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Imager User's Manual

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Imager User's Manual

This program is used to edit, view, animate and analyze data collected from video, CCD or cinefilm digitizing. The program can also convert data from one format (e.g., APAS .1T or .3D) to that used by the Biomech Motion Analysis System (.DG file). It will also assist you to edit your data if any errors occurred during digitizing. It can manipulate a single frame, an individual point or the whole set of frames in your file. It also allows you to look at your data synchronized with force platform data (after running Cinedata), after data smoothing by the Biomech Motion Analysis System program, Kinematics, or simulated by the Simulate program. Various modes of animation allow your data to be presented in a more meaningful fashion. Two or three data files can be compared against each other, for example, simulated data compared with its original, two trials by the same subject against each other, comparison of two different subjects performing the same activity or the three views of a three-dimensional data set.

Please note the case sensitivity of this program. In some cases pressing a capital letter will perform a different function than pressing a small letter. Consult the Table of Keyboard Functions at the end of this manual for the functions of each key. To get started, please read the manual thoroughly and practice on a test set of data. Keep the original data in a separate directory until you are familiar with the editing functions. The program does keep a backup of any edited file.
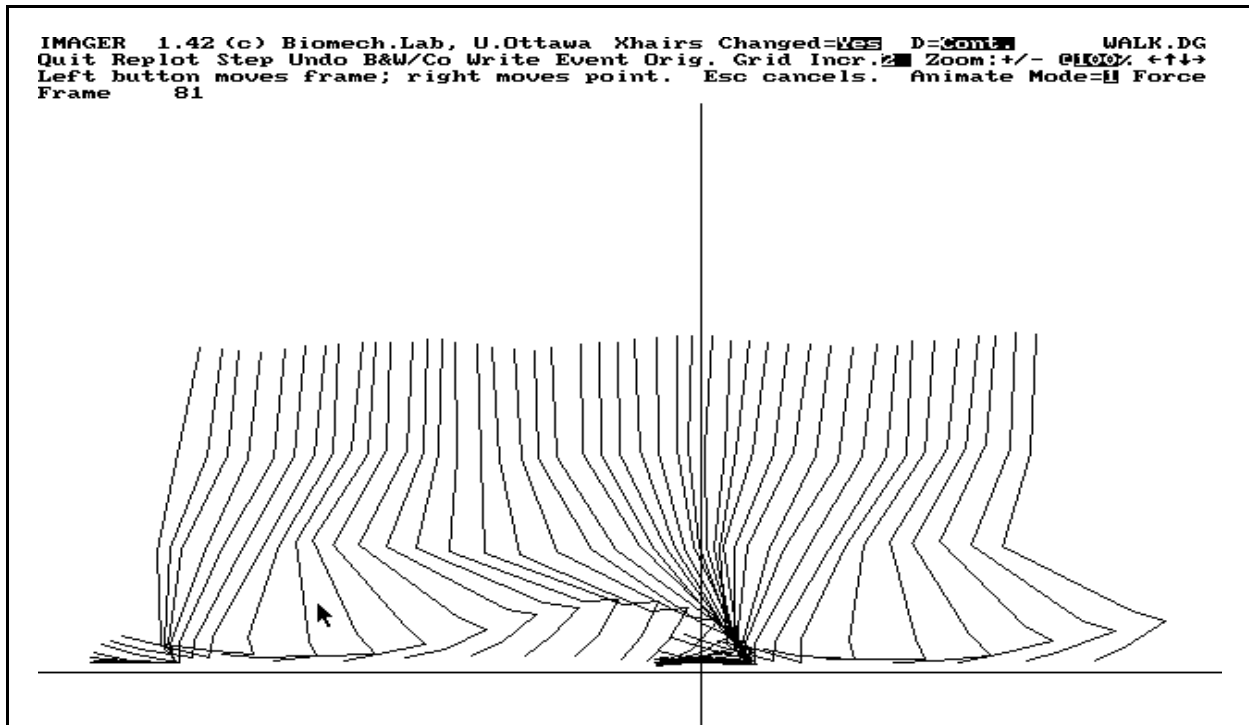
Figure 1. Example of display of digitized data.

1. Starting Imager

a) To start Imager from DOS (command line options):
Enter the command,
Imager or
Imager [/options] filename
Where "/options" can be include one of the following ways of displaying the markers:
"/Bigpoints" for displaying all markers as large points,
"/Continuous" for connecting all the markers point-to-point,
"/Point" for displaying all markers as single points,
"/Links" for customized displaying of the markers using the associated links (.LIN) file (see below) or
"/Trajectory" for displaying all markers as trajectories.
To enable the different animation modes use options "/0", "/1", "/2" or "/3" and use "/Z" to suppress connecting lines to (0,0) coordinate pairs or missing values. The option, /Write, is used to convert the input file (for example, Ariel .1T file) to the .DG filetype. This is useful for processing your data with the Biomech Motion Analysis System software. (Note, only the first letter of the option is needed in the command line. E.g., **Imager /w walk2.1t**.)
Option, "/Quick", minimizes the amount of information displayed while loading the data and if eliminates "pauses" before displaying the data graphically. Option, "/Debug", maximizes that amount of information displayed textually.
Option, "/Allow", permits the saving of file formats that are not normally saved, for example, .CN and .KM files. The output file format is always the .DG format used by the Biomech Motion Analysis System software. Use "/Readonly" to prevent writing to a file.
Option, "/X", causes the X-coordinates to be reversed. Note, for some file types reversing will occur only when the data are saved and then refined by the Cinedata program. This program is part of the Biomech Motion Analysis System.
And where "filename" is the name of the data file that you want to view or edit. If the file is not in the current directory then include the path with the filename. The file must have one of the following extensions:
".DG" (digitized, raw data used by Biomech Motion Analysis System),
".CN" (scaled data from Cinedata that can have an associated control file, .CFB),
".SN" (simulated data from Simulate that can have an associated control file, .CFB),
".KM" (filtered marker data from Kinematics that <u>requires</u> a control file, .CFB),
".#T" (Ariel raw data, "view", file where # can be any digit from 1 to 9 that <u>requires</u> a common file, .CF),

".3D" (Ariel scaled data file that <u>requires</u> a common file, .CF) or

".CDA" (Peak Performance data file that requires a .STK file).

If no extension is given, .DG, will be assumed.

Option "/G" when used with .KM files will permit the plotting of the total body centre of gravity as long as the associated .KS file is present.

Options, "/P1", "/P2" and "/P3" enable the default printer to be set to LPT1, LPT2 and LPT3, respectively. LPT1 is used by default.

For APAS .3D files the following options are available:

Options "/V1", "/V2" and "/V3" to view either of the 3 planes of motion and "/F" or "/NF" to automatically display the filtered or raw data, respectively.

Links. Imager will also look for a "links" file called "filename.LIN" in the current directory. If not found it will then search for a file called, "DEFAULT.LIN", in the current and then parent directories. If found, stick-figures will be drawn according to the pairs of numbers in these file. The first line in the .LIN file must begin with the word "LINKS" followed by the number of pairs of links or segments. The links are defined by pairs of numbers representing the two markers that are to be connected in the stick-figure. To display a symbol enter the number of the marker followed by the number listed in Table 2.

```
LINKS   10
    1    2    2    3    3    4    4    5    5    6    6    4    4   -1    1   -2
    2    5    5   -3
```

Table 1. Example links (.LIN) file for creating customized stick-figures

b) To start Imager from XTreeGold:

Start XTreeGold and then move to the data file's directory. Highlight the filename and then press **O** (open). Use **<Alt>O** if insufficient memory is available to "open" the file and start Imager.

c) To use Imager with Windows:

Run the program, Imager95.exe. This program allows you to open various filetypes in a user-friendly fashion. Alternately, from Windows Explorer, double-click on the data's filename once the file's extension has been registered. To register the various files that Imager can display, run the program, REGEDIT.EXE. Then choose the option "<u>I</u>mport Registry File" from the "<u>R</u>egistry" menu.

Name	Symbol	No.	Key
pixel / point	@ / C	0 / -15	. / p
small x	×	-1	x
dash	–	-2	-
box	~	-3	#
diamonds	, / /	-4 / -5	b / d
plus / cross	+ / **3**	-6 / -14	+ / c
tic			-7		
asterisk	**t**	-8	*
triangle	Î	-9	v
circle		-10	0 (zero)
square	■	-11	s
X	X	-12	Ctrl_X
target	**″**	-13	g

Table 2. List of plotting symbols

Find the file, IMAGER.REG, and double-click on it to register the various filetypes. This file should be found in your Biomech Motion Analysis System directory or installation disk.

Another method is to use Windows Explorer to enter each filetype separately. Click the following options to created associated files: <u>V</u>iew, <u>O</u>ptions..., File Types, and <u>N</u>ew type.... Pressing the **<F1>** helps to describe what to enter in each field. Once Imager is running and the file is loaded, the program will display header information, pause until you press a key and then display the data graphically.

2. Editing Data

The first screen you see is the main screen.

a) Moving one whole frame of the data (see Figure 2):

- click the left mouse button on the frame. If the wrong frame is highlighted click again or use the arrow keys to move to the correct frame.

- hold the left key down to drag the frame to its new location. To cancel this movement press the **<Esc>** key.
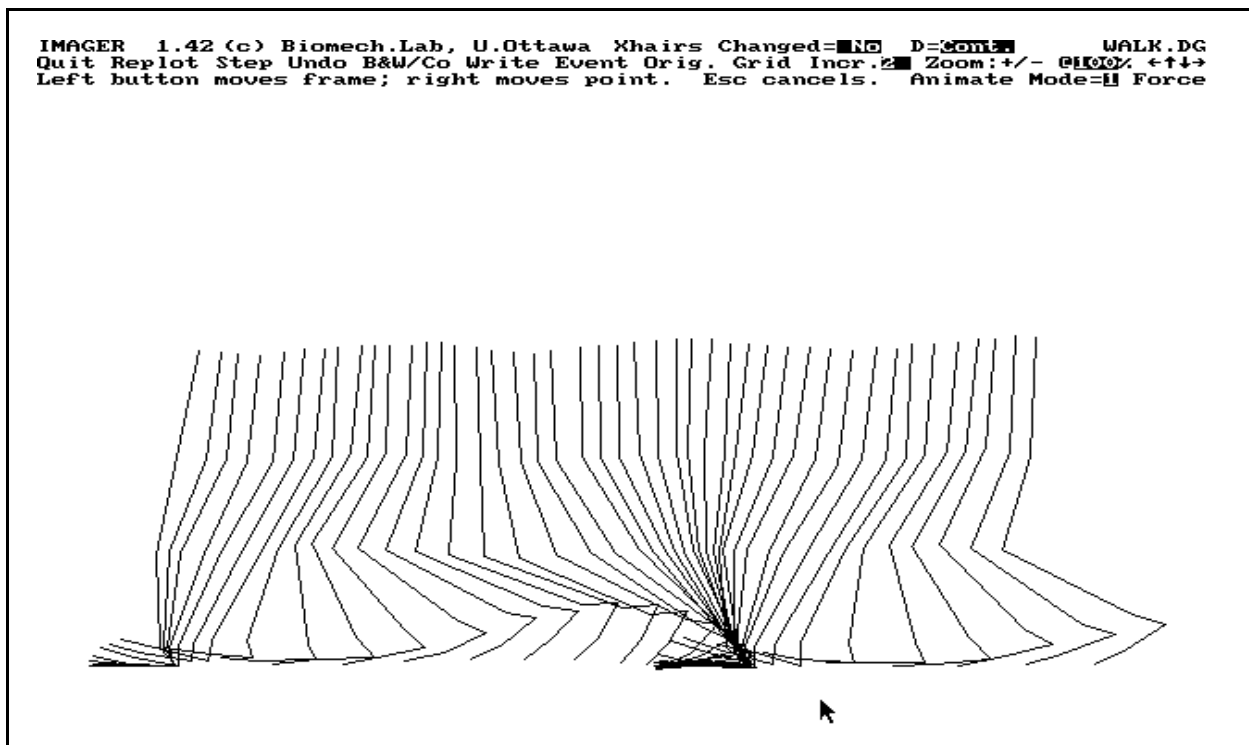
Figure 2. Example of continuous or stick-figure display of a data file. The arrow indicates position of mouse cursor. When clicked the nearest frame will be highlighted.

b) Moving one point or marker:
- first select the frame that needs editing as outlined above.
- click on the marker that you want to move then drag it to its new position. Notice that the selected marker number and name will be displayed in the third line at the top of the screen. To undo any changes press **U** or the **<Esc>** key. If you have difficulty selecting a point, select any point on the body and press the arrow keys while holding the right mouse button down. The program will step from one marker to the next in ascending (down or right arrow keys) or descending (up or left arrow keys) order.

c) Deskewing data (press **X** to obtain crosshairs):
- after pressing 7 or **K**, the screen asks you to set an origin to the left of the data that you want to deskew. Use the mouse to move the crosshairs.
- press **K** again to set the origin or the **<Esc>** to cancel
- you are then asked to set a right point that will define the line that will be used to deskew the data. The data will be rotated about the left point so that this line is horizontal.
- set this with use of the mouse and follow the directions on the screen
- once the two points are set the program will draw a line between them and ask you if you want the data deskewed, answer appropriately. No permanent changes are made unless the data are saved (written) to disk.

d) Displaying grid or control points (see Figures 3 and 4):
- from the main screen, press **G**, to shows the original digitized grid, linear scaling system or control points
- pressing **g** will show the points of the grid. A red cross indicates the first datum.
- **Ctrl-G** displays the grid or control points their associated numbers
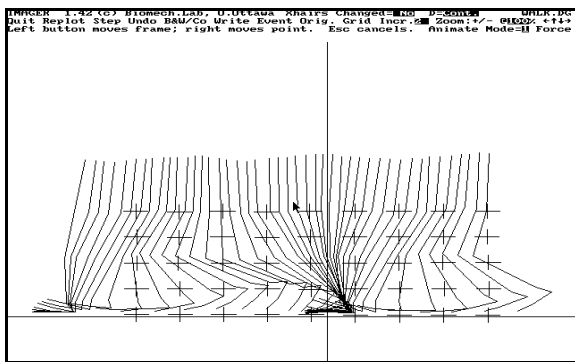
Figure 3. Example of open grid display and large origin axis.
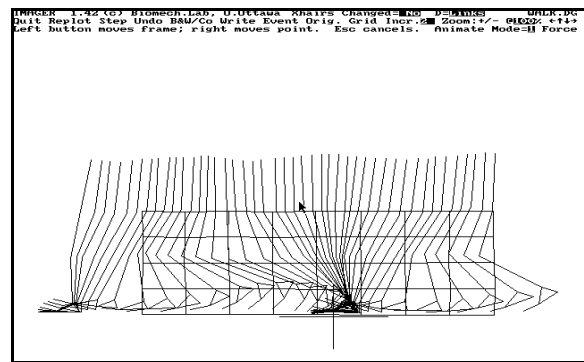
Figure 4. Example of closed grid and small origin axis.

e) Adding or editing event codes:

Press **E** to add or change an event code at the selected frame. Only .DG files can have event codes. Entering a "0" erases the current event code. Only one code is permitted per frame and only codes from 1 to 9 are allowed.

f) Averaging a frame to smooth data:

After selecting a frame (excluding first or last) press **<Alt>V** (move) to have the selected frame replaced by the average of the surrounding two frames. This quickly eliminates a frame that was badly digitized. You should use this feature sparingly.

g) Manipulating forces (see Figure 5):

Note, this option can only be used with .CN or .KM files.
- to increase length of force vectors relative to the marker data, press **<F7>**
- to decrease size of force vectors, press **<F8>**
- to remove forces press **F** twice or **<Ctrl>F**
- **<Alt>F** will replot the forces on top of the digitized images
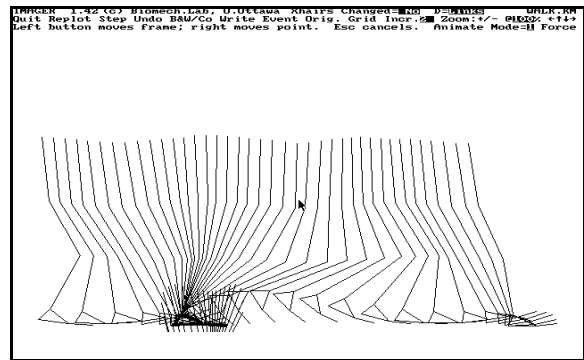
Figure 5. Example of a file that includes ground reaction forces (WALK.KM).

h) Adding notations to frames:

Press **<Ctrl>N** to add a notation or caption to a frame. You will be prompted for the notation and the current notation will be displayed. There is a maximum of 60 characters per frame. These notations can only be saved to the .DG file format.

i) Editing the scaling (grid) system or control points:

Press **<Alt>S** to open the scaling editor. Note, that only .DG files or Ariel View (i.e., .1T, .2T etc) files can have control point or scaling information. To just view the control points press **G** or **g**. This function may not be implemented therefore editing may require a text editor like Windows Notepad. Scaling coordinates are placed before the card labelled **DATA**.

j) Suppression of missing or zero coordinates:

Press **<Alt>Z** to suppress the display of missing coordinates or coordinates of (0,0). Many motion analysis software records zeros when a coordinate pair cannot be digitized. Note, suppression only occurs when both coordinates are zero.

k) Connect to initial coordinate (fixed reference point):

Press **<Alt>O** to toggle between connecting or not connecting to the initial or fixed reference point. Reference points are usually not included when data are

displayed in "continuous" or "trajectory" display modes but are displayed in "points" mode.

l) Inserting a frame:

Press **<Alt>I** to insert a frame. Currently, this can only be done to beginning or ends of the data file.

m) Deleting a frame:

Press **<Alt>D** to delete a frame. Currently, this can only be done to first or last frames.

n) Renumbering:

Press **<Ctrl>R** to renumber the frame numbers. You will be prompted for the initial frame number. Then each frame's number will be incrementally increased from the initial frame number.

o) Cancelling read-only status:

Press **<Ctrl>W** to enable changes to a edit protected file. Files can be loaded to prevent inadvertent editing. This option permits the saving of changes to a data file opened in edit protected mode.

3. Screen Editing (not permanent)

a) Displaying crosshairs and starting digitizing mode (see Figure 6):

Press **X** to show crosshairs for digitizing, adding text to the screen and editing and deskewing (rotating) the axes.

After pressing **X** you have these options:
- left mouse button exits digitizing mode
- right mouse button leaves the crosshairs in place
- 6 or **X**, cancels the axes system
- 7 or **K**, allows you to deskew data in a .DG file (see above)
- **O**, asks if you want to set a new origin (.DG files only), pressing
    - **Y** sets origin at crosshair location
    - **N** keeps original origin
- **L**, draws a point and start line draw mode to the next crosshair location. Move crosshairs to next location and press **L** to draw a line, **P** to draw a point or press the space bar to cancel.
- **P**, draws a point at the current crosshair location
- **T**, lets the user enter text at the current crosshair location. To exit this mode press the **<Esc>** key.

```
IMAGER  1.42 (c) Biomech.Lab, U.Ottawa  Digitizing mode.                WALK.CN
Choose: Origin, Deskew, Line, Point, Cross or Text. Press <Esc> or Quit to exit.
        Bigpoint, X=small X, .=pixel, +=cross, *=star
Length =        8.20 centimetres          X,Y posn:   78.2, 172.9 centimetres
```

Trial: WN01XX

1 metre
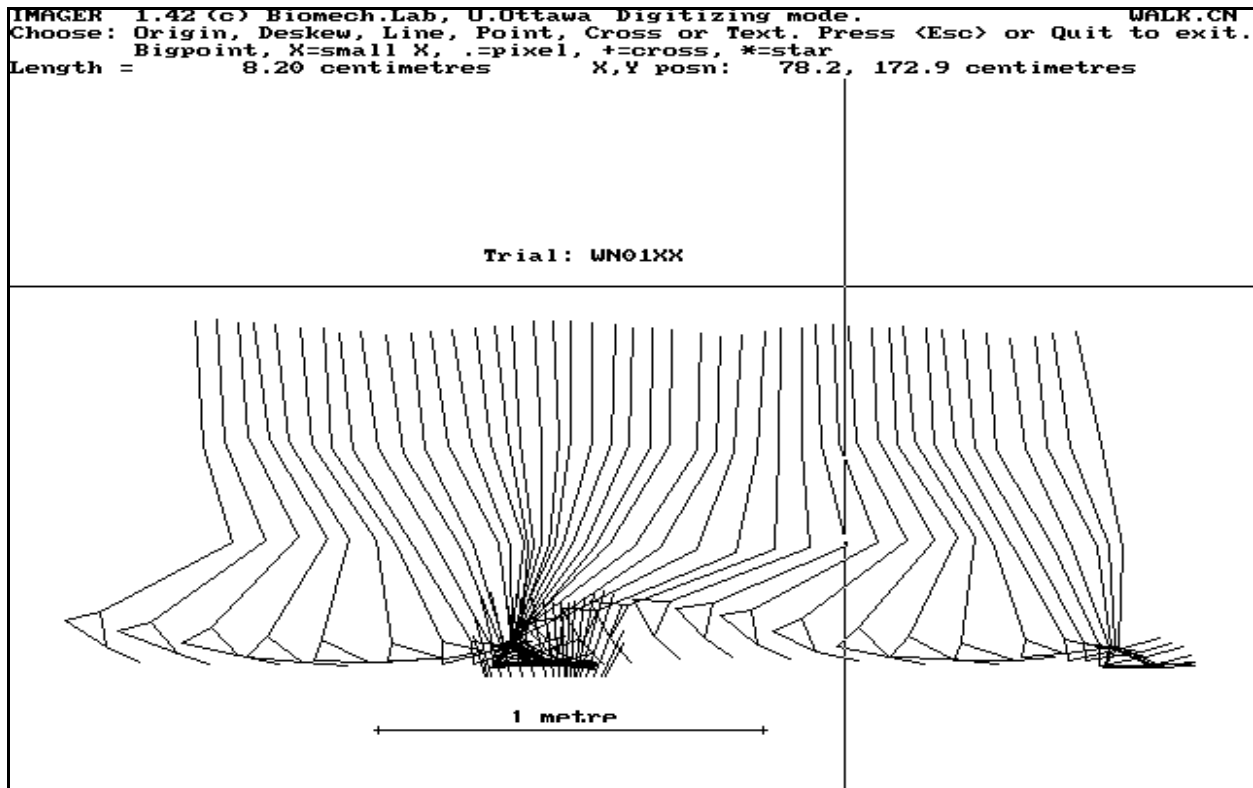
Figure 6. Example of "Digitizing mode" with text added to the display. Coordinates (X,Y posn:) of cursor are displayed at the top of screen with distance (Length =) from previous position.

b) Displaying digitized origin (see Figures 3 and 4):
> Press **o** to display the current origin with a small axis or (capital) **O** to display the current origin with a larger axis. Press **0** (zero) to display the absolute origin (at digitizer coordinates: 0,0).

c) Incrementing the frames (looking at fewer frames of data):
> Note, most of the figures in this manual have been displayed with an increment of 2 frames.
> - to decrease the number of frames, press **<F9>** or **I**
> - to decrease the increment, press **<F10>** or **i**
> - use **<Ctrl>I** to return to single (frame-by-frame) increment

d) Changing data display:
> (from stick-figures to trajectories, points, big-points or links):
> - this can only be done from the main screen
> - press **D** once or press **T** to change stick-figures to marker trajectories
> - press **D** twice or press **P** to change stick-figures to points
> - press **D** thrice to display with big-points

- pressing **D** a fourth time or press **L** to produce a "links" display if a .LIN file is available, otherwise,
- to get back to stick-figures, press **D** again or press **C** for continuous (stick-figure) mode

e) Replotting data:
- you can press **R** at any time to replot data
- pressing **R** will erase the axes systems from the picture and any non-permanent information form the screen

f) Viewing help display:
- press **<F1>** one or more times
- press **<Ctrl><F1>** to remove help display

g) Loading or reloading a data file:
- press **<Alt>N** to load a new file
- press **<Alt>L** to reload the current data file. If the file is a .3D file you can change to a different plane.

h) Reverse direction of X-coordinates:
- press **<Alt>X** to reverse X-coordinates for file types that cannot be edited

4. Display Options

a) Using keystrokes to select a frame:
- to move one frame forward, press 8or 6
- to move one frame backward, press 9or 7
- to move one frame right, press 6, this function may be reversed if the subject moves from right to left
- to move one frame left, press 7, this function may be reversed if the subject moves from right to left
- to move to the first frame, press **<Home>**
- to move to the last frame, press **<End>**
- to view and edit one frame at a time, press **<Alt>E**. The proceeding and following frames are also displayed.
- to jump to a particular frame press **J** then enter the frame number

b) Zooming in the digitized image (see
      Figure 7):
      - press +, **<PageUp>**, = or **<F5>**
      to zoom in on the image
      - press **-**, **<PageDown>**, or **<F6>**
      to zoom out on the image
      - press _ (underscore) to reduce
      the image to 50% while – (minus)
      reduces to 75%
      - these operations can be used
      from the main or the step-mode
      screens
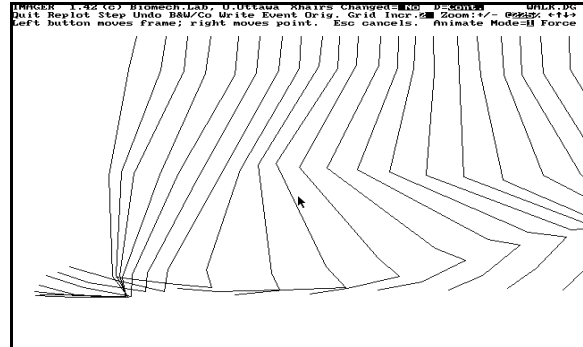
Figure 7. Example of a zoomed display with the marker highlighted for correction. The small crosshair indicates point to be moved.

c) Highlighting segments and changing
      colours:
      - to highlight the segment you want, press **h** or **H** until the appropriate segment is
      highlighted. Use **<Alt>H** to automatically highlight each segment and **<Ctrl>H**
      to remove highlighting.
      - to change the image from colour to black & white and vice versa: press **B**
      - this can only be done in the main screen, once the step (press **S**) screen has been
      chosen, you cannot use the **B** key
      - to change the images to a different colour, press **z** or **Z**

d) Rotating and changing colours of all the segments:
      - pressing **Y** will change the sequence of segment colours in the forward direction
      and pressing **y** will change the colours in reverse. **<Ctrl>Y** resets the order and
      <Alt>Y colours each frame with a different colour.

e) Moving (panning) the viewing window:
      - left, press **<Ctrl>**7
      - right, press **<Ctrl>**6
      - up, press **<Ctrl>**8
      - down, press **<Ctrl>**9
      - to re-centre the image, press **<Ctrl><Home>**
      - move mouse cursor to a location and press **<Enter>**
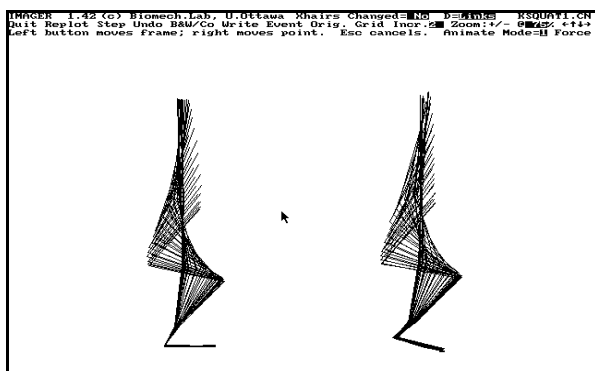
f) Toggle background:
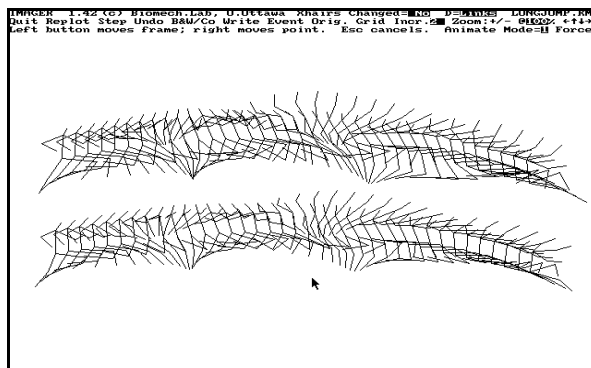Use **<Ctrl>B** to toggle between a black background and a gray background.

g) Toggle dashed or solid lines for selected frame:
Use **<F6>** to toggle between dashed and solid lines for highlighting selected frame.

h) Getting two images on one screen (see Figures 8 and 9):

Figure 8. Example of loading a second data file with **<Alt>M**.

Figure 9. Example of loading a second data file with **<Alt>L**.

To display a second (or third file), simultaneously, press **<Alt>L** or **<Alt>M**; each new file is artificially shifted upwards or laterally a specified distance, respectively. This shift does not affect the original data files because you cannot use this option with .DG or .1T type files. (The only types of file that can be edited.) Furthermore, you cannot use this option with files that have different numbers of markers. You can, however, compare .CN, .SN, .KM and .3D files and files from different subjects. Note, if you are using a "links" file all files should have the same ordering of the markers, otherwise, the presentation will be confusing. Press:
- **a** (with **<Shift>**, **<Ctrl>** or **<Alt>**) to display all the loaded frames sequentially
- **k** (with **<Shift>**, **<Ctlr>** or **<Alt>**) to animate the files, synchronously
- use **–** to zoom out or **+** to zoom in
Note, with the "**K**" options some frames are not displayed if there are no matching frame numbers in the preceding file. If the preceding file has more frames than subsequent files then all loaded frames are displayed. The speed of the displayed images increases with whether you press a lowercase letter, an uppercase letter or with pressing the <Ctrl> key. The **<F2>** or **<Alt>** key with **A** or **K** creates continuous animation of the images. Note that pressing the space bar will pause the animation at which time the display mode or animation speed or mode may be changed. Press **<Esc>** to exit the animation mode and redisplay all the data.

i) Toggle displaying centres of gravity:
If centres of gravity were loaded (filetypes .3D and .KM) then the path of the centres of gravity may be displayed. To toggle them on or off press **<Alt>G.**

j) Change graphics mode:
Use **<Ctrl>U** to change the resolution of the graphics driver.

k) Toggle help display:
Use **<Alt>U** to alternate between coloured and monochrome help displays.

5. Optional Viewing Modes

a) Looking at individual steps of the data:

- press **S** to present the data in Step-mode
- the screen will have all the data in a neutral colour except the selected frame

Pressing: **<Home>** highlights the first frame

<End> highlights the last frame

7, moves to the left through the frames

8, moves forward through the frames

6, moves to the right through the frames

9, moves backward through the frames

b) Changing type of data display:

(continuous stick-figure, trajectories, points, big points or links)

Also see section 3, "Screen editing" part (d).

For an example of point plot mode see Figure 10, for trajectory mode see Figure 11, for links mode see Figure 13 and for continuous mode see Figure 2. Links mode cannot be accessed by pressing **D** unless a .LIN file has already been loaded. Press **L** to read a "links" file or view the current links.
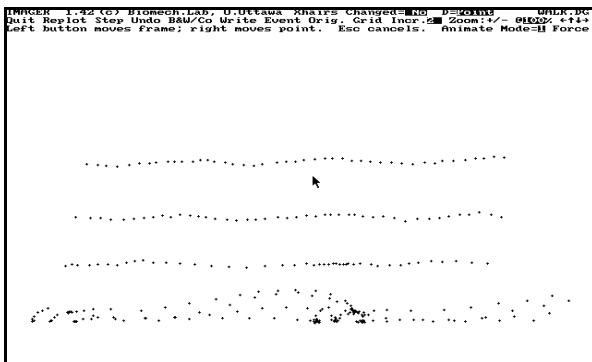
Figure 10. Example of a point plot display.
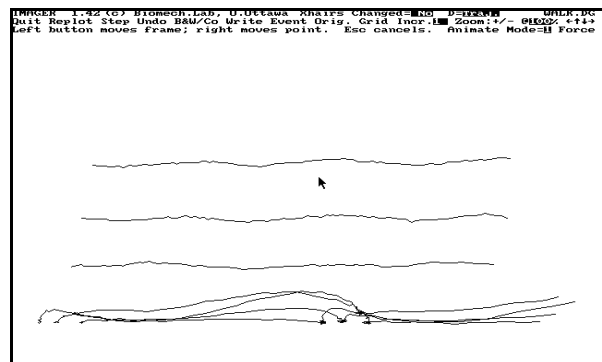
Figure 11. Example of a trajectory plot.

c) Animating the data:

      - pressing **<Ctrl>A**, **A** or **<Shift>A** animates the data at increasing display speeds

      - the way the data are presented is dependent on the display mode set (see below, **M**)

      - **<Alt>A** and **<F2>** will animate the data continuously, to quit this operation, press **<Esc>**

      - to increase the absolute speed of the animation, press **<F3>**

      - to decrease the absolute speed of the animation, press **<F4>**

      - press **Alt>B** to animates in reverse (backwards) order

d) Changing animation mode:

      - press **M** to change modes or press **<Alt>0**, **<Alt>1**, **<Alt>2** or **<Alt>3** for modes 0, 1, 2 or 3, respectively.

      Mode 0 when animated, starts out with no frames visible and then shows one frame at a time leaving behind either no frames or the highlighted segment of each frame (this depends on the Highlight function, see section 4).

      Mode 1 when animated, starts with no frames. It highlights a single frame one at a time, while previous frames are shown in a dull grey after being highlighted. One segment of each frame may be highlighted depending on the Highlight function. It does not draw the next frame until it is time for it to be highlighted.

      Mode 2 when animated, starts with all coloured frames and one at a time, turns them all dull grey. The dull grey frames may or may not have one segment highlighted (see Highlight function, section 4).

      Mode 3 when animated, first turns all the frames to a dull grey then at the beginning of the frames, it colours one frame at a time and then erases it (may leave behind the highlighted segment of the frame). The frames are redrawn in colours after all of them have been erased.

e) Viewing and editing frame-by-frame:

      Press **<Alt>E** shows allows for the editing of a single frame but includes the display of the previous and following frames monochromatically

      Note, in this mode only the right mouse button may be used to edit the coordinate pairs. To cancel is mode press **<Alt>V** again.

f) Display marker numbers or names:

      - press **n** to display the marker numbers for the current frame

      - press **N** to display the marker names for the current frame

6. Printing the Images

To print the screen, press **<Ctrl><F5>** or **<Alt><F5>** for HP (PCL), Epson or IBM Proprinter type printers. You may want to hide the top "help" display by pressing **<F1>** several times or pressing **<Ctrl><F1>** or **<Alt><F1>**. Note, the program will check whether the printer is online before printing. If you use a network printer press **N** to eliminate this requirement.

To print on printers attached to ports LPT2 or LPT3 start the program with the command line switches **/P2** or **/P3**, respectively. The default is LPT1 or switch **/P1**.

7. Saving, Exiting or Quitting Imager

a) Writing new data to the original file without quitting the program:
- press **W** from the main screen (this operation can only be performed with a .DG type file).
Caution must be taken with this operation. The program does not warn you that it is writing data to the original file. So use it wisely. The original file is renamed with the extension, .DG$.

b) Exiting or quitting Imager (see Figure 12):
- while in the main screen, press **Q**, if a .DG file was loaded and data were modified and not stored the program will request advice.
- to write data to disk, press **W**
- to exit without saving, press **X**
- to cancel and return to editing or viewing, press **C**

```
IMAGER 1.42 (c) Biomech.Lab, U.Ottawa                          WALK.DG
  Modified data have not been saved (i.e., written to disk).
  Press W to write/save, X to exit without saving or C to cancel.
Record     69
```

Figure 12. Example of exit display when the data have been edited but not saved.

8. Digitizing Coordinates, Lines and Angles

To enter digitizing mode press **X** (see Figure 6). Within this operating mode various graphical features can be added to the display as outlined previously in Section 3. This mode also allows the user to view the (*x, y*) coordinates of any point in the display or to compute the length or angle of a line segment. These possibilities are outlined below. In general, only file types that have been converted to real metric units should be analyzed with this feature. For example, Biomech .DG files and APAS .1T files need to be converted by Cinedata or APAS Transform to produce .CN, .KM or .3D files so that the data are converted to metric units of measure.

To exit digitizing mode press **Q** or **<Esc>** once or twice depending upon the current operation. After exiting, to erase any points or lines added during digitizing mode press **R** to refresh the display.

a) Displaying coordinates:
Once in digitizing mode, moving the cursor displays the (*x, y*) coordinates of the cross-hairs on the third line from the top of the screen beside the label "X, Y posn:" (see Figure 6).

b) Measuring a distance or length of a line segment:
When digitizing mode starts, line length calculation is automatic. If not press the period "." to start automatic length calculation. Just press the right mouse button at the start of the line and press again at the end of the line to compute the line's length. The length will be displayed in the third line at the top of the screen beside the label "Length =" (see Figure 6). Be careful to press the mouse button only once at each end of the line. Each time you press the right mouse button, a new line length is computed. Pressing the space bar stops line length calculations.

c) Measuring a line segment's angle:
Press **A** to start angle measurements. Follow the instructions at the top of the screen. Press **A** again to anchor the line segment (usually at the proximal end of a body segment). Move to the other end of the line and press **A** to have the line's angle with respect to a right-horizontal from the first point computed. The angle in degrees and radians is displayed on the third line of the display.

d) Measuring a joint angle:
Press **J** to start joint angle measurements. Follow the instructions at the top of the screen. Press **J** again to define the distal end of the first segment, then move to apex of the angle (proximal end of first segment) and press **J**. A line will be drawn to this point. Finally, move the mouse to the distal end of the second segment and press **J**. The angle between the segments will de displayed in degrees and radians on the third line of the display. The angles will range between +/- 180 degrees. A positive angle indicates a rotation from the first segment to the second in the counterclockwise direction. A negative angle indicates clockwise rotations.

9. Other Topics

a) Help menu:

To get help about the function keys, press **<F1>** one or more times.

b) To undo previous operations:

- press **U**, this will only work for the immediately previous operation

c) Loading a "links" file:

To load a "links" file, press **L** (see Figure 13). These files contain the pairs of coordinates that you want to have plotted as your stick-figures. Links or segments do not have to be defined sequentially nor do all markers or segments have to be defined. For example, you could develop a file which only displays one segment, one limb or one side of the body. The program will still edit any marker but will display only the selected segments.

d) Changing graphics cursor:

To change cursor press **<Alt>C** (see Figure 12).

e) Authors:

To see the names of the authors of Imager, press **?** or **/**.
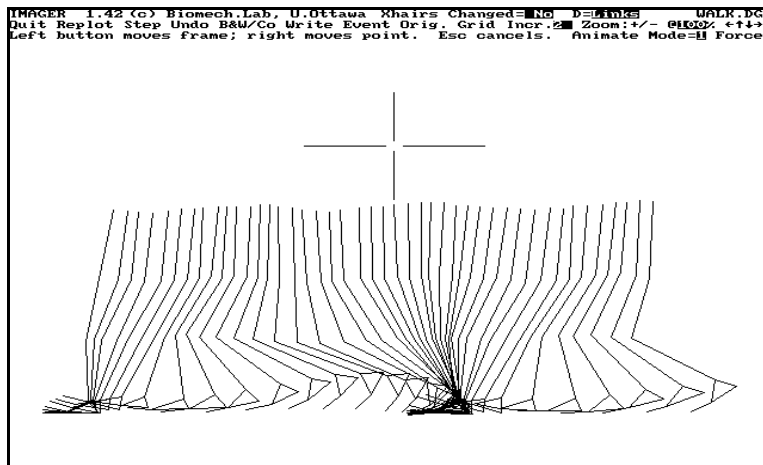
Figure 13. Example of a figure drawn with the "links" display option. Notice the triangular foot segment and alternate cursor.

Table of Keyboard Functions

	Lowercase	Uppercase (Shift)	Control (Ctrl)	Alternate (Alt)
A	slow animation	medium animation	fast animation	animate continuously
B	toggle black&white	same	alternate background	animate backwards
C	continuous view	same	(not usable)	alternate cursor
D	change display view	same	reset display mode	delete frame
E	edit event codes	same		edit in single frame mode
F	toggle force display	same	reset force display	draw forces over images
G	show grid	show control points	show CP numbers	toggle centre of gravity
H	highlight next	highlight previous	remove highlighting	auto-highlight
I	increment more	increment less	reset increment to 1	insert frame
J	jump to a frame	same		
K	slow synched anim'n	med. synched anim'n	fast synched anim'n	animate continuously
L	links view	same	read/show links file	load next file above
M	toggle animate mode	same	reset animate mode	load next file beside
N	show marker numbers	show marker names	add notation to frame	load next file
O	display origin	display origin axes		toggle display of ref' points
P	toggle point view	same		
Q	quit	same		
R	replot	replot	renumber frames	reload
S	step mode	same	(not usable)	edit scaling data
T	trajectory view	same		
U	undo	same	change graphics mode	alternate help display
V				average adjacent frames
W	write (save) data	same	allow writing to file	
X	digitizing mode	same		reverse X-direction
Y	initial colour next	initial colour prev.	reset initial colour	alternating colours
Z	single colour next	single colour prev.	reset multicolour	suppress (0,0) coordinates
+ or =	increase zoom			
-	decrease zoom to 75%			
_	zoom out to 50%			
/ or ?	show authors			
0	draw axes at (0,0)			set animation mode to 0
#	show marker numbers			
@	show marker names			
F1	toggle help menu		reset help menu	show file title
F2	animate continuously		reset animation	reset all defaults
F3	increase anim. speed		reset anim. speed	fastest anim. speed
F4	decrease anim. speed		reset anim. speed	
F5	print		print	
F6	toggle dashed/solid lines			
F7	increase force vectors		reset force vectors	
F8	decrease force vectors		reset force vectors	
F9	increase frame increment		reset frame increment	
F10	decrease frame increment		reset frame increment	
F11	increase zoom		reset zoom	
F12	decrease zoom		reset zoom	
Home	go to first frame	same	recentre images	
End	go to last frame	same		
Enter	centre on mouse			
Space	remove frame number			