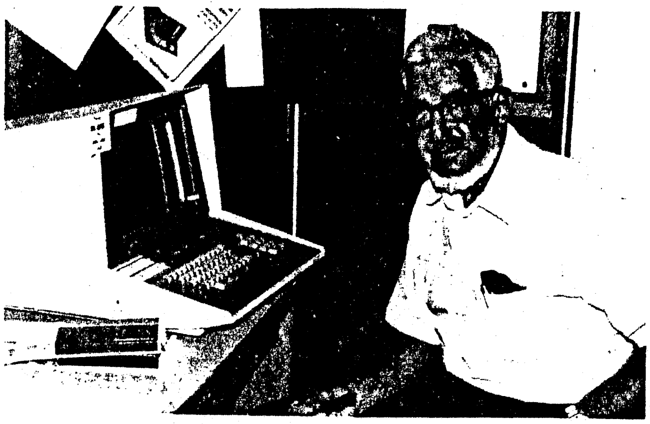
4051 Option 1 MOD AA is available as a complete communications backpack interface or may be purchased as a kit to modify an existing standard 4051 Option 1. Your local Tektronix Sales Engineer can tell you more about 4051 Option 1 MOD AA CM021-0256-00 (complete backpack) or 4051 Option 1 MOD AA CM021-0415-00 (kit).

Engineer Designs Spacecraft

By Patricia Kelley

"Designing the spacecraft to go where you want it to go and to face the way you want it to face" is how Erwin Vogel describes his job at Fairchild Industries' Space and Electronics Division, located a few miles outside of Washington, DC. These simple terms belie the complicated nature of his work. Vogel, a longtime engineer with Fairchild, is involved in systems analysis, theoretical analysis, and attitude control of spacecraft. Aiding in such precise engineering is the TEKTRONIX 4051 Graphic System.

Vogel explains that every inch of a spacecraft is subject to



Erwin Vogel, engineer at Fairchild Industries, explains one aspect of spacecraft design, using the 4051.

varying magnitudes and directions of physical, electrical, magnetic and gravitational forces. To analyze the effects of the forces, the engineers create three-dimensional models representing all areas of the craft. Producing the models by hand is extremely time consuming, as well as being prone to error.

To overcome these problems, Vogel has designed a number of programs for the 4051, one of which is the "NASTRAN Deck Generator for Electronic Enclosure Analysis." The engineer works interactively with the 4051 to describe his model; from this information the program calculates, formats and writes the model specifications to tape. Then from tape, the data is transmitted through the Option 1 RS-232 interface to a host computer where bulk data and JCL cards are automatically keypunched. The cards are fed to the host computer and a complex structural analysis program (NASTRAN) analyzes what displacement, distortion, stress, and so on, occur upon the model due to the forces acting upon it.

Vogel's program is tutorial. Initially a schematic is drawn on the graphic screen; the program them prompts the user to enter 12 coordinates on his model (Figure 1), specifying

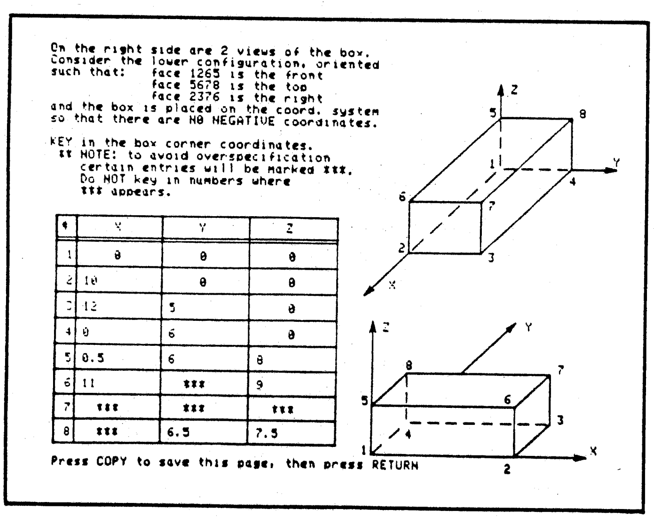


Fig. 1. Referencing his drawing, the engineer keys in the coordinates of his model.

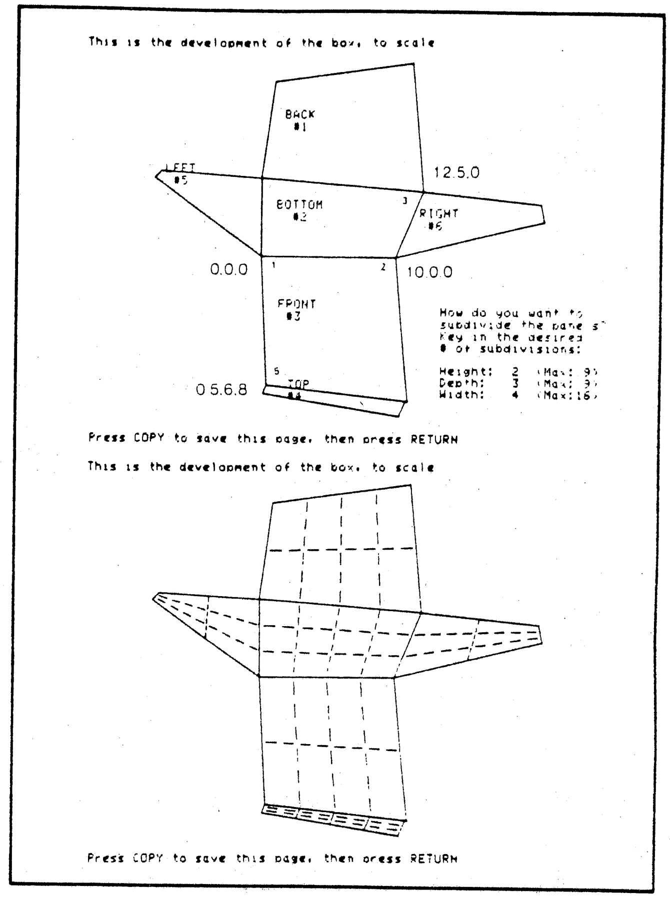


Fig. 2. A few of the node numbers and coordinates have been superimposed to show the relationship to Figure 1.

```
THIS IS NASTRAN DECK GENERATOR FOR BOX FREQUENCY ANALYSIS**

INPUT CHARGE NUMBER FOR NASTRAN RUN?  (9 DIGITS)   123456789
Keyin TITLE to appear on NASTRAN run
TITLE ABCDE

The standard material for all panels is aluminum, and the
standard thickness is 0.030 inch.  If these are satisfactory
key in 0
If you wish to change material or thickness, key in 1     1

 This is the materials list:
                  Aluminum       Number 1
                  Fiberglass     Number 2
                  Steel          Number 3
                  Magnesium      Number 4

 For each panel, key in desired material and thickness

                  Panel number 1:    1,0.025
                  Panel number 2:    2,0.05
                  Panel number 3:    2,0.04
                  Panel number 4:    3,0.1
                  Panel number 5:    1,0.02
                  Panel number 6:    1,0.025

Press COPY to save this page, then press RETURN
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Fig. 3. Charge number and title for the run are keyed in. The operator is then prompted for the material and its thickness.

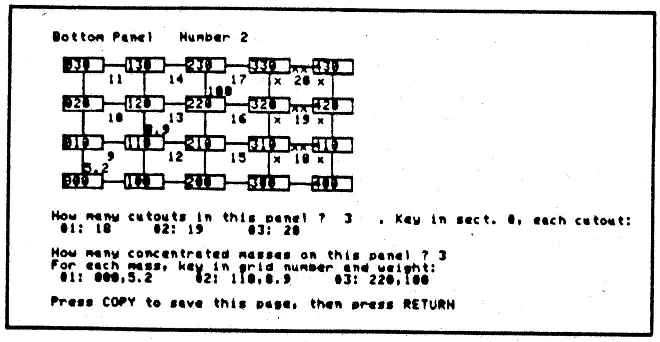


Fig. 4. The small "x" indicates the cutouts. The concentrated mass weight is printed above the grid number.

the corners of any rectangular or skew box. Constant coordinate data, or those coordinates calculated from other points, needn't be entered. Calling the Matrix ROM, the program calculates and displays the direction cosine data of the normals to the six faces (panels).

The next step "opens up" the box and the operator specifies how many subdivisions are required on each panel (Figure 2). Material type and thickness are also keyed in for each panel (Figure 3).

The panels with their subdivisions are drawn on the screen. The program prompts the user for the number and location of cutouts (no material), and the number and weights of concentrated masses for each panel (Figure 44). The final entries specify support points and locations (Figure 5). Vogel points out that every box is supported somewhere.

The 4051 calculates the data, formats it to NASTRAN requirements, prints it to the screen (optional) and writes it to tape (Figure 6). The data are now ready for transmission to the host computer.

Vogel says handling the data through the 4051 takes one-tenth of the time previously required using a calculator and keypunch operators. And more important, he adds, it's accurate.

This is an application of a more general nature. But as might be expected for an engineer whose company's end products fly to Jupiter and other celestial points, Vogel has designed many highly technical and specific 4051 programs for solving spacecraft design problems.

Vogel has contributed the "NASTRAN Deck Generator for Electronic Enclosure Analysis" to the 4051 Applications Library. It is described in the New Abstracts section of TEKniques.

Outside of his work at Fairchild, Vogel has developed programs to custom design greeting cards. These are discussed in the Editor's Note.

Interview arranged by Brett Nelson, Tektronix Sales Engineer, Rockville, Md.

```
How many support points ?
Key in the number of such support points: 3

Refer to the box schematic and to panel schematics.
The box corners have grid numbers :
Bottom - left  - front 000  - rear 030
       - right - front 400  - rear 430
Top    - left  - front 002  - rear 032
       - right - front 402  - rear 432

NOTE: supports need not be at corners.

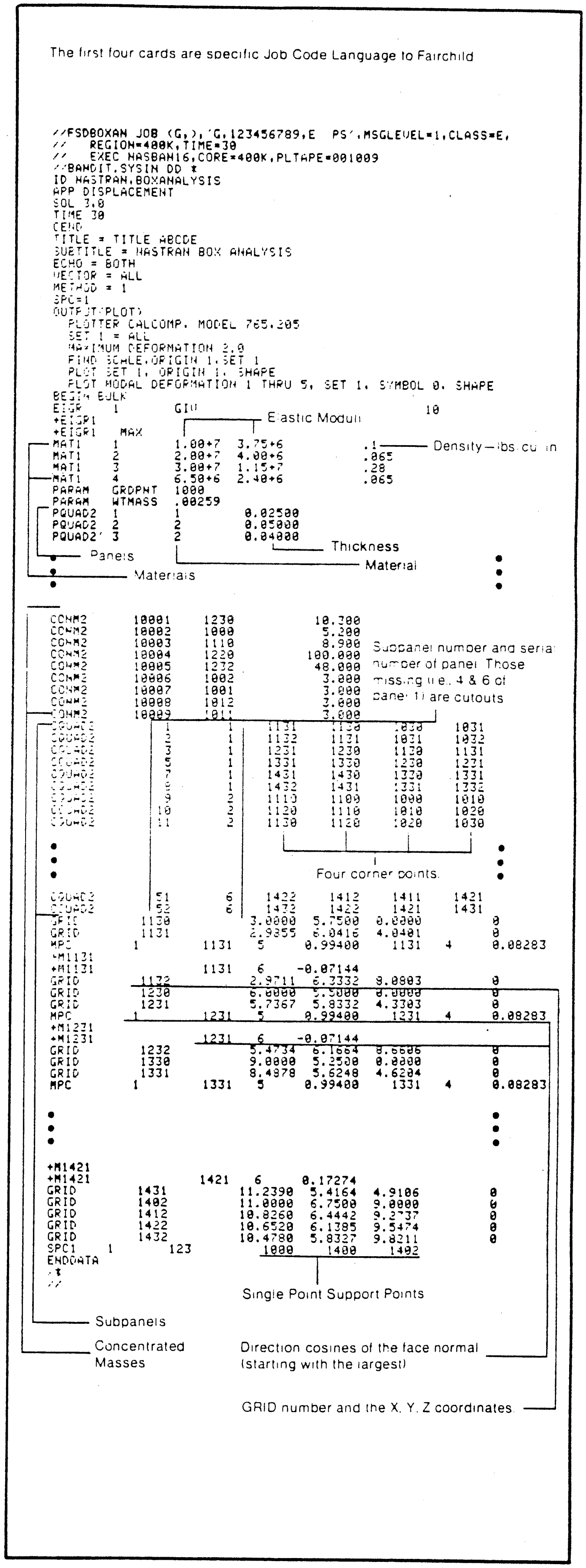
Key in the grid number for each support point

Support point 1 grid number: 000
Support point 2 grid number: 400
Support point 3 grid number: 402


 This completes all the inputs. Please wait until the completion message
 appears

Press COPY to save this page, then press RETURN
```

Fig. 5. The support points are on the bottom of the box at the left front corner, the right front corner, and partially along the grid between grid numbers 400 and 410. Refer to Figure 4.

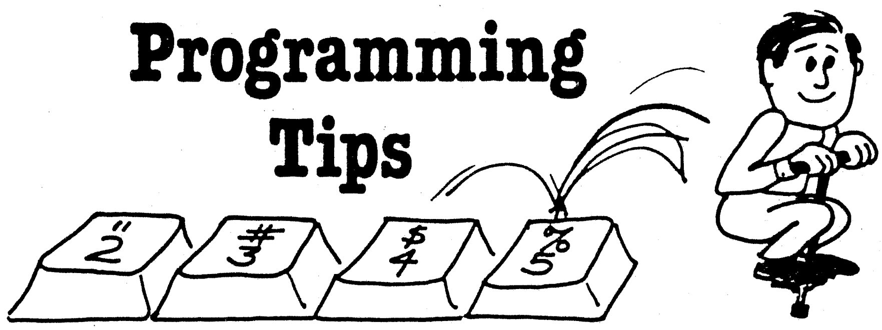

The first four cards are specific Job Code Language to Fairchild

```
//FSDBOXAN JOB (G,),'G,123456789,E  PS',MSGLEVEL=1,CLASS=E,
//   REGION=400K,TIME=30
//   EXEC NASBAN16,CORE=400K,PLTAPE=001009
//BANDIT.SYSIN DD *
ID NASTRAN,BOXANALYSIS
APP DISPLACEMENT
SOL 3,0
TIME 30
CEND
TITLE = TITLE ABCDE
SUBTITLE = NASTRAN BOX ANALYSIS
ECHO = BOTH
VECTOR = ALL
METHOD = 1
SPC=1
OUTPUT(PLOT)
  PLOTTER CALCOMP, MODEL 765,205
  SET 1 = ALL
  MAXIMUM DEFORMATION 2.0
  FIND SCALE,ORIGIN 1,SET 1
  PLOT SET 1, ORIGIN 1, SHAPE
  PLOT MODAL DEFORMATION 1 THRU 5, SET 1, SYMBOL 0, SHAPE
BEGIN BULK
EIGR     1        GIV                                  10
+EIGR1
+EIGR1   MAX
MAT1     1        1.00+7  3.75+6            .1
MAT1     2        2.00+7  4.00+6            .065
MAT1     3        3.00+7  1.15+7            .28
MAT1     4        6.50+6  2.40+6            .065
PARAM    GRDPNT   1000
PARAM    WTMASS   .00259
PQUAD2   1        1          0.02500
PQUAD2   2        2          0.05000
PQUAD2'  3        2          0.04000
  •
  •
  •

CONM2        10001     1230          10.300
CONM2        10002     1000           5.200
CONM2        10003     1110           8.900
CONM2        10004     1220         100.000
CONM2        10005     1232          48.000
CONM2        10006     1002           3.000
CONM2        10007     1001           3.000
CONM2        10008     1012           3.000
CONM2        10009     1011           3.000
CQUAD2           1        1     1131     1130     1030     1031
CQUAD2           2        1     1132     1131     1031     1032
CQUAD2           3        1     1231     1230     1130     1131
CQUAD2           5        1     1331     1330     1230     1231
CQUAD2           7        1     1431     1430     1330     1331
CQUAD2           8        1     1432     1431     1331     1332
CQUAD2           9        2     1110     1100     1000     1010
CQUAD2          10        2     1120     1110     1010     1020
CQUAD2          11        2     1130     1120     1020     1030
  •
  •
  •
CQUAD2          51        6     1422     1412     1411     1421
CQUAD2          52        6     1432     1422     1421     1431
GRID          1130             3.0000   5.7500   0.0000            0
GRID          1131             2.9355   6.0416   4.0401            0
MPC        1           1131    5        0.99400     1131    4      0.08283
+M1131
+M1131                 1131    6       -0.07144
GRID          1132             2.9711   6.3332   8.0803            0
GRID          1230             6.0000   5.5000   0.0000            0
GRID          1231             5.7367   5.8332   4.3303            0
MPC        1           1231    5        0.99400     1231    4      0.08283
+M1231
+M1231                 1231    6       -0.07144
GRID          1232             5.4734   6.1664   8.6606            0
GRID          1330             9.0000   5.2500   0.0000            0
GRID          1331             8.4878   5.6248   4.6204            0
MPC        1           1331    5        0.99400     1331    4      0.08283
  •
  •
  •
+M1421
+M1421                 1421    6        0.17274
GRID          1431            11.2390   5.4164   4.9106            0
GRID          1402            11.0000   6.7500   9.0000            0
GRID          1412            10.8260   6.4442   9.2737            0
GRID          1422            10.6520   6.1385   9.5474            0
GRID          1432            10.4780   5.8327   9.8211            0
SPC1     1         123          1000     1400     1402
ENDDATA
/*
//
```


Fig. 6. Portions of the formatted data are shown with brief interpretations.

Programming Tips



PARSING A STRING

by Carl Dawson
Tektronix, Inc.

The following subroutine will parse any input string for the items delineated by a comma, a space or an equal sign.

Each call to the parser returns, in A$, the next text item. Multiple adjacent spaces are discarded and multiple commas or equal signs are returned as null text with a string length of zero.

For example, the string "TEXT1,,TEXT2" would return "TEXT1" as the first item, a null string as the second item, and "TEXT2" as the third item.

As the input string, C$, is parsed, the test item returned in A$ is deleted and C$ condensed. A length of zero for C$ signals that no more text items remain to be parsed.

The sample program illustrates these features. Statements 100 through 170 contain the controlling program; statements 1000 through 1260 contain the parser.

```
100 INIT
110 C$="TEST PARM1,PARM2=YES,PARM3,,PARM5   PARM6"
120 PRINT C$
130 GOSUB 1000
135 PRINT
140 PRINT "LEN A$ = ";LEN(A$),"A$='";A$;"'"
145 PRINT "LEN C$ = ";LEN(C$),"C$='";C$;"'"
150 IF LEN(C$)>0 THEN 130
160 PRINT "JEND OF INPUT STRING.J"
170 END
1000 REM - SUBROUTINE PARSER
1010 REM -    INPUT VARIABLE(S) :
1020 REM -           C$ - STRING TO BE PARSED
1030 REM -   OUTPUT VARIABLE(S) :
1040 REM -           A$ - NEXT TEXT ITEM FOUND
1050 REM -           I9 - POSITION IN C$ WHERE DELIMITER FOUND
1060 REM -   TEMPORARY VARIABLE(S) :
1070 REM -           I  - SCRATCH (COUNTER)
1080 REM -           W$ - SCRATCH
1090 REM -   VALID TEXT DELIMITERS ARE "," , " " , "="
1100 REM -------------------- PARSER ---------------------------------
1110 A$=""
1115 I=1
1120 W$=SEG(C$,I,1)
1130 IF W$<>" " THEN 1152
1140 I=I+1
1150 GO TO 1120
1152 C$=REP("",1,I-1)
1160 IF C$="" THEN 1260
1170 I9=LEN(C$)+1
1180 FOR I=1 TO LEN(C$)
1190 W$=SEG(C$,I,1)
1200 IF W$<>"," AND W$<>" " AND W$<>"=" THEN 1230
1210 I9=I
1220 I=LEN(C$)
1230 NEXT I
1240 A$=SEG(C$,1,I9-1)
1250 C$=REP("",1,I9 MIN LEN(C$))
1260 RETURN
```

String Search Utility

by Howard Mozeico
Tektronix, Inc.

Do you ever need to find all the calls of a particular GOSUB, such as GOSUB 700? Or do you ever get an error for branching to an invalid line number and want to scan for other branches to that line number? These problems can quickly be solved by the simple program listed below which searches for all occurrences of a given string.

For example, as a useful debugging or documentation aid, you may wish to locate all your GOSUBs. Input 'GOSUB' in response to the question in statement 160; then designate which files are to be searched. In line 240 press 'RETURN' and output will default to the screen; or input 'P' and it will go to the printer.

As each file is searched, the file number is printed along with all statements containing GOSUB.

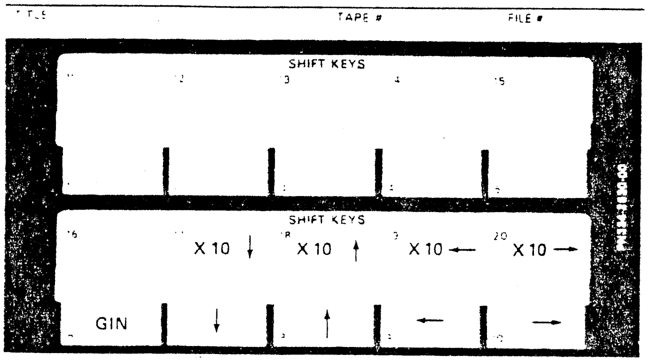
```
100 REM STRING SEARCH UTILITY ROUTINE
110 REM
120 REM Set printer address to 41
130 P=41
140 ON EOF (0) THEN 400
150 PRINT "LISTRING SEARCHJJ"
160 PRINT "Enter the string for which to search: ";
170 INPUT X$
180 PRINT "JIEnter the first file to be searched: ";
190 INPUT F1
200 F1=ABS(F1)
210 PRINT "IEnter the last file to be searched: ";
220 INPUT F2
230 PRINT "JIEnter 'P' for output on the printer: ";
240 INPUT I$
250 D=P*(I$="P")+32*(I$<>"P")
260 PRINT "GGGJJINSERT YOUR PROGRAM TAPE IN THE 4051 ";
270 PRINT "AND PRESS 'RETURN'";
280 INPUT I$
290 PRINT @D:"L"
300 I=F1
310 F9=0
320 FIND I
330 INPUT @33:I$
340 IF POS(I$,X$,1)=0 THEN 330
350 IF F9 THEN 380
360 F9=1
370 PRINT @D:"JFile ";I
380 PRINT @D:I$
390 GO TO 330
400 I=I+1
410 IF I>F2 THEN 430
420 GO TO 310
430 PRINT "JGGGGSEARCH COMPLETED"
```

Editor's Note: This routine is not intended for statements containing control characters. Comprehensive searching programs are contained in the 4051R06 EDITOR ROM (see TEKniques Vol. 2 No. 6) and in the PLOT 50 4050A08 General Utility Programs, Volume 1, both available through your local Tektronix Sales Engineer.

Graphic Input With the User-Definable Keys

by Bob Wainright
Tektronix, Inc.—United Kingdom

For 4051 users who have no joystick but wish to have graphic input, here is a solution that uses the User-Definable Keys. Simply include the statement GOSUB 1010 in your program when graphic input is required; a flashing arrow will appear in the center of the screen. The arrow may be moved around the screen by pressing User-Definable Keys 7 through 10 for minimum units, or User-Definable Keys 17 through 20 for units 10 times larger.



When the point of the arrow has been placed in the desired position, press User-Definable Key 6. Program control is now handed back to the statement following the GOSUB 1000 statement, and X and Y contain the coordinates of the flashing arrow's point.

Statements 28, 32, 36, 40, 68, 72, 76, and 80 control the resolution of graphic input. The constants 0.5 and 5 in these statements can be modified to suit your resolution requirements, and can be altered to suit your WINDOW parameters if they are other than 0, 130, 0, 100.

Statement 1050 designates the graphic symbols font. This translates the slash (press the shift key along with the backslash key (/)) in statement 1080 into an arrow on the graphic screen. Note that the arrow is refreshed by using the secondary address of 24 in statement 1080.

```
24 Z=1
25 RETURN
28 Y=Y-0.5
29 RETURN
32 Y=Y+0.5
33 RETURN
36 X=X-0.5
37 RETURN
40 X=X+0.5
41 RETURN
68 Y=Y-5
69 RETURN
72 Y=Y+5
73 RETURN
76 X=X-5
77 RETURN
80 X=X+5
81 RETURN
1000 REM GRAPHIC INPUT SUB
1010 SET KEY
1020 Z=0
1030 X=65
1040 Y=50
1050 PRINT @32,18:5
1060 IF Z=1 THEN 1100
1070 PRINT @32,21:X,Y
1080 PRINT @32,24:"x"
1090 GO TO 1060
1100 PRINT @32,18:0
1110 RETURN
```

TEKniques Vol. 1 No. 5 carried a similar programming tip. It contains a slightly different approach to the WINDOW and units incremented or decremented.

Recovering From Alternate Delimiters

TEKniques Vol. 2 No. 7 carried the programming tip "Recovering ASCII Programs Saved With Alternate Delimiters," (p. 13). Several readers responded with another method.

```
PRI @37,0:13,255,10
OLD %33:
```

This instructs the microprocessor that parameters for input operations specified with a % sign instead of an @ sign are to be changed. In this case the carriage return is retained as the end of record separator (ASCII 13), the default end of file mark remains (ASCII 255), but all line feeds will be deleted (ASCII 10).

Mr. Webber had provided the above code, but since it eliminated **all** Control Js (J) in a program, we didn't print it. Apparently, for many 4051 users, the time and memory saving with this method outweighed its one disadvantage.

Sizing Viewport

by Dan Taylor
Tektronix, Inc.

A two-line routine determines whether a VIEWPORT command should reflect the graphic screen or 4662 Plotter size.

```
INP @D:X,Y
VIE 0,X,0,Y
```

If the device is 32 (screen), X will be 130; if it's 1 (Plotter), X will be 150. In both cases Y equals 100.

Number Randomizing Routine

by Dan Taylor
Tektronix, Inc.

TEKniques Vol. 2 No. 8 contained a routine to randomly order a set of positive integers. Another routine will randomly order data consisting of negative numbers or decimals as well as positive integers.

Initially, N data values are entered into Array X. Statement 500 then randomly picks a starting point on the random number chain. Subsequent random numbers in the chain will be used as index values to scramble the Array A elements.

Statement 530 randomly selects the element to take part in the exchange. Since an array subscript cannot be 0, note that a 1 is added to the random value before the integer function is performed. Statement 540 transfers the value in the receiving element to temporary storage and statement 550 loads the value from the randomly chosen element into the receiving element. The value in temporary storage shifts into the randomly chosen element in statement 560. The random selection and transfers progress through all elements of the array.

```
500 N1=RND(-1)
510 N=64
520 FOR L=1 TO N
530 K=INT(N*RND(1)+1)
540 T=X(L)
550 X(L)=X(K)
560 X(K)=T
570 NEXT L
```

Correction to Programming Tip

Two lines of code in the "Consistent Plotter Window" tip in TEKniques Vol. 2 No. 8 had the wrong device number. Change line 130 to read:

```
130 MOVE @1:21.5,0
```

Change line 160 to read:

```
160 MOVE @1:124.5,75
```

Shading Routine for Complex Shapes

by Chuck Eng
Tektronix, Inc.

You can shade any polygon shape using the following routine. The shading density and angle are variable. You can input from, and plot to, either the 4662 Plotter or 4051 graphic screen. To begin the routine, type 'RUN'. You will be prompted for the number of sides in the polygon, the angle of the shading lines in degrees, the density of the shading in GDUs, and the device for input and output.

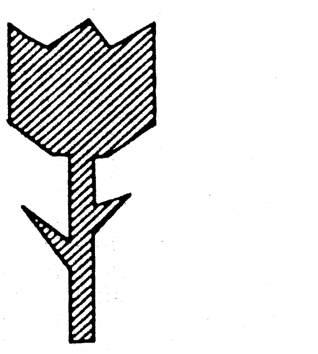
4662 Plotter—Input/Output Device #1

Position the pen at the first point and depress the CALL button momentarily. (Don't hold the button down.) Move to the subsequent points, depressing CALL momentarily at each. As the points are specified, the polygon is outlined. When the last point is entered the program closes the polygon and begins shading. Note that the last point will be connected to the beginning point automatically.

4952 Opt. 1 Joystick—Input/Output Device #2

Position the pointer on the screen and press RETURN. The sequence is the same as the Plotter, but press RETURN instead of CALL for each point.

```
100 INIT
110 WINDOW 0,130,0,100
120 PRINT "LENTER # OF SIDES IN POLYGON: G";
130 INPUT N
140 PRINT "JJENTER ANGLE OF SHADING LINES: G";
150 INPUT A
160 PRINT "ENTER SHADING LINE DENSITY IN GDU'S: G";
170 INPUT D
180 PRINT "JJENTER GIN DEVICE # (1)=PLOTTER OR (2)=JOYSTICK: G";
190 INPUT Z
200 PRINT "JJENTER OUTPUT DEVICE #: G";
210 INPUT Z1
220 DIM P(2,N),W(2,N+1),X(N-1),P1(2)
230 GO TO Z OF 1000,1100
240 GO TO 200
250 S=1.0E+307
260 L=-1.0E+307
270 S1=SIN(A*0.01745327)
280 C1=COS(A*0.01745327)
290 FOR I=1 TO N
300 W(1,I)=P(1,I)*C1+P(2,I)*S1
310 W(2,I)=-P(1,I)*S1+P(2,I)*C1
320 S=S MIN W(2,I)
330 L=L MAX W(2,I)
340 NEXT I
350 W(1,N+1)=W(1,1)
360 W(2,N+1)=W(2,1)
370 Y2=S+0.5*D
380 IF Y2>L THEN 1090
390 K=0
400 FOR I=1 TO N
410 W1=W(2,I) MIN W(2,I+1)
420 IF Y2<W1 THEN 540
430 W2=W(2,I) MAX W(2,I+1)
440 IF Y2=>W2 THEN 540
450 X1=W(1,I)-(W(2,I)-Y2)*(W(1,I)-W(1,I+1))/(W(2,I)-W(2,I+1))
460 K=K+1
470 J=K
480 IF J=1 THEN 530
490 IF X(J-1)=>X1 THEN 530
500 X(J)=X(J-1)
510 J=J-1
520 GO TO 480
530 X(J)=X1
540 NEXT I
550 FOR I=1 TO K
560 P1(1)=X(I)*C1-Y2*S1
570 P1(2)=X(I)*S1+Y2*C1
580 IF 2*INT(0.5*I)-I>-0.1 THEN 610
590 MOVE @Z1:P1(1),P1(2)
600 GO TO 620
610 DRAW @Z1:P1(1),P1(2)
620 NEXT I
630 Y2=Y2+D
640 GO TO 380
1000 REM 4662 AS GIN DEVICE
1010 FOR I=1 TO N
1020 INPUT @1,27:P(1,I),P(2,I)
1030 IF I=1 THEN 1050
1040 MOVE @Z:P(1,I-1),P(2,I-1)
1050 DRAW @Z:P(1,I),P(2,I)
1060 NEXT I
1070 DRAW @Z:P(1,1),P(2,1)
1080 GO TO 250
1090 END
1100 REM JOYSTICK AS GIN DEVICE
1110 FOR I=1 TO N
1120 POINTER P(1,I),P(2,I),P$
1130 IF I=1 THEN 1150
1140 MOVE @Z1:P(1,I-1),P(2,I-1)
1150 DRAW @Z1:P(1,I),P(2,I)
1160 NEXT I
1170 DRAW @Z1:P(1,1),P(2,1)
1180 GO TO 250
```



TEKniques
The 4051 Applications Library Newsletter
Vol. 2 Index (8 Issues)

ARTICLES—BY ISSUE

PROGRAMMING TIPS—BY ISSUE

ARTICLES BY APPLICATION AREA

PROGRAMMING TIPS—BY PROCEDURE

ARTICLES & PROGRAMMING TIPS—BY EQUIPMENT

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* Editor's Note

Programming Tip Exchange

Send in your programming tip. Any one of the following 4051 Applications Library programs* will be yours when it's published. Simply jot down a brief description of the function, the code and your choice of program. Mail it to the 4051 Applications Library serving you; Library addresses are listed at the back of each TEKniques issue.

51/00-0101/0	51/00-5503/0
51/00-0702/0	51/00-7002/0
51/00-0715/0	51/00-8006/0
51/00-1401/0	51/00-9505/0
51/00-1402/0	51/00-9511/0
51/00-5401/0	51/00-9521/0

***Documentation and listing only.**

Engineer Designs Greeting Cards

Erwin Vogel, spacecraft engineer at Fairchild Industries, says "one must not neglect entertainment." He is a strong supporter of Arena Stage, a renowned local theater in dowtown Washington, DC. For a recent auction to raise funds, Vogel offered to produce greeting cards and poetry using the 4051. This was an outgrowth of applying his expertise to design original greeting cards.

Vogel also ran for the State House of Delegates (lower house of the Maryland State Legislature) as an Independent. He found the 4051 a useful tool to construct campaign messages.

The New Abstracts section of this issue carries Vogel's programs for custom designing greeting cards.

Catalogs and Back Issues

Did you miss an issue of TEKniques, from Volume 1 or 2? Or perhaps you haven't yet gotten your copy of the 4051 Applications Library Program Catalog. We have catalogs and back issues of TEKniques on hand in the TEKniques office. If you'd like to receive a catalog, or have been wanting to find a copy of a previous issue of TEKniques, drop a note to the Applications Library serving you; Library addresses are located at the back of each TEKniques issue.

4051 Applications Library Program Abstracts

Order

Documentation and program listings of each program are available for a nominal charge. Programs will be put on tape for a small recording fee per program plus the charge for the tape cartridge. One tape will hold several programs. (The program material contained herein is supplied without warranty or representation of any kind. Tektronix, Inc. assumes no responsibility and shall have no liability, consequential or otherwise, of any kind arising from the use of this program material or any part thereof.)

Domestic U.S. Prices:

Documentation and listings	*$15 per program*
Recording Fee	*2 per program*
Tape Cartridge	*26 per tape*

Contribute

Contribute one program to the Library and receive three in exchange. Send in the membership card from your 4051 Graphic System Reference Manual to get the details. Or call us (503) 682-3411, ext. 2618.

Forms

Please use the Applications Library Order Form. Order forms are included in the Membership Packet and are available from your local Tektronix Sales Engineer.

Outside U.S.

Program contributions or orders outside the U.S. must be processed through the local Tektronix sales office or sent to one of the Libraries serving your area. See Library Addresses section.

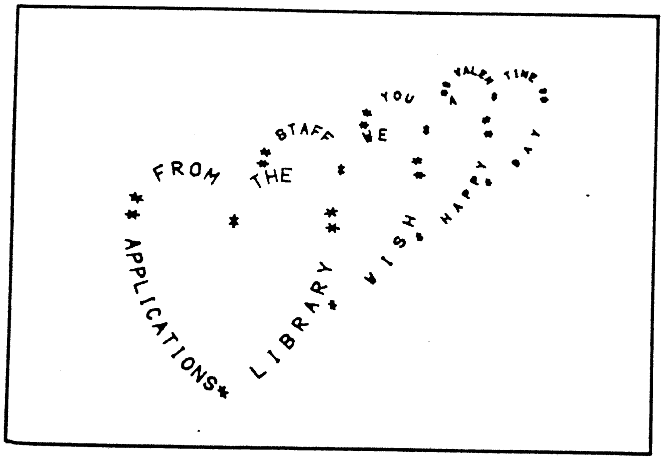
ABSTRACT NUMBER: 51/00-6004/0

Title: **Greeting Cards & Party Invitations**
Author: Erwin Vogel
Fairchild Space & Electronics Company
Germantown, MD
Memory Requirement: 32K
Peripherals: 4631 Hard Copy Unit
Statements: 933
Files: 8

The program has seven separate programs to print text in fancy patterns.

Program 1: Print 16 lines of text in the form of 4 flowers.

Program 2: Prints text in the form of a heart. The hearts are repeated—scaling text and pattern—4, 5, or 6 times.



Program 3: Prints text in the form of a knot pattern.

Program 4: Distorted lettering—printing radially outward from a circle.

Program 5: Distorted lettering—printing to fit inside a heart.

Program 6: Prints a party invitation, lettering (message) in the form of a house.

Program 7: Calculates when a special birthday occurs. Such as a billion seconds old, or 10,000 days. Input is the day and time of birth; desired anniversary. Output is the date of the event.

The first five programs use as a subroutine an alphabet generated by the author. The alphabet contains only capital letters. The subroutine specifications (input) are:

A = letter width

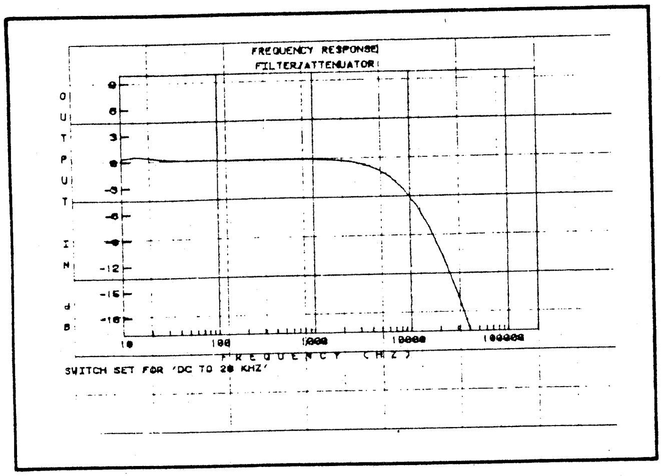
B = letter heigth

S = slant

ABSTRACT NUMBER: 51/00-8024/0

Title: **GPIB Frequency Response Measurement**
Author: Phil Somerset
Tektronix, Inc.
Memory Requirement: 8K
Peripherals: Optional—4662 Plotter
Statements: 240
Files: 1

This program uses a Fluke 6011A Synthesized Signal Generator and a Fluke 8502A Digital Multimeter to measure the frequency response of any device working in the range 10 Hz to 1 MHz. The device under test may be a passive deivce, such as a resistor, inductor, filter, transformer, etc., or it may be a voltage or power amplifier. Input of test parameters is interactive and the results are graphed on a logarithmic scale and documented with user-supplied data. The output graph may be directed to the 4662 Plotter if available.



ABSTRACT NUMBER: 51/00-8022/0

Title: **Automatic Tape Directory**
Author: E.A. Bleiweiss
University of New Mexico
Civil Engineering Research
Albuquerque, NM
Memory Requirement: 8K
Statements: 150
Files: 1

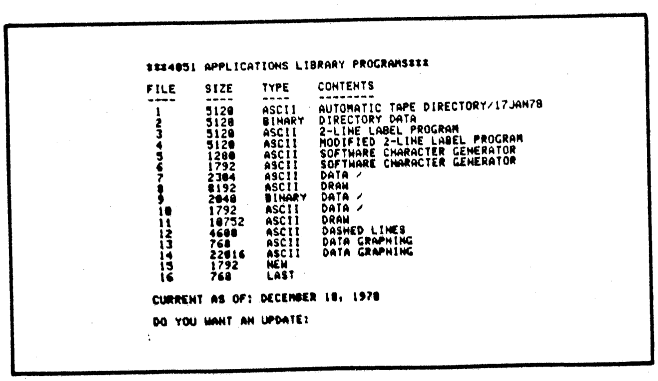
The program will list in order the contents of a magnetic tape cartridge by file number, size, type (ASCII or BINARY) and contents (title of Program). It will then load and run a selected program if requested.

The program requires the first 2 files on the tape. File 1 is for the program, file 2 for the data (Table of Contents).

When used for the first time the program will scan each file starting with file 3, then read and list the first line of each file. The first line of each program must be a REM statement and contain the title in braces [ ]. Up to 48 characters may be used in the title.

The maximum title storage capability in file 2 is 43 files. If more are required file 2 may be marked larger and the appropriate lines of code changed in the program.

NOTE: Requires a data file.



4051 APPLICATIONS LIBRARY PROGRAMS

FILE	SIZE	TYPE	CONTENTS
1	5120	ASCII	AUTOMATIC TAPE DIRECTORY/17JAN78
2	5120	BINARY	DIRECTORY DATA
3	5120	ASCII	2-LINE LABEL PROGRAM
4	5120	ASCII	MODIFIED 2-LINE LABEL PROGRAM
5	1280	ASCII	SOFTWARE CHARACTER GENERATOR
6	1792	ASCII	SOFTWARE CHARACTER GENERATOR
7	2304	ASCII	DATA /
8	8192	ASCII	DRAW
9	2048	BINARY	DATA /
10	1792	ASCII	DATA /
11	10752	ASCII	DRAW
12	4608	ASCII	DASHED LINES
13	768	ASCII	DATA GRAPHING
14	22016	ASCII	DATA GRAPHING
15	1792	NEW	
16	768	LAST	

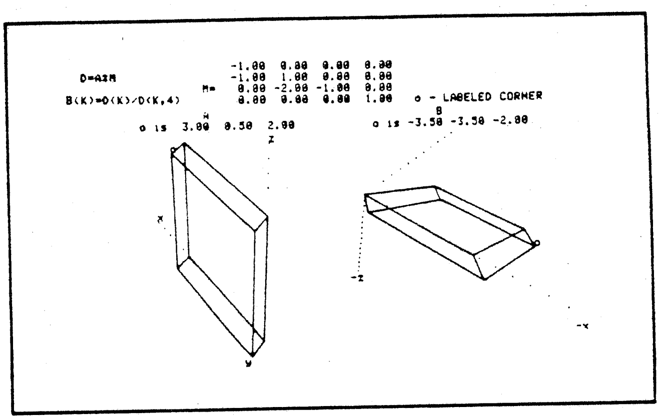
CURRENT AS OF: DECEMBER 18, 1978

DO YOU WANT AN UPDATE:

ABSTRACT NUMBER: 51/00-9527/0

Title: **3D-Transformation Using Homogeneous Coordinates**
Author: George E. Heckler
Department of Chemistry
Idaho State University
Pocatello, ID
Memory Requirement: 24K
Statements: 339
Files: 1

The program displays two straight sided 3-D figures on the screen. On the left is the original figure; the points at the corners of the original are transformed by a 4 x 4 matrix and displayed on the right. The transforming matrix, and coordinates of illustrative points, are also displayed. The matrix multiplication uses homogeneous coordinates.



ABSTRACT NUMBER: 51/00-9528/0

Title: **"NASTRAN Deck Generator for Electronic Enclosure Analysis"**
Author: Erwin Vogel
Fairchild Industries
Germantown, MD
Memory Requirement: 32K
Peripherals: RS-232 Data Communications I/F
Host w/NASTRAN Software
Statements: 1024
Files: 2

An interactive tutorial program creates three-dimensional models for structural analysis.

The engineer enters 12 coordinates specifying the corners of any rectangular or skew box. Each panel is subdivided and the material types and thickness for each keyed in. Number and location of cutouts, number and weight of concentrated masses for each panels along with support points and locations are input.

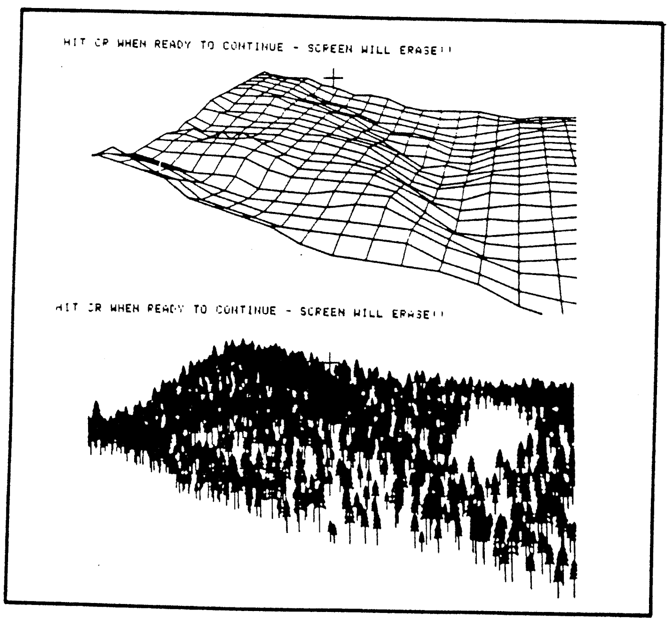
The 4051 calculates the data, fromats it to NASTRAN requirements and writes it to tape. The data may then be transmitted over the RS-232 to the host computer where bulk data and JCL cards are automatically keypunched.

The program's step-by-step graphically tutorial prompting enable the engineer without computer experience to use it with ease.

ABSTRACT NUMBER: 51/00-9529/0

Title: **SCOPE**
Author: Devon Nickerson
U.S.F.S. Logging Systems Group
Six Rivers National Forest
Edit by: Steve Wells
Tektronix, Inc.
Memory Requirement: 32K
Peripherals: 4956 Graphic Tablet
4631 Hard Copy Unit
Optional—4662 Plotter
Statements: 1166
Files: 8 program
25 data

"SCOPE," a timber management planning tool, depicts a partial cut timber stand in perspective view. The timber stand is drawn with a TV-scan approach, producing a panoramic reproduction. By specifying the percentage of timber to be removed in a partial cut operation, the planner can get a feel for the textural change in the timber canopy that results from his management activities. This program is similar to CDC 6400 program "PREVIEW" developed at SUNY, Syracuse, NY, by Myklestad and Wager (see USDA Forest Service Research Paper NE-355 (1976)). However, "SCOPE" was developed for a desktop computer system.



Using the TEKTRONIX 4051 and 4956 digitizing tablet, and optionally a 4662 Plotter, the user delineates the boundary of a proposed unit, the boundary of any unforested land within the unit boundary, and the top and bottom points of skyline corridors. Next, the user prepares a matrix of elevation observations by digitizing the contours on the topographic map. Then the user describes the timber stand and the cut. Finally, the user identifies a vista point, and the depiction of the stand is drawn on the Plotter.

"Trees" are described on the basis of a series of random numbers. The height, crown ratio, crown width, DBH, and position of each tree are functions of the stand characteristics and the random number. As a result, the stand is convincingly natural in appearance.

A topographic map provides the basis for input data. Use a map of the largest possible scale with the most detailed contour information. Once all data is input, a typical plot may take 30 minutes or more.

ABSTRACT NUMBER: 51/00-9530/0

Title: **GRAFUS**
Author: GCS Group
EMC Tektronix
Amstelveen, Holland
Memory Requirement: 16K
Level 5 Firmware
Peripherals: 4907 File Manager
or 4051R05
Optional—4662 Plotter
Statements:
Files: 21

The software package contains three graphing routines and a number of utility routines.

Graphing routines: GRAPH for drawing a curve through user-defined data pairs.
POLAR for drawing a curve defined by magnitudes and angles.
CURVE for drawing curve defined by coefficients and exponents.

The selectable options include:

1. Autoscaling
2. Lin-lin, semi-log, log-log axis systems
3. Curve smoothing
4. Multiple curve plots
5. Line types
6. Data point identification
7. Graphic device address
8. Data point connection

GRAFUS can be easily used in combination with user programs using the APPEND command.

The user has access to a set of graphic routines with selectable options which can be inserted into his/her application program.

GRAFUS is equipped with a data-checking and error-message routine.

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