TN-IMAGE

Description of TN-Image and xmtnimage
Image Analysis Software

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Latest revision: 05/20/1997

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ftp sites:
ftp://sunsite.unc.edu/Linux/X11/xapps/graphics (Linux versions)
ftp://las1.ninds.nih.gov/pub/unix/tnimage (all Unix versions)
http://las1.ninds.nih.gov/pub/unix/tnimage (all Unix versions)
ftp://las1.ninds.nih.gov/pub/dos/tnimage (DOS version)
ftp://las2.ninds.nih.gov/pub/dos/tnimage (DOS version)

A collection of sample test images, mostly in TIF format, is also available at these sites. These are also the ftp sites for **nplot**, the scientific graphics plotting program, and **tnshell**, the DOS file manager.

The DOS version is also available at SimTel mirror sites.

BBS sites:
Compuserve, PCAPP, library 10

1.0.0 Introduction

TN-Image is an advanced image analysis program oriented toward scientific and technical image analysis and editing. This manual describes both the DOS and Unix versions. The functionality of both versions is similar. However, those parts of the manual discussing DOS specific issues and registration are not applicable to the Unix version.

1.1.0 Contents

2.2.0 Summary

TN-Image allows you to scan, view, edit, and print PCX, IMG, TIF (both Macintosh and PC), JPEG, BMP, GIF, and TGA images, of any depth between 1 and 32 bits per pixel, color or monochrome, as well as raw binary images, raw 3D, and user-definable image formats. You can edit, cut/paste, add text, adjust color intensity or contrast, superimpose multiple images, and create drawings using lines, circles, splines and Bezier curves. It handles 8 bit/pixel (indexed-color), as well as 15,16, 24 and 32-bit per pixel screen modes. In the indexed-color modes, you can change the color map to one of 10,000 pre-defined colormaps or graphically create a new one. TN-Image is completely menu-driven with an extremely user-friendly graphical user interface. Dialog boxes and graphs can all be clicked-and-dragged to one side so as not to obscure the image. Image size is limited only by available memory or disk space (whichever is greater).

TN-Image is particularly useful for scientific image analysis, with densitometry, background subtraction, molecular weight calibration, and automatic detection of peaks, bands and spots in your image for quantitative measurement of optical density. Images deeper than 8 bits/pixel, such as medical grayscale images, can be viewed with a sliding scale to enhance any particular intensity region. Images can be rotated, resized, warped, flipped, color-remapped, or filtered (with sharpening, blurring, edge enhancement, freeze-fracture effect (shadow sharpening), background subtract, or noise filter). Quantitative data, peak area tables, or color histograms can be exported to an ASCII file with a single mouse click.

Areas or parts of images can be filled with a solid color or a color gradient, copied to another region, superimposed, subtracted, XOR'd, added, averaged or erased. All operations function seamlessly across multiple images regardless of their color depth. Images can be up- or down-converted into a different color depth.

It is particularly useful to biochemists and molecular biologists who wish to analyze SDS gels, blots, and DNA gels. The blot can simply be scanned in a scanner, then labeled, analyzed, quantitated, and printed on a laser printer. Printed blot images and quantitative results have already appeared in several scientific papers. The print quality is optimized for high resolution, and gives extremely high quality output on a laser or inkjet printer up to 2400 dpi.

Images can be Fourier-transformed and the real or imaginary components can be viewed, edited and modified. Pairs of images can also be convoluted and deconvoluted. Power spectra can also be viewed.

TN-Image can use up to 2GB of extended and virtual memory. Up to 512 images can be viewed and edited simultaneously. The program requires an 80386 with a minimum of 4MB of RAM, DOS 3.2 or above or a supported version of Unix, and a Super VGA monitor. It handles all VESA screen modes, including 1600x1200 resolution, in 256, 32768, 65536, and 16 million (true color) modes. A mouse is required. Laser or inkjet printer is required for printing. TN-Image can also run in a DOS box under Windows or OS/2 if desired.

Images can overlap without interfering with each other or the background. You can use the mouse to scroll through the image in adjustable steps.

3.0.0 Usage license

NOTICE

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The Unix versions and the DOS Shareware version of TN-Image, including this manual, may be freely redistributed, copied, and uploaded to computer networks or bulletin boards without restriction, provided that the following conditions are met:

(1) This documentation file and all other files included in the TN-Image package, including the sample images and tutorial files, must be included in their entirety whenever the program is distributed. Any modifications of the documentation must be clearly indicated as such.

(2) The executable file must not be modified in any way without express written permission from the author.

(3) No algorithm used in this program or any part of the user interface may be patented or trademarked by any party.

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3.0.1 Source code usage license

No Warranty

This source code is provided with no warranty of any kind. No guarantee is made that this software will even compile or execute properly on any given machine after compilation. The author retains copyright on all files except xmtnimage16.cc, which is largely derived from the work of the Independent JPEG group. The distribution of the JPEG interface source code in xmtnimage16.cc is covered under the GNU General Public License (GPL) which may differ in some details from this License. A copy of the GPL is included in the file "GPL".

End users are encouraged to use the pre-compiled versions of this program if possible rather than compiling this source code. Pre-compiled versions are available by anonymous ftp at las1.-ninds.nih.gov for the following platforms: MS-DOS, ConvexOS, Linux (x86), Solaris (Sparc), and SGI Irix.

Usage license

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3.1.0 Summary of features in different versions

Feature	DOS Shareware	DOS Registered	Linux	Irix	Solaris	ConvexOS
Max. images	2	512	512	512	512	512
Image editing	x	x	x	x	x	x
Image conversion	x	x	x	x	x	x
Format conversion	x	x	x	x	x	x
Labeling	x	x	x	x	x	x
Drawing	x	x	x	x	x	x
Multiple fonts			x	x	x	x
Image algebra		x	x	x	x	x
Grayscale images > 8 bits	x	x	x	x	x	x
Histograms	x	x	x	x	x	x
Selectable color planes	x	x	x	x	x	x
Image calibration	x	x	x	x	x	x
TIFF	x	x	x	x	x	x
TGA	x	x	x	x	x	x
BMP	x	x	x	x	x	x
IMG	x	x	x	x	x	x
PCX	x	x	x	x	x	x
GIF	x[1]	x[1]	x	x	x	x
Raw	x	x	x	x	x	x
ASCII	x	x	x	x	x	x
Custom image formats		x	x	x	x	x
JPEG		x	x	x	x	x
3D			x	x	x	x
Densitometry		x	x	x	x	x
Fourier transform		x	x	x	x	x
Deconvolution		x	x	x	x	x
Selectable colormaps	2	10000	10000	10000	10000	10000
Filters	2	13	13	13	13	13
Virtual memory		x	x	x	x	x
Peak Area analysis		x	x	x	x	x
PCL Printing		x	x	x	x	x
PostScript Printing		x	x	x	x	x
Macro language		x	x	x	x	x
Scanner interface			x	x	x	
Plugins			x	x		

[1] Read-only due to patent restrictions.

3.2.0 Submitting bug reports

If TN-Image crashes, hangs, draws the screen incorrectly or fails to read or write a valid image, it is probably a bug. I would greatly appreciate receiving bug reports from all users. Bug reports should be sent to the above Internet e-mail address for fastest response, or alternatively to the P.O. box listed above. If you send a bug report, please run the command "tnimage -diag" first and write down any relevant information. Also indicate your computer type, video card, and monitor type, what resolution you are trying to use, and the operating system and OS version you are using, and any other relevant information. Most importantly, indicate what version of TN-Image you are using, and the sequence of actions that cause the problem. If the problem only occurs with a specific image, you may also need to send a copy of the image file. The easiest way to do this is to upload it by ftp into the 'pub/incoming' directory on las1.ninds.nih.gov. All bug reports will receive immediate attention. If you are a registered user, you will also receive a replacement disk if I am able to reproduce the bug.

4.0.0 Upgrade policy

Registered users of the DOS version can obtain the latest version at any time by ftp at a special ftp account.

Read the file TNIMAGE.NEW, available at the ftp site, for news about the latest features and changes in TN-Image.

The latest Unix version(s) are freely available at the ftp site.

5.0.0 System Requirements (DOS Version)

TN-Image has the following minimum system requirements:

DOS Version:

1. MS- or PC-DOS above version 3.2 or Windows.

2. A minimum of 4 MB of RAM, preferably 8 MB. 8MB is strongly recommended and may be required in future versions (If you have 4 MB of RAM or less, see *Operating under low-memory conditions* below).

3. A computer with an 80386 or higher CPU.

4. A Super VGA card with at least 1 MB of video memory, and capable of handling 256 or more colors.

5. A super VGA monitor capable of displaying 256 colors. The default screen mode for TN-Image is 800 x 600 pixels. If you don't know whether your monitor can display at this resolution, it is advisable to check first, either in your monitor documentation, or using the diagnostics program that should have come with your video card. WARNING: It is the responsibility of the video card, not this program, to determine whether your monitor can handle any given screen mode. The only way for the program to determine whether it is safe to set a given screen mode is to query your video card. Unfortunately, not all video cards respond with accurate information. If your video card supports this screen mode but your monitor doesn't, you could experience a computer crash or even (theoretically) damage your monitor. This has never happened in all the months of extensive testing of the program on a variety of monitors. Nonetheless:

THE AUTHOR ASSUMES NO RESPONSIBILITY FOR PROBLEMS CAUSED BY RUNNING THIS PROGRAM IN A COMPUTER WHICH HAS A SUPER VGA CARD ATTACHED TO A REGULAR (NON-SUPER VGA) MONITOR!

If you have a super VGA monitor but it cannot handle 800x600 pixel mode, TN-Image can also use other video modes. See "Command-line options" below.

6. A mouse. It is advisable to obtain a mouse driver that is compatible with super VGA modes, such as Logitech's mouse driver version 6.12 or later. Earlier mouse drivers will work, but you will not have as fine control of the mouse as with later versions. A mouse driver is needed even if TN-Image is run in a Windows DOS box.

7. TN-Image should be run from a hard disk. If run from a floppy, do not remove the floppy while the program is running.

8. A PCL laser or inkjet printer or PostScript Level 2 printer is required to obtain hard copies. (H/P Laserjet compatible or a similar 600 dpi laser printer is recommended). A 300 dpi printer will also work, but will give inferior quality prints. A H/P compatible color laser or inkjet printer is required for color printing.

6.1.0 Image file types supported

TN-Image reads and writes image files in TIF, JPEG, PCX, TGA, BMP, as well as the IMA format produced by NPLOT (available at the ftp site) and the IMG format produced by frame-grabbers, as well as GEM IMG and several others listed below. Any other generic uncompressed file type can also be read, provided that:

1. you know the number of x and y pixels in the image
2. you know the no. of bits per pixel.
3. the image stores its pixels in the usual scanning order (left to right, top to bottom).

In addition, you can create new image file formats to read and write images in virtually any uncompressed format that uses fixed-size headers.

The IMG format produced by TN-Image is the same as that produced by most frame grabbers: 4 bytes indicating the x and y size, followed by the image data. This is not the same as the GEM "IMG" format, which is seldom used for image analysis. TN-Image can read GEM IMG Raster files, however.

For densitometry, it is recommended that images be stored in TIF format because this format allows the image to provide a calibration curve to accurately convert pixel intensity to optical density

(O.D.). This is important for quantitative applications. Most scanners provide this information. If not, TN-Image will still function, but the results will be in uncorrected pixel intensity values instead of O.D. (This consideration does not apply for color images).

*****NOTE*** Targa (TGA) files must have the extension .TGA to be readable.**

*****NOTE ON COMPRESSED TIF FILES*****

As of Version 2.11, creation of compressed TIF image files is not supported in TN-Image. LZW- and PackBits-compressed TIF files are, however, readable. The reason for this discrepancy is the choice by Aldus Corporation of LZW compression, which is patented by Unisys, for the compression algorithm. The most recent TIFF documentation indicates that LZW is now being phased out of TIFF. This means that LZW-compressed TIF files will no longer be a valid image format.

The following file subtypes/features in all valid permutations have been tested to be readable by TN-Image:

Tif files: 1 to 32 bit/pixel TIF-B,G,P, and R files (B=black/white, G=gray scale, P=indexed color, R=RGB full color) Tiles/Strips/CMYK Intel and Macintosh TIF

PCX files:

1,2,4,and 8 bit/pixel PCX

IMG files: 1,2,4,and 8 bit/pixel IMG

Other:

4 bit IMA (from VGA or EGA mode NPLOT and NPDATA) Unformatted 1 to 32 bit/pixel raw binary images (color and monochrome)

JPEG:

Color JPG (JFIF) (registered version only)

Targa:

8, 16, and 24 bit/pixel TGA

BMP:

4,8, and 24 bit BMP (Windows 3.x subtype)

GIF

GEM IMG

Raw 3D (Unix version only)

The following file subtypes can be created by TN-Image:

1 to 32 bit PC TIF-B,G,P,and R, incl. CMYK extension(uncompressed)

1 to 32 bit raw bytes

1 to 32 bit custom files for PC, Mac, and MVS mainframe OS's

1 and 8 bit PCX

1 and 8 bit IMG

24 bit JPG (JFIF subtype) (registered version only)

8,16, and 24 bit TGA

8 and 24 bit BMP (Windows 3.x subtype)

8,15,16,24, and 32 bit ASCII

8,15,16,24, and 32 bit raw 3D (Unix version only)

The following file types may be also supported if enough requests are received:

Creation of 1 to 32 bit Mac TIF

OS/2 BMP

PNG

6.2.0 Pixel values and image manipulation

Image types

Images fall into 3 distinct categories:

1. Grayscale: Pixel values directly correspond to intensity. There may in addition be a table mapping each intensity to an optical density value.
2. Indexed-color: Pixel values have no intrinsic meaning and are merely indexes into a color map containing 256 colors in a random sequence which is totally different for each image.
3. Color: Pixel values are a composite number containing intensities of red, green, and blue. The number of bits of each color is different for each standard image depth (*i.e.,* 15, 16, 24, 32, and 48 bits/pixel).

Each image type has benefits and drawbacks. For example, cutting and pasting among different indexed-color images requires finding the closest matching colors. If the color maps are too different, the pasted image will not have the same color as the original. This problem can be avoided by converting the images to true color first, then converting back to the original image type afterwards. Similarly, densitometry and FFT only work well on grayscale images. Before performing FFT's, it is necessary to convert color images to grayscale. For indexed-color images, the additional step of sorting the colormap is necessary to ensure that pixel values bear a linear correspondence to intensity. Converting grayscale images to color involves defining a colormap, then converting the image to indexed color, and finally to true color. All of these operations can be done (and automated) in TN-Image.

When you move the mouse in TN-Image, the information area shows the x and y coordinates and the value of the pixel at the mouse position. This is convenient when manipulating the image, since much image manipulation uses simple mathematical functions to transform the image. Thus, to make the image lighter, you could "add" a value of 50 to each pixel. To increase contrast, you can multiply each pixel value by a constant factor. These steps are not hidden from the user for the sake of ease of use. This ensures that quantitative manipulations on the image remain directly traceable to the original data.

6.3.0 Description of Menu Bars (DOS Version)

TN-Image displays a variety of information in the information area. In the DOS version, this consists of two lines of text at the top of the screen. One or both of these lines can be hidden to create a less cluttered display. The menus are still active even when the menu bars are hidden.

Top line:

File Image..etc - The main menus - use the mouse to select the desired option.

- Foreground color indicator

- Clicking on these small triangles will move the topmost image in the indicated direction. The distance is determined by the “Cursor movement rate” (see below).

r255g255b255 - The red, green, and blue components of the current pixel, i.e., the pixel the mouse is pointing to. For 8 bit/pixel images, the red, green, and blue components of the colormap entry for that color are shown.

i=32767 - The intensity value of the current pixel, This is only displayed if TN-Image is in a mode with a wide enough screen width. This value will be different for images with different numbers of bits per pixel.

Second line:

0.12345 - The current pixel value, scaled from 0 to 1 and corrected for bits/pixel of the point.

123 456 - The next 2 numbers are the x and y coordinates of the current pixel.

Size 8 - The cursor movement rate. This is the distance by which the mouse will move when an arrow key is pressed, and the distance an image will move when you click one of the small triangles. The cursor size can be changed by pressing the gray (+) or (-) keys, or selecting “Configure... Cursor movement rate”.

8 bpp - The bits per pixel of the current pixel, calculated for the topmost image.

16 bits/pixel - The rightmost item is the bits/pixel of the screen.

Vertical

- A click box is visible when the program is in a state such as “vertical text” mode or “drawing” mode. Clicking on this box returns to normal mode.

6.3.1 Description of Menu Bars (Unix Version)

In the Unix version, the menu bar automatically wraps to multiple lines if there is not enough space. Thus, the program window can be resized so that only the main information window and the menu bar are visible. Images can then be loaded into separate, positionable windows. On occasion, it is necessary to quit and restart TN-Image after resizing the window to obtain a multi-line menu bar.

The Motif menus can be “torn off” and dragged to one side. Thus it is possible, for example, to have one or more of the menus on the screen permanently and then shrink the main window to an inconspicuous size.

Clicking on one of the four large arrows in the information area moves the current image in the direction of the arrow. The distance moved is determined by the “step value” which can be changed by the gray + and – keys (KP_add and KP_subtract) or in the “Config” dialog.

The main cancel button is always active and interrupts many repetitive operations, such as flood fill, densitometry, circle-drawing mode, etc.

6.4.0 Tutorial files

Five tutorial files are included with TN-Image:

1 DENSITOM.PCX - an image file demonstrating strip densitometry.
2 DENSITO2.TIF - an image file demonstrating spot densitometry.
3 DECONVOL.TIF - an image file demonstrating convolution and deconvolution using FFT (Part 1).
4 DECONVO2.TIF - an image file demonstrating convolution and deconvolution using FFT (Part 2). (Included in registered version).
5 FILTER.TIF - an image file demonstrating digital filtering using FFT.

7.0.0 Operation

(DOS version) - To start TN-Image, type TNIMAGE. If VESA BIOS is present, TN-Image will run using the functions defined in the VESA specification. Otherwise, TN-Image will try to use video card-specific functions. If no VESA BIOS is present and the card is unsupported, TN-Image will terminate. VESA 1.2 or above is required to run in 15-, 16-, 24-, and 32-bit/pixel color modes, since in the earlier VESA specification, modes 110 to 11b were text modes.

7.1.0 Command-line options (DOS version)

`-n` = Skip introductory screen in 8-bit modes.

`-vesa` = forces TN-Image to use VESA BIOS even for Trident or Tseng Labs cards.

`-oldvesa` = forces TN-Image to use functions for version 1.0 VESA BIOS (slightly slower, but required on some cards).

`-trident` = Forces TN-Image to use Trident-specific calls, even if VESA BIOS is present.

`-tseng` = Forces TN-Image to use Tseng-specific calls, even if VESA BIOS is present.

`-diamond` = Forces TN-Image to use Tseng-specific calls, even if VESA BIOS is present and sets the program to use Diamond Speedstar mode. This option is experimental and will be subsumed under the "Tseng" option after we obtain a Tseng-based Diamond card for testing. Feedback as to whether this option actually works will be appreciated.

`-w32` = Forces TN-Image to use Tseng-specific calls, even if VESA BIOS is present and sets the program to use W32 chip mode. This option is experimental and will be subsumed under the "Tseng" option after we obtain a card with the Tseng ET4000W32 chip for testing. Feedback as to whether this option works will be appreciated.

`-S3, -ATI, -XGA` = Force TN-Image to control these chips directly, even if VESA BIOS is present. S3 and ATI are not currently implemented. XGA mode currently only works in 640 x 480 mode.

`-diag , -diagnose` = Diagnostic mode (Prints status messages at each stage of setting your video mode). Useful if you have difficulty starting TN-Image on your computer. At each step, you need to press a key to continue. **Please report this information when requesting technical assistance.**

`-fyu` = This option is for debugging use only.

`-macro` *macro_file* = Automatically runs the specified macro file. See "Batch mode processing" `-files` *file_list* = Specifies a list of image files to be automatically loaded. Using a text editor, create an ordinary text file containing a list of the files to be read, with one filename on each line, for example:

```
t*.tif
c:\ images\ abc.bmp
hubble.img
```

Then start TN-Image with the command:

`tnimage -files test.lst` substituting the name of your list for "test.lst". Do not put a dash before the filename of the list file. Wildcard characters such as '*' or '?' are also permissible. Up to 512 images can be loaded from the list file (if you have the Registered version). If you only need to load a few files, it may be easier to use the *filename* option (below) instead.

`filename` *filename ...* = Reads the specified file(s). You can load as many files as you can cram onto the command line. If you have a large number of files, it may be easier to use the "-files" option (above). Do not precede the filename with a dash ("-"). Filenames may contain path specifications and wild cards (* or ?).

Examples:

`tnimage my.gif` = Loads my.gif

`tnimage *.tif` = Loads all TIF files in current directory.

`tnimage c:\images\*.tif b:\abc.img` = Loads all TIF files from the C:\images directory, then file abc.img from drive B.

`tnimage -mode 103 *.tif -files file.lst -vesa`

Any combination of command line options is also acceptable. See *Screen modes supported* (below) for a list of screen modes.

`-mode` xxx = Start up in screen mode xxx, where xxx is a hexadecimal number indicating the desired screen mode (see below). Some monitors cannot handle the highest resolution modes and will fail to 'sync' or display a white screen. If this happens, press Alt-X two or three times to escape from the program. You can determine which screen modes your computer can handle by checking in the manual that came with your video card and monitor. **Read the warning below before using this option.**

Example: `tnimage -mode 111`

`-xres` xxx

= Start up in a VESA screen mode with x resolution of xxx, where xxx is the no. of horizontal pixels to display per scan line. 8 bits/pixel is automatically selected unless specified with the -bpp option. Some monitors cannot handle the highest resolution modes and will fail to 'sync' or display a white screen. If this happens, press Alt-X two or three times to escape from the program. You can determine which screen modes your computer can handle by checking in the manual that came with your video card and monitor. **Read the warning below before using this option.**

`-bpp` xxx = Start up in a VESA screen mode of xxx bits/pixel. (Used in conjunction with the -xres option).

`?` *or* `-?` = List the available screen modes.

The options can be in any order, except that if a parameter is needed, it must follow the option. The arguments must be separated by spaces.

Examples: To run TN-Image in VESA 1024x768 mode, type:

`tnimage -vesa -mode 105` *Enter* or

`tnimage -mode 105` (The word "Vesa" is only required if you happen to have a Tseng or Trident chip and you want to bypass direct chip addressing).

If you have an old card, specifying "-vesa" will cause display problems. If problems occur, use:

`tnimage -oldvesa` or

`tnimage -oldvesa -mode 105` to select 1024x768 mode.

To run TN-Image on a computer equipped with a Trident card, in 640 x 480 mode, type:

`tnimage -mode 5d`

or

`tnimage -trident -mode 5d` To run TN-Image on a computer equipped with a card containing a Tseng Labs ET4000 chip, in 800 x 600 mode, type:

`tnimage -mode 30` or `tnimage -tseng -mode 30`

To run TN-Image and automatically load and display the image "test.img", type

`tnimage test.img` or `tnimage -file test.img`

To run TN-Image in a 1600 x 1200 resolution at 8 bits/pixel, type:

`tnimage -xres 1600` or `tnimage -xres 1600 -bpp 8`

To run TN-Image in a 1600 x 1200 resolution at 24 bits/pixel (true color), type:

`tnimage -xres 1600 -bpp 24`

The command line options are stored in the file TN-Image.INI, so the next time you start TN-Image, it is not necessary to specify the screen mode.

7.1.1 Unix Command-line options

`-macro` *macro_file* = Automatically runs the specified macro file. See *Batch mode processing*

`-files` *file_list* = Specifies a list of image files to be automatically loaded. Using a text editor, create an ordinary text file containing a list of the files to be read, with one filename on each line, for example: `t*.tif /images/abc.bmp hubble.img` Then start TN-Image with the command: `tnimage -files test.lst` substituting the name of your list for "test.lst". Do not put a dash before the filename of the list file. Wildcard characters such as '*' or '?' are also permissible. Up to 512 images can be loaded from the list file. If you only need to load a few files, it may be easier to use the *filename* option (below) instead.

filename filename ... = Reads the specified file(s). If you have a large number of files, it may be easier to use the "-files" option (above). Do not precede the filename with a dash ("-"). Filenames may contain path specifications and wild cards (* or ?).

Examples: `tnimage my.gif` = Loads my.gif

`tnimage *.tif` = Loads all TIF files in current directory.

`tnimage /images/*.tif /mnt/abc.img`

= Loads all TIF files from the /images directory, then file abc.img from /mnt.

Any combination of command line options is also acceptable.

`?` , `-?` = List the available options.

`-fg` or `-foreground` = Specify foreground color

`-bg` or `-background` = Specify background color

Example: `tnimage -fg white -bg MistyRose3 &`

`-geometry` *geometry-string*

Example: `tnimage -geometry 400x500+100+100`

`-display` *screen-IP-address:screen*

Example: `tnimage -display 192.168.1.1:0.0 &`

See ' man X ' for more details. The options can be in any order, except that if a parameter is needed, it must follow the option. The arguments must be separated by spaces.

To run TN-Image and automatically load and display the image "test.img", type

`tnimage test.img`

To run TN-image remotely on a supercomputer and have the display appear on your local PC, type the command:

`xhost +`*supercomputer_host_name*

Then login to the other computer, and type:

`tnimage -display` *your_PC_hostname*`:0.0 &` where *your_PC_hostname* can be a registered host.domain name or an IP number. For example, if you are connected over a ppp link, and `ifconfig` indicates your IP address to be 156.40.65.151, type:

`tnimage -display 156.40.65.151:0.0 &` .

This can also be done from DOS or Windows using X-Window server software such as Xappeal, Exceed, Chameleon NFS/X, etc.

Alternatively, this can be done by setting an environment variable, *e.g.,*

`setenv DISPLAY 156.40.65.151:0.0`

(in tcsh or csh) or

`DISPLAY=156.40.65.151:0.0;export DISPLAY`

(in bash, ksh, etc.) instead of using the "-display" option.

7.1.2 X Window Resources

(Unix version only). Each of the Motif widgets in TN-Image has resources that can be individually set, by specifying the widget's name in your .Xdefaults or Tnimage file (in /var/X11R6/lib/app-defaults/). These files also interact with the X Window keymapping which can be changed with `xmodmap`.

As an example, suppose for some bizarre reason it was desired to make the 'Del' key actually delete a character. One way of doing this is as follows:

1. Create a keymap file: `xmodmap -pke > keymaps`

2. Edit the line for keycode 91 to read: `keycode 91 = 0x004` . (The keycode can be obtained using `xev`).

3. Load the new key translation table: `xmodmap keymaps` . Pressing the Del key now creates an 0x004. (You could also use 'Delete' or some valid key name - these are listed in the file /usr/X11/include/X11/keysym.h).

4. Edit .Xdefaults in your home directory and add the line:

```
Tnimage*Editor*Translations:  #override \n \
                <Key> 0x4:  delete-next-character() \n
```

(Note this must be entered exactly; in particular, the number must be 0x004 in the `keymap` file but 0x4 in the `.Xdefaults` file. Do not use a lowercase 't' in "Tnimage".

5. The change will now take effect in the Macro Editor only. On some systems, it may be necessary to restart the window manager for the new key to take effect. Leaving out the "*Editor" portion will cause the change to take effect in all Widgets.

Some of the important widgets in TN-Image are:
`Editor` - macro editor (Text)
`MenuBar` - the top menu bar (MenuBar)
`f1 to f70` - the menu items (PushButton)
`drawing_area` - the main drawing window (DrawingArea)
`drawing_area2` - the status area at left (DrawingArea)
`Image` - all the images (DrawingArea)
`List` - list selection boxes (ScrolledList)

Each of these has an extensive set of resources (such as fonts, colors, etc) that can be modified. For instance, Text Widgets have delete-next-word(), cut-clipboard(), page-left(). Refer to the X Window system manuals for details.

Here are additional examples. More specific settings will override more general ones.

`Tnimage*drawing_area2*background:green` -Sets the left drawing area to "green".

`Tnimage*drawing_area2*background:#2233AA` -Sets the left drawing area to red=22, green = 33, and blue=AA hex (34, 51, and 170 decimal, respectively).

`Tnimage*drawing_area*background:#223344`

`Tnimage*MenuBar*background:#223344`

To set the main drawing window color, select "colors...set colors", then select "erase background".

`Tnimage*marginHeight: 0` Sets the height of the margin in all widgets

`Tnimage*marginWidth: 0` Sets the height of the margin in all widgets

`Tnimage*foreground: black` Sets the widget text color

`Tnimage*background: gray` Sets the background color (Foreground and background colors of the main drawing area are set separately, from within TN-Image).

`Tnimage*shadowThickness: 1` Sets the depth of shadows on all buttons

`Tnimage*MenuBar*spacing: 3` Sets the separation between items on menus

`Tnimage*MenuBar*background: gray` Sets the color of menu bar

`Tnimage*MenuBar*fontList: *helvetica-bold-r-normal--12*` Sets the font for the top menu bar

`Tnimage*fontName: *times-bold-r-normal--12*` Sets the default font

`Tnimage*information_area.foreground:black` Sets the text color of the information area at the left

`Tnimage*information_area.background:gray` Sets the background color of the information area at the left

`Tnimage*list*fontList:*times-bold-r-normal--12*` Sets the font in list boxes to times bold (Not recommended, a fixed width font should be used).

These resources control the appearance of the file selection dialog:

`Tnimage*FileSelector*background: gray`
`Tnimage*FileSelector*foreground: black`
`Tnimage*FileSelector*fontList:*helvetica-bold-r-normal--12*`
`Tnimage*FileSelector*marginWidth: 5`
`Tnimage*FileSelector*marginHeight: 5`
`Tnimage*FileSelector*listVisibleItemCount: 30` Sets the number of files to show at a time
`Tnimage*FileSelector*borderWidth 0`

Other miscellaneous examples:

`Tnimage*Editor*foreground: black` Color of text in text editor
`Tnimage*Editor*background: gray` Color of text editor
`Tnimage*Editor*fontList:*helvetica-bold-r-normal--12*` Font for text in editor
`Tnimage*Warning*background: red` Set warning messages to red
`Tnimage*Ok*background: red`
`Tnimage*Cancel*background: white`
`Tnimage*Help*background: blue` Set the Ok, Cancel, Help buttons to red, white, and blue
`Tnimage*f1*background: red` set the 1st item in the first menu to red.
`Tnimage*borderWidth: 2000000000` Add a border 2 billion pixels wide around each image (Not recommended).
`Tnimage*borderColor: papaya whip` Change image border to papaya whip.

The labels and fonts for the dialog boxes may also be individually set. In this case, the resource name is the default string for the label. This also permits non-English labels to be substituted. For example:

`Tnimage*DialogForm*fontList: *helvetica-bold-r-normal--12*`
`Tnimage*DialogForm*radiobox*fontList: fixed`
`Tnimage*DialogForm*boxbutton*fontList: fixed`
`Tnimage*DialogForm*boxtext*fontList: fixed`
`Tnimage*DialogForm*boxpushbutton*fontList: fixed`
`Tnimage*DialogForm*boxfilename*fontList: fixed`
`Tnimage*fontList: hanzigb16st` This sets all fonts to Chinese. For fonts encoded by multi-byte strings (such as Chinese fonts), the label string and your locale must also be changed.
`Tnimage*Interaction mode.labelString: Information at your fingertips!!!`
`Tnimage*DialogForm*File type.labelString: This is a feature!`
`Tnimage*DialogForm*Read Image.labelString: Where do you want to go today?`
These three resources change the text in the menu from "Interaction mode", " File type", or "Read image" to the corresponding commonly-used computer terms. The latter two text labels are changed only if they occur in a DialogForm Widget.
`Tnimage*DialogForm*Filename.labelString:`
(An example of a foreign-language font; may not display correctly on all systems)

Capitalization and spacing of the original label must be specified exactly. More specific settings override less specific ones. For example, the combination

`Tnimage*Ok*fontList: *helvetica-bold-r-normal--12*`
`Tnimage*DialogForm*Ok*fontList: *helvetica-bold-r-normal--24*`
will set a size of 24 for the Ok button in dialog boxes and 12 elsewhere.

If the specific resource name is unknown, it may still be set by specifying the general Motif class name beginning with Xm. This is true for any Motif program. For example:

`Tnimage*XmMessageBox*marginHeight: 5`
Sets the vertical margin around warning and information boxes
`Tnimage*XmMessageBox*marginWidth: 5`
Sets the horizontal margin around warning and information boxes
`Tnimage*XmMessageBox*foreground: black`
Sets the text color in warning and information boxes
`Tnimage*XmMessageBox*background: gray`
Sets the color of warning and information boxes
`Tnimage*XmMessageBox*fontList: *helvetica-bold-r-normal--12*`
Sets the font to use in warning and information boxes
`Tnimage*XmDialogShell*background: gray` Sets the color of dialog boxes, clickboxes, etc.
`Tnimage*XmDialogShell*foreground: black` Sets the the text color of dialog boxes, clickboxes, etc.
`Tnimage*XmArrowButton.background: gray` Sets the color of the four arrow buttons in the information area.

A number of other generic resources may also be set by specifying the Motif widget class (such as XmPushButton, XmList, etc.). In general, any resources (of which there are many) not explicitly hard-coded in the program can be set two different ways: by specifying the Xm class (such as "XmFileSelectionBox"), or by specifying the name used in the program (such as"FileSelector"). The latter method permits specifying properties for each widget instead of all instantiations of the widget type. So in this spirit, below are listed the names of most of the main widgets used in the program.
Message boxes: Information Prompt Error Question YesNoQuestion Warning
Top menu bar: MenuBar
Arrow buttons at left: Button
Ok buttons at bottom of dialog boxes: Slew Ok Help Load Save Cancel No
Components of dialog boxes: radiobox label DialogForm
The main windows: Main drawing_area_form drawing_area2 frame information_area drawing_area
Images: Image
List boxes: List list drag_area GraphForm graph
Click box components: FileSelector Chdir Editor ClickboxForm MultiClickboxForm PrintItemForm EditForm Menu3DForm SamplePaletteColorForm SamplePalettePseudoForm
Menu items: f1 to f70.
Menus: fileMenu imageMenu processMenu colorMenu drawMenu aboutMenu configMenu helpMenu.
3D controls: Menu3DForm

More examples:

`Tnimage*fileMenu.background: LavenderBlush1` Sets the color of the file menu to "Lavender Blush 1" (See your Xlib documentation for a list of valid color names, or use a 6-digit hex number such as "#aa7733").
`Tnimage*fileMenu*background: bisque` Sets the color of the file menu, including the menu items, to "bisque".
`Tnimage*DialogForm.fontList:*helvetica-bold-r-normal--12*`
`Tnimage*DialogForm*XmToggleButton*fontList:fixed`
`Tnimage*DialogForm*XmPushButton*fontList:*times-bold-r-normal--12*`

These 3 lines set the toggle buttons to "fixed" font, the push buttons to a times font, and everything else (i.e., the labels) to helvetica. Use 'xlsfonts' to find what fonts are available on your system.
`Tnimage*List.XmLabel.fontList: *helvetica-bold-r-normal--12*` sets the labels in all lists to helvetica font, while
`Tnimage*List*fontList: *helvetica-bold-r-normal--12*` sets all text in all lists to helvetica font.

Notes

1. Be conservative about setting all these widgets to different colors. Each color used by a widget is one less color available for rendering images. In particular, the top menubar and individual menu items should be set to the same color, otherwise if TN-Image starts up in "modifiable colormaps" mode, the menus may become unreadable. Modifiable colormaps mode is set automatically if there are fewer than 32 color entries available.
2. Be careful not to put spaces after the setting in your .Xdefaults file. This will confuse Motif.
3. Some resources, such as "transient", although legal, produce instability in Motif, and must not be put in .Xdefaults.

Non-Motif Resources

In addition to the Motif resources, a variety of XLib and program resources are stored in the file `tnimage.ini` . Most of these are set from within the program, but can also be edited. However, using inappropriate values will create undesirable behavior. For example:

`default_font *times-bold-r-normal--12*` = Sets the font in the left information window to "times bold 12 pt". Setting this too large will render the information unreadable. If problems occur, the file may be deleted to restore the defaults.

Some of the more useful settings are:

`want_colormaps 0` = If set to 1, TN-Image will set a colormap instead of allocating colors. The first *save_colors* colors in the colormap are never altered when the colormap is changed. If the value for "save_colors" is too low, colormap flashing will occur when the mouse moves from one window to another.

`foreground_color`
`foreground_red`
`foreground_green`
`foreground_blue`
These values specify the color index and RGB colormap values of the foreground color in the main drawing area.

`information_width 120` = width of the information area at the left. If set to 0, the information area is not displayed. This setting cannot be changed from within the program.

`default_font fixed` = Sets the font in left information window to system default font (may be faster than the default Helvetica font).

`window_handle_size` = Sets the size of active area around the edge of each image. Clicking on this area causes the image to be grabbed and moved.

7.1.3 Image windows

(Unix version only).

Images loaded into the X Window version of TN-Image can be placed in separate windows instead of the large main window by checking the “Separate window” box in the “Load image” dialog. With a few minor exceptions, images in separate windows have the same functionality (cut/paste, image math, densitometry, etc) as images on the main window. Cut/paste functions identically regardless of whether the source and destination are on the main window or on separate windows. Additionally, if the Window Manager permits, image windows can be created with or without a frame, depending on the settings in the “Config” dialog.

The advantages of separate windows are:

1. Entire image is visible without scrolling
2. Image can be iconized when not needed
3. Scroll bars can be added (using the menu in the upper left corner. This feature is only available in window managers that support it, such as fvwm.)
4. Images can be positioned anywhere on the screen

Disadvantages are:

1. Images cannot be superimposed, added, or subtracted without using “image math” function.
2. Transparency does not work (Transparency and an alpha channel are features which will be added later).
3. Composite images cannot be created.

7.2.0 Video cards supported (DOS version)

Currently three SVGA chips are directly supported:

a) Trident 8800, 8900, or more recent chips. Trident cards seem to be popular in many local computer stores.

b) Tseng Labs ET4000 or more recent chips. Note: the older Tseng ET3000 chip is not supported. The ET4000 chip is in many cards made by a variety of manufacturers.

c) IBM XGA and XGA-2.

If these chips are not detected, TN-Image will use VESA super VGA functions.

Other cards will also work if they are VESA-compatible. To use a VESA-compatible card, you may need to first install a VESA BIOS extension, which is usually a small program that came with your video card, and may be named “VVESA.COM” (for Mach32 cards), “VESART.COM” (for Realtek cards), or something similar. Installing this VESA BIOS means you have to run the VESA program before running TNEDIT. This is conveniently done by putting it in your AUTOEXEC.BAT file. Newer cards often have VESA already installed in the card in ROM so no action needs to be taken.

Certain early video cards interact with the mouse cursor, making smooth movement of the mouse difficult. Some older mouse drivers also cannot handle SVGA modes smoothly. It should be possible to position the mouse at each point on the screen. If you experience difficulty reaching odd-numbered pixels, try to obtain a newer mouse driver. If this doesn't help, it may be necessary to upgrade to a better SVGA card. This problem is known to occur with some RTG3106-based Realtek cards.

If you have one of the above video cards and TN-Image still doesn't work on your computer, please let us know. We will try to fix it for you.

ATI video card users: Computers with Mach 32 ATI cards may have problems running TN-Image in true-color modes from within a DOS box. The only known solution is to run TN-Image from DOS, or use TN-Image in an 8 bit/pixel mode (e.g., mode 103). (See “Command-line options” above).

If your ATI video card won't go into desired screen mode, even though the manual states that mode is supported, run ATI's “Install” program again to verify the specified video mode is activated. If this doesn't work, it is possible that the computer was turned on before turning on the power to the monitor. ATI cards only examine the monitor type at power-up, and could become confused if the monitor is off during a cold boot-up, and refuse to set high-resolution modes.

The display in TN-Image is corrupted when using ATI Mach 64 cards if the UNIVBE TSR is present.

7.3.0 Screen modes supported (DOS version)

The mode value 'xxx' on the command line can be one of the following:

Video card/chip	Mode	Resolution	Colors	Video RAM Needed	Bits per Pixel
Tseng ET4000/	2E	640 x 480	256	1/2 meg	8
W32	30	800 x 600	256	1/2 meg	8
	38	1024 x 768	256	1 meg	8
	2E1[2]	640 x 480	32,768	1 meg	15
	301[2]	800 x 600	32,768	1 meg	15
	381[2]	1024 x 768	32,768	2 meg	15
	2E2[2]	640 x 480	65,536	1 meg	16
	302[2]	800 x 600	65,536	1 meg	16
	382[2]	1024 x 768	65,536	2 meg	16
	2E3[2]	640 x 480	16,777,216	1 meg	24
	303[2]	800 x 600	16,777,216	2 meg	24
	383[2]	1024 x 768	16,777,216	3 meg	24
Trident 8800/	5D	640 x 480	256	1/2 meg	8
8900	5E	800 x 600	256	1/2 meg	8
	62	1024 x 768	256	1 meg	8
IBM XGA/	2	1024 x 768	256	1 meg	8
XGA2	4	640 x 480	256	1/2 meg	8
	5	640 x 480	65,536	1 meg	16
	7	800 x 600	256	1 meg	8
	8	800 x 600	65,536	1 meg	16
VESA	100	640 x 400	256[3]	256 k	8
	101	640 x 480	256	1/2 meg	8
	103	800 x 600	256	1/2 meg	8
	105	1024 x 768	256	1 meg	8
	107	1280 x 1024	256	2 meg	8
	110	640 x 480	32,768[5]	1 meg	15
	111	640 x 480	65,536	1 meg	16
	112	640 x 480	16,777,216[1]	1 meg	24-32
	113	800 x 600	32,768[5]	1 meg	15
	114	800 x 600	65,536	1 meg	16
	115	800 x 600	16,777,216[1]	2 meg	24-32
	116	1024 x 768	32,768[5]	2 meg	15
	117	1024 x 768	65,536	2 meg	16
	118	1024 x 768	16,777,216[1]	3 meg	24-32
	119	1280 x 1024	32,768[5]	3 meg	15
	11a	1280 x 1024	65,536	3 meg	16
	11b	1280 x 1024	16,777,216[1]	4 meg	24-32
	120[4]	1600 x 1200	256	2 meg	8
	[4]	1600 x 1200	65,536	4 meg	16
	[4]	1600 x 1200	16,777,216[1]	6 meg	24-32

[1] Most cards use mode 115, 118, and 11b as 32-bit/pixel modes for speed purposes, but the maximum no.of colors is still only 16,777,216.

[2] Experimental - awaiting testing with W32 card. Any feedback as to whether these modes work is appreciated.

[3] #9GXE64 card does not support this mode.

[4] Numbering for screen modes above 11b may vary from card to card. All VESA modes with 8 or more bits/pixel are available using the -xres and -bpp options (Sec.7.1.0).

[5] Some video cards, such as the #9GXE, do not support any 15-bit screen modes.

If after trying the above options, you still cannot get TN-Image to run on your machine, you can try utilities such as UNIVBE, which can permit your Super VGA card to use VESA modes.

If your monitor makes a buzzing or squeaking sound and/or fails to synchronize (evidenced by jagged diagonal lines or other unusual effects), turn the monitor off immediately and press Alt-X several times to stop the program. This could occur if your video card reports that it is safe to set a given screen mode when in fact it is not safe. Although it should be the responsibility of the video card to determine whether it is safe to set a given screen mode, this feature is absent from many cards. All SVGA monitors, however, should be capable of running safely at the default screen mode (800x600 pixels).

WARNING!

CHECK YOUR MONITOR MANUAL *BEFORE* ATTEMPTING TO RUN TN-IMAGE IN A SCREEN MODE OTHER THAN THE DEFAULT MODE! THE AUTHOR IS NOT RESPONSIBLE FOR ANY MONITOR DAMAGE CAUSED BY ATTEMPTING TO SET YOUR MONITOR TO A MODE WHICH IT IS UNABLE TO HANDLE. MOST VIDEO CARDS WILL REFUSE TO SET AN UNSAFE MODE, BUT SOME WILL!

7.4.0 Basic operations

Most operations, such as filtering, saving images to disk, etc. use a "selected region" which has to be selected before you perform the operation. To select a region, move the mouse to one corner of the desired area, click and drag to the other corner, then release the mouse button. A rectangle shows the selected region while you are dragging. This selected region stays in effect until you (1) quit the program, (2) select another region, (3) pick "unselect region" from the menu, or (4) double-click on an image to select an entire image. If no region has been selected, or it was unselected, the region defaults to the entire screen. If you make changes to or select a region that is partly on an image and partly on the background, the portion of your changes that falls on the image will remain with the image, and the rest will stick to the background.

The background is maintained independently of the images. Thus, if an image is moved over the background or another image, the background is not disturbed. When many images are simultaneously present, it is often convenient to keep most of them out of the way by stacking them up or moving them out of the visible region, off the edge of the screen. If an image gets lost off the edge, you can find its coordinates by selecting "About the program" or "About the image".

You can select an entire image by double-clicking on that image. To change to a different image, single-click on the other image to bring it to the foreground or double-click on it to select it. Selecting an image means that, all subsequent operations will be performed on the entirety of that image.

You can move an image around by clicking on the small arrows on the top menu bar. The distance by which a single click on the arrow moves the image is adjustable by pressing the gray "+" or "-" keys, or by selecting "Cursor movement rate" from the "Configuration" menu.

When the mouse cursor passes over an edge of an image, it changes from a diagonal arrow to double arrows. If you click the left mouse button at this point, the image will be "grabbed". Keep pressing the mouse button, move to a new location, and then release. The image is then moved to the new location. The same is true for message boxes, graphs, dialog boxes, the colormap window, and information windows.

7.5.0 Operating under low-memory conditions

If you have 4 MB or less of RAM, or use large images or a lot of images simultaneously, or work in a Windows DOS box, eventually you may run out of memory.

There are several things you can do to increase available memory:

(1) In the "Config" menu, turn off the "Automatic undo" option before loading any images. This will double the amount of space available for images, but TN-Image will not create an "undo" buffer for each image. This means you will not be able to erase anything from the image (such as text or graphic elements) without creating blank areas on the image. You can still back up and restore images manually, however.

(2) Start TN-Image in a lower screen mode. In lower resolution modes, less memory is needed to manipulate images and background. (See under "Command-line options"). Try using 8-bit/pixel modes instead of true color modes. TN-Image reserves a fixed amount of memory for drawing dialog boxes and error messages. The amount of reserved memory is also screen mode-dependent.

(3) In TN-Image registered version, memory is limited only by the available hard disk space. You can create more virtual memory by using a disk utility to unfragment your hard disk, or you can erase unneeded files.

(4) If high resolution is not essential, images can be loaded in a small size. Loading an image with "X size=50" and "Y size=50" uses only as much memory as a full-size image. (See under "File menu...Load image").

(5). If you have more than one image loaded, unload one of the images using "File... Unload image". This removes it and its backup from memory.

(6). Erase FFT's as soon as possible by selecting "File...Erase FFT". Fourier transforms use large amounts of memory.

7.6.0 Commonly asked questions

Q. *How do I add text?*

A. Move the mouse cursor to the desired location and begin typing. It is not necessary to click the mouse before typing. Make sure the mouse does not move while you are typing. The text will stick to the foremost image, or if no image is present, to the background. Unix versions can also select the font, font size, and weight.

Q. *How do I undo an operation?*

A. Select "Process...Restore". The image will be restored to its state at the last time you backed it up. If you never backed it up, it will be restored to its original state – unless the "Auto-Undo" option has been turned off.

Q. *How do I turn off box- or line-drawing mode?*

A. Click anywhere on the top menu bar or pull down any menu. This automatically turns off everything. Alternatively, click on the small rectangle which displays the current mode on the right side of the menu bar. In the Unix version, click on the main "Cancel" button in the information area.

Q. *Is there an easy way to change the color of text, lines, etc.?*

A. Yes, click the left mouse button on the color palette to select the foreground color. Click the right mouse button on the palette to select the background color.

Q. *How do I make the background color white?*

A. Select "Color..Set background color" and set the color to the highest value (255 on an 8-bit display). Then select "Image.. erase background" to redraw the background in the new color (**Note:**This will erase everything that was drawn on the background).

Q. *When filtering, changing contrast, etc. of color images, why does junk sometimes briefly appear on the screen?*

A. If TN-Image is in an 8-bit screen mode, manipulating 16 and 24-bit images temporarily causes the image to be filled with 16 or 24 bit data, which appears as random noise because of the discontinuous colormap. After the operation is finished, the colormap is automatically recalculated, and the image will appear normal again.

Q. *How can I combine two or more indexed color images into one image so that they have the same colormap?*

A. Start TN-Image in a color mode by typing: `tnimage -xres 800 -bpp 24` (if using DOS version). If using the Unix version, it is necessary to restart the X server in a true-color mode by typing: `startx - --bpp 24` or some similar command. Load both images into the same window, then select "Create image" and select a region covering both images, using the mouse. Select "Change image depth" to convert the image to 1 byte (8 bits) per pixel. A new 8-bit colormap will be generated to fit both images.

Q. *Why is* xxx *image file format not supported?*

A. Some image formats (such as GEM IMG) are not commonly used in image analysis. Others (such as lossless JPEG, LZW-compressed TIF, and creation of GIFs) are not supported because of patent restrictions. JPEG is not included in the Shareware version because it requires virtual memory. Requests for other formats are welcome.

Q. *Is a Windows-NT version of TN-Image being planned?*

A. This has not been decided. For Windows 3.1 and Windows 95, TN-Image has an icon and PIF file, and works perfectly in a DOS box. TN-Image is very demanding on the hardware and will always run better from the DOS command line than in Windows.

Q. *Is a Windows-3.1 or Windows-95 (or 97) version of TN-Image being planned?*

A. No.

Q. *Is a Macintosh/NeXt/Rhapsody version of TN-Image being planned?*

A. No.

Q. *Is a SunOs 4.x/OpenWindows version of TN-Image available?*

A. The program requires Motif and does not compile under OpenWindows. A static version which will not require Motif will be created if appropriate libraries can be obtained.

Q. *Will lower-resolution screen modes (such as 640 x 480 x 16 colors) ever be supported?*

A. No. Reducing the number of colors to 16 would render any quantitative analysis of the image almost meaningless. Users are advised against using 4-bit images for any scientific work, as many such images that have previously appeared in the literature are now being questioned.

Q. *Is the source code available?*

A. Currently the source code still in a state of transition from the MS-DOS version and is not in a presentable condition. Eventually the source code will probably be released.

Q. *How do I scan an 8-bit color image? In the dialog box, all the selections for color images are at least 24 bits/pixel.*

A. HP scanners cannot create 8-bit indexed color images. Scan the image at 24 bits and then select "Color.. Change image depth" to change the image to 1 byte (8 bits)/pixel. This will automatically generate an optimal colormap.

Q. *Why do controls for red, green, and blue appear when I try to change the contrast on my grayscale image?*

A. Some other software incorrectly sets the image identifiers in their image to values which indicate the image is "color" even though it appears as a gray scale. Selecting "Color..Convert to grayscale" will repair the image.

7.7.0 Batch mode processing

TN-Image can also be run in "batch" mode for unattended operation. This is useful for operations that are time-consuming or need to be done every day. You can use a cron-like utility or a DOS command scheduler such as **tnshell** (available from the author) to automatically carry out any sequence of operations at (for example) 3 a.m. on Thursdays or to automatically load a series of images before you come to work. The computer's mouse and video card must still be present, and if your monitor is turned on the images will still appear on the display.

Procedure:

1. Create a macro in TN-Image and save it to disk. The last command in the macro should be "exit" to ensure TN-Image quits when finished. The command "messages 0" can also be used to ensure that any error messages are ignored instead of causing the program to wait for an acknowledgement (Make sure the macro works before using this!).

2. Using `tnshell` (or other program), set the following DOS command to be executed at the desired time (e.g., 3 a.m. every Saturday): **tnimage -macro** *macro_file* where *macro_file* is the name of your macro (without brackets). See *Macro programming guide* for examples of useful batch macros.

7.8.0 Editing text files

The Macro Editor in TN-Image can also be used as a text editor for small (up to 65536 characters) text files. This can be used to take notes on your image analysis, create color-remapping files, etc. as well as writing macros. The Unix version also supports clipboard cut & paste.

7.9.0 Reading mail attachments with TN-Image (Unix version)

To use TN-Image as an image viewer for MIME mail attachments, add the following line to your /etc/mailcap or /.mailcap file and remove all other lines containing "image":

`image/*; showpicture -viewer /your_tnimage_path/tnimage`

or

`image/*; /your_tnimage_path/tnimage`

This will cause your mail reader (e.g., `pine`) to automatically run TN-Image when an image attachment is to be viewed.

8.0.0 Menu options

Menus, dialog boxes, message boxes, and click boxes can all be moved by moving the mouse to the edge of the object and clicking the left mouse button. Move to the desired location and release the mouse button.

8.1.0 File menu

8.1.1 Load image

Reads an image from a disk file.

Vertical/Horizontal - Selects whether the image should be loaded in its normal orientation (vertical) or rotated 90 deg (horizontal).

Positive/Negative - Selects whether the image is to be loaded normally or as a negative (color-inverted) image.

Filename - Name of the image to be read. The previous 20 filenames are kept on a stack and can be selected with the up and down arrow keys. Alternatively, if you press *Enter* when no filename is showing, you can select a file from a menu. Wildcard (* or ?) characters are permissible; thus, "*.pcx" is a valid filename, and will cause all matching files to be loaded.

X position - Horizontal starting pixel position to place the image (in pixels). If the image is in a separate window, the position is relative to the upper left of the screen; otherwise, it is relative to the upper left of the main window.

Y position - Vertical starting position to place the image (in pixels). If the image is in a separate window, the position is relative to the upper left of the screen; otherwise, it is relative to the upper left of the main window.

X size - If x size is 100, the image is loaded in its actual size. If set to some value between 0 and 100, the image is shrunk in the x direction.

Y size - If y size is 100, the image is loaded in its actual size. If set to some value between 0 and 100, the image is shrunk in the y direction.

Auto File Type/ Raw bytes -
Select 'raw bytes' if you wish to read the image as a series of bytes and override the automatic image file type detection. (If the image is an unknown format, "raw bytes" mode is selected automatically).

Invert byte order -
Certain other imaging programs save the RGB values in the wrong order. This could also happen with certain video cards. Clicking this option will switch the byte order to the correct value.

CMYK to RGB -
If the TIF file happens to be a 32-bit CMYK image, TN-Image will automatically convert it to RGB format for display purposes. Occasionally, an image file header says the image is a CMYK image but in actuality it is not. Un-clicking this option will cause TN-Image to treat the image as if it were an ordinary RGB image. This option has no effect on images less than 32 bits/pixel.

Convert to gray scale
Changes the image to shades of gray instead of its original colors. This is particularly useful for CT or MRI images of greater than 8 bits per pixel, because the gray scale can be remapped as a "sliding scale" to enhance specific regions of the image.

Color reduction - Quantization/Fit current colormap/None

If TN-Image is in an 8-bit/pixel (indexed-color) mode, when a color image is loaded the number of colors must be reduced to 256 for display purposes. This can be done by "quantizing" the image or by trying to fit the image to the currently-selected colormap. Even though the quantization algorithm used is new and one of the fastest known, converting the image to 8 bits/pixel often still takes much longer than reading it from the disk.

Quantizing is more general than colormap fitting, and is guaranteed to give a viewable image. Many GIF files were produced with quantizing. However, because it changes the colormap, all other images currently being viewed will become "garbage" if TN-Image is in an 8-bit mode (Of course they are not really garbage, but temporarily unviewable). Clicking on an image restores the colormap for that image.

Colormap fitting uses less memory than quantizing. If the error message "Insufficient memory to convert to 8 bits/pixel" appears, try changing the color reduction method to "fit current colormap". This can be quite slow, however, for certain types of images.

Because quantized colormaps are usually not a continuous flow of colors, it may not always be possible to perform all types of quantitative analysis or filtering on a quantized 8-bit image. The best solution is to select "Change color depth" and convert the image to a 24 bits/pixel color image. The colors will then work as expected during filtering.

Fitting to the current colormap does not affect the other images on the screen, and gives a result that is still quantitatively analyzable and filterable. Also, if the original colors in the image are similar to those in the colormap, the result will be a much smoother image. However, if the colormap is substantially different, none of the colors may match up. (Of course, you can easily change the colormap and repeat). This method incidentally uses much less memory than quantizing.

If TN-Image is in a color mode, this option has no effect except when saving images to disk when "8-bit/pixel colormap" is specified as the file type. Color images are filtered in an identical manner regardless of whether or not TN-Image is in a color mode. The colormap is also used in color modes when an image with 8 or less bits/pixel (i.e., a indexed-color image) is loaded.

All 8,16,24, and 32-bit images are kept in memory in their original color depth, regardless of the current screen mode. Other images are converted at read time to the next highest multiple of 8. This means that you can safely edit full-color images even if your computer's video card can only handle 256 colors. Editing operations also are handled in a manner appropriate for each image. Thus, for example, you can select an area encompassing both an 8-bit image and a 24-bit image, and filter them simultaneously, with no problems. TN-Image automatically knows the color depth of each pixel being processed and handles it appropriately.

See also under "Color settings" for more details.

Images between 1 and 7 bits/pixel are automatically converted to 8 or 16 bits/pixel when they are loaded. The conversion makes use of whichever colormap is selected. If you have not specifically changed the colormap, the default "spectrum" colormap will be used. This can result in an unexpected color appearance. 8 bit/pixel images are a special case, because they are usually saved with their own colormap.

If TN-Image cannot identify the image type, or finds an invalid file, it asks if you want to try to read it anyway as raw bytes. It then makes a guess as to the x and y sizes, and bits/pixel. You should correct these as needed. In order to read raw bytes, the image should have a constant no. of bytes per scan line, be uncompressed, and have the image rows stored in consecutive order. You may also have to skip a number of bytes to get the image to line up horizontally. This number has to be determined experimentally. If the file is not really an image file, in all likelihood you will just get junk on the screen.

This feature allows you to import other types of files that are not normally thought of as images. For example, to read a database of 16 x 16 Chinese characters, use the following parameters:

Filename: ziku (or name of the database)

x pixels: 16

y pixels: *length of file* $\div$ *16* , e.g. 15000 or so.

bits/pixel: 1

bytes to skip: 0

The database will be loaded as a long strip of Chinese characters, which then can be cut and pasted as desired. Of course, this is not the most efficient way to edit Chinese, but it demonstrates the usefulness of the feature.

See the following section for a detailed procedure for reading raw bytes and creating custom formats.

If a single-color image containing between 1 and 8 bits/pixel is loaded, the values are automatically filtered through the currently- selected colormap. If the image itself contains a colormap, the colormap in the image is used. This is not done for single-color images greater than 8 bits/pixel, because of the large size of the colormap table that would be required (usually, only 8-bit images actually contain a colormap).

Procedure for converting a 24-bit image to an 8-bit image with a desired colormap.

A common operation is reducing a color image to 8 bits, with the constraint that the colormap should be the same as that of some other image. For example, a grayscale image might be accidentally converted to 24 bits/pixel and it is desired to reconstruct the original continuous color map.

1. Select "Color...Colormap...Select colormap".
2. Click Ok and select the desired colormap.

1a-2a. Alternatively, the colormap of some other image can be copied by selecting "File...Create/Resize image" and clicking on "Method...Copy colormap only". The colormap of the image specified under "Image # to copy" will be copied to the currently-selected image.

3. Select "Config...Configure" and change the "Color reduction method" to "Fit current colormap".
4. Select "Color...Change color depth" and convert the image to the new depth (i.e., 1 byte/pixel).

8.1.1.1 Reading CT, X-ray, or MRI images, or raw bytes

Below is a detailed example for reading images produced by X-ray, CT or nuclear magnetic resonance scanners and other equipment. These machines typically use unusual file formats not recognized by TN-Image, but usually the images can easily be read as "raw bytes".

The same procedure is applicable to any non-compressed file of unknown type.

NOTE: The Registered version of TN-Image can be used to create a "custom" image file format, which is a superior method for reading medical image files, because once the custom format is set up, reading the image is transparent to the user, obviating the necessity for reading "raw bytes" as described here (See "Create File Format").

(1) Select "File...Load image" and enter the image file name.

(2) Click on "Raw bytes".

(3) Click on "OK".

(4) TN-Image will make a guess at the image width. If the image width is known, enter the image width and height. Otherwise, if the guess turns out to be wrong, use the auto-increment method described below to determine the width. In this case, the width happens to be 381.

(5) Select the bits/pixel of the image. This is usually 12 or 16 for CT images (MAMOGRAM.LUM is 16 bits).

(6) (Optional): If the length of the image file header is known, enter this value under "skip bytes". Otherwise, leave it as 0.

(7) Click on "OK" to load the image.

(8) Once the image is loaded, if the skip bytes were incorrect in step 6, the image border will be visible as a vertical strip in the image. Use the mouse to locate the X-position of this strip. Unload the image and re-load it, using the X-position * bytes/pixel as an estimage for skip bytes.

(10) If the image was color, it may be necessary to add 1,2, or 3 additional skip bytes to get the colors to line up correctly.

(11) If the image is grayscale, the grayscale mapping can be adjusted by selecting "Color...Change colormap...Grayscale brightness/ contrast". This allows you to interactively adjust the appearance of the image as a sliding scale, to highlight areas of different intensity (See "Grayscale brightness" below).

(12) The image can now be saved in a conventional file format.

Determining the width of an unknown image:

TN-Image has a unique feature for determining the width of an image whose dimensions are completely unknown. This procedure is substituted for step (4) above:

(4a) Make a conservative guess of the image width. For instance, if the image is known to be square, and it is 16 bits (2 bytes) per pixel, use

$$width = \sqrt{(}filesize/2)$$

as your starting estimate.

(4b) Click on "Auto increment". This will cause the width to be increased with each scan line.

(4c) For "Increment", enter "1" or "2".

(4d) Click on "OK" to load the image. The image should consist of a swirling pattern, with fuzzy lines in a horizontal "U" shape. Usually, the image is slightly clearer at the vertex (marked with a *). If so, find the Y-coordinate of the vertex using the mouse. Subtract 32 (the size of the menu bar) from this value and add the result to your previous estimate of the image width.

(4e) Unload the image.

(4f) Turn off "Auto increment" and load the image again. The image should now be recognizable. If the image slopes to the right as you move down the screen, this means the value is still too low. Increase the image width slightly and try again. If it slopes left, the value is too high.

If the image is still not recognizable after these steps, try changing the byte order, or check the "Convert–gray scale" option.

If you selected the wrong number of bits/pixel or y size for a "raw bytes" image, the automatic grayscale detection may estimate tne maximum and minimum gray levels incorrectly. This will result in an image that is too dark or too light. This can be easily corrected by remapping the gray levels (See *Grayscale intensity mapping*).

8.1.1.2 Reading raw byte files

The .IMG files produced by some other software contains a value for the image width that is off by 1. Thus, in order to read the image properly, it is necessary to read the image as "raw bytes". After manually changing the width from 511 to 512, the file will read normally.

8.1.1.3 Reading Images from Macintoshes

Files imported from Macintosh via Mac-TCP are corrupted by the addition of an extra header unless they are sent as "Raw Binary". This often creates the impression that PC-based programs are incapable of reading Macintosh images. TN-Image, however, automatically detects the presence of the header and eliminates it before reading any image.

8.1.1.4 Reading Raw ASCII images

Raw ASCII images consisting of a series of integers are readable by TN-Image. To read an image in ASCII format, you must select *Raw ASCII* as the File Type in the Load Menu. Then set the remaining parameters the same way as for *Raw Bytes* (Sec. 8.1.1.1). Some of the options (such as bit packing) do not apply to ASCII files and their setting is ignored.

8.1.1.5 Reading 3D images (Unix version only)

Select "File type = Raw 3-D", select a filename, and then enter the following information:
No. of frames = Total number of sub-images in the file.
Frame width(pixels) = The width of each frame in pixels.
Frame height(pixels) = The height of each frame in pixels.
Bits/pixel = The image depth (8,15,16,24, or 32).
Currently, only raw 3-D images are supported.

8.1.1.5 Reading images from confocal microscopes and PET scanners

These images, which contain multiple views in 3 dimensions, must be read as Raw 3D images. Typically, the image size for confocal images is 512 x 512. PET scan images are typically 128 x 128. It is necessary to know the number of frames (slices) in the image. Most PET scan images are only 8 bits/pixel, while confocals often produce 24 bit/pixel images.

8.1.2 Save image

Transfers an image or selected portion of the screen to a disk file.

File format
Format in which to save the image. See *Custom format* below for details on creating files in your own customized format).

Save entire image/selected region -
If "entire image" is selected, the currently-selected image will be saved in its entirety. Otherwise, only the currently-selected screen region (which can beyond an image or contain 2 or more images) will be saved. The actual size of the region saved is displayed after the file is written.

Bits/pixel -
You can select standard values of 1,8,15,16,24, or 32 bits/pixel, or select "other" to specify any other value between 1 and 32. The resulting file size is proportional to the bits/pixel. This can result in a considerable savings in disk space. Monochrome (1 bit/pixel) is ideal for line drawings and graphs. Don't forget that saving an image in a lower bits/pixel than it was created causes a loss in color accuracy. For example, if you save an 8-bit image as a 3 bit/pixel image file, the colors in the image will look slightly different from the original colors when you load it back. If you save it as a monochrome (1 bit/pixel) image, all pixels above 50% of the maximum color will come out white and those below 50% of maximum will come out black.

NOTE - Some file formats (e.g., GIF and PCX) only allow certain values for bits/pixel and number of colors. TN-Image displays an error message if an illegal value is selected.

WARNING - Due to limitations in the capabilities of some other programs, saving images using "non-standard" bits/pixel or using "non-standard" numbers of colors can result in image files that are not readable by some other image viewers. For example, one well-known shareware file interconversion program can only handle 4,8, and 24 bit/pixel TIF images, but not the common 15 and 16 bit images. One commercial Macintosh program can only handle 8,15,24, or 32 bit/pixel images, but not 16 bits/pixel. Very few other programs can handle odd values such as 12 bits/pixel. However, these values can be extremely useful and widely used in handling radiological, electron microscope, or MRI images, which are often of unusual pixel depths.

TN-Image will display an appropriate warning if you select a "non-standard" file format.

Treat data as Color / Gray scale -
When saving images greater than 8 bits per pixel as TIF or Custom files, it is sometimes useful to save the image as if the image data represent shades of gray instead of colors. Selecting "gray scale" causes TN-Image to treat the image as if each pixel value was already a "luminosity", and skips the conversion from RGB to luminosity. This setting is ignored if the image is saved as 8 or less bits/pixel, or if it is saved as a color image (by selecting "2" or "3" as the number of primary colors). Normally, this setting should be kept on "Color".

Filename - The file name under which the image will be saved (can include drive and path). The previous 20 filenames are kept on a stack and can be selected with the up and down arrow keys.

Image no. - Indicates the currently-selected image which will be saved if you have selected "save entire image". Has no effect if you are saving a "selected region". This option is mainly for informative purposes and does not normally need to be changed.

Extra TIF Param.(for 'Other') -
If you select *Other* , it is also possible to customize several additional parameters. Currently, these values only have an effect for TIF and "custom" file formats.

No.of primary colors(1-4) -
If you select "1", the image will be converted to grayscale ("luminosity") before saving, and the red, green, blue, and black bits/pixel specified below are ignored. If you select more than 1 color, the number of bits for each color, when added together, must equal the total number of bits/pixel you specified under "other bits/pixel". If they don't, TN-Image displays a message to that effect.

Red bits/pixel No.of bits of red to save.

Green bits/pixel No.of bits of green to save.

Blue bits/pixel No.of bits of blue to save.
Black bits/pixel No.of bits of black to save (CMYK files only).

For example, to save only 4 bits each of the red and blue planes of your image, set the following values:
'Other' bits/pixel (on left side of dialog box) = 8
Number of primary colors = 2
Red bits/pixel = 4
Blue bits/pixel = 4
Green bits/pixel = 0
Black bits/pixel = 0

NOTE: TN-Image currently cannot display more than 8 bits/pixel of each color (i.e., a total of 24 bits/pixel). This is due mainly to limitations in the current generation of PC video cards. Thus, there is no advantage in setting the bits/pixel for any one color higher than "8".

You can only specify black bits/pixel if the "cmyk" option is checked.

RGB to CMYK -
Convert the image from RGB to CMYK (cyan, magenta, yellow & black) format when saving. (When reading a CMYK image, it is automatically converted to RGB for display, since there cannot be a "CMYK computer monitor"). If you are using a non-standard bits/pixel mode, you also need to specify the number of red, blue, green, and black bits/pixel (the values will be changed to the corresponding c,m,y, and k values). If you select a non-standard format, TN-Image will display a warning to that effect. Selecting CMYK is only allowed for the 32 bit/ pixel standard mode and the "Other" (non-standard) mode. If you try to save an image with CMYK checked in any other mode, TN-Image will display an error message. This is because the TIF specification (as of version 6.0) does not recommend using lower color depths for CMYK.
This option is useful for exporting the image to other programs which cannot create their own CMYK images for printing.

JPEG quality factor -
An integer between 1 and 99. Values above 90 or below 10 are not recommended. Smaller values result in greater compression and more signal loss.
NOTE: Jpeg is a lossy file format. This means an image saved in JPEG format will lose some information. Images consisting of text and sharp lines are not good candidates for Jpeg compression, because the compression algorithm is optimized for realistic scenes such as images from photographs. Files should only be saved in Jpeg format when all image processing has been completed, and the smallest possible size is needed.
Also, some settings, such as red, green, blue, and black bits/ pixel, and CMYK conversion, are ignored for JPEG.

8.1.3 Printing images

Prints the image or selected portion of the screen on a laser printer. A laser or inkjet printer that uses a page control language similar to Hewlett-Packard's PCL3 or PCL5, or any PostScript printer supporting PostScript Level 2 or above is required. (Postscript Level 2 is not to be confused with "PostScript Type 2 Fonts", which don't exist).

8.1.3.1 Printing Black-and-White or gray scale images

Most laser printers are optimized to print text. This means the pixels are printed by the printer as dark as possible and adjacent pixels partially overlap. The effect that this has on graphics printing is that the darkest 50% of the image will appear as black. For example, if you are printing at 8x8 dithering mode (64 gray levels), shades 1-32 will appear white to black and shades 33-64 will all appear black. Thus, your gray-scale resolution is effectively cut in half. Although you can make your image lighter before printing or select a lighter setting from TN-Image, the only way to avoid any loss of resolution is to set your printer to print lighter. This is easy to do but varies from printer to printer. See your printer manual for the procedure.

To select a lighter print intensity from TN-Image, select 'file...print' from the menu, then click on 'printer color adjustment'. Adjust the red, green, or blue intensity factors as desired. 128 is normal (dark) printing. Any other values will be multiplied by the data going to the printer to make it lighter or darker. If you are using a monochrome printer, be sure to select "B/W or grayscale". The red, green, and blue intensity factors will be averaged for grayscale printing.

Currently, only laser and inkjet (bubble jet) printers are supported. No support is planned for dot-matrix printers, because the image quality would be unacceptably low.

Print quality can often be improved by using glossy paper sold for pen plotters instead of regular paper.

—**Column 1**—

Vertical/Horizontal - Selects whether image will be printed in "portrait" (vertical) or "landscape" (horizontal) mode.

Positive/Negative - Print normally (white on the screen = white on the paper) or as a negative.

Print entire image/ print selected area - Select whether to print the entire currently-selected image, or the currently-selected screen area which may span 2 or more images.

Color type See Sec. 8.1.3.2

Printer type: PCL / PostScript - Select printer language to use.

—**Column 2**—

No. of copies - Number of copies of the image to print. Not all printers accept this command.

Printer Device/file name - See Sec. 8.1.3.4

Color adjustment - Darkness of printed image (255=darkest). The red, green, and blue factors are averaged when *color type* is "B/W".

Vert. offset (inches) - Offsets the image by the specified no. of inches down the page.

Horiz. offset (inches) - Offsets the image by the specified no. of inches to the right across the page.

Media type - Optimizes the output for the type of paper being used. The following table shows the differences used for different media types on a typical PCL printer:

Media Type	Print Quality	No. of passes[1]	Recommended Depletion[1]
——	———	———	————

Plain	Draft	1	–
	Normal	2	25% w/gamma
	Presentation	4	50% w/gamma
Bond	Draft	1	–
	Normal	2	25% w/gamma
	Presentation	4	50% w/gamma
Premium	Draft	1	–
	Normal	2	25% w/gamma
	Presentation	4	50% w/gamma
Glossy	Draft	2	25%
	Normal	4	25%
	Presentation	4	0%
Transpar-ency	Draft	2	25%
	Normal	4	25%
	Presentation	4	0%

On certain printers, e.g., H/P 540, the number of passes and the depletion are determined automatically by the printer and may differ from the value in the table. On some other printers, depletion and no. of passes cannot be changed, and setting them to different values has no effect.

[1] Recommended by H/P.

PCL Printer settings

For PCL printers, such as the HP LaserJet and most inkjet printers, the following options also apply:

Resolution - Selects the desired dots/inch resolution to print the image. Normally this is set to the highest value your printer can handle (see discussion above).

Typical values are:
150 dpi
300 dpi
600 dpi
1200 dpi

This number must be set **exactly** . For example, a 300 dpi printer may ignore the setting, or it may print nothing at all if the resolution is set at 299 or 301.

Dither size - Determines the number of separate gray or color levels that can be printed:

Dithering size	No. of gray/ color levels
1x1	2
2x2	4
4x4	16
8x8	64
16x16	256

The size of the printed image also increases proportionately with the dithering size. No “error propagation” is performed, in order to maximize resolution for text.

Print Quality: Draft/ Normal/ Presentation - Selects the quality of printout. Presentation quality takes longer, but gives slightly better results.

Not all printers support this option.

Depletion – Improves image quality by removing a certain percentage of the pixels. It is recommended to leave this setting at “printer default” unless unsatisfactory results are obtained. The highest two settings also apply gamma correction to the printed image, if this feature is supported by your printer. Gamma correction produces a smoother transition from one color to the next.

See the table above for recommended depletion levels.

Not all printers support this option.

Printer gray balance - If checked, the internal gray balance adjustment in the printer will be activated if present. This is supposed to adjust the colors so that blacks appear black instead of dark green. Do not check this box if you have changed any of the values under "Printer color adjustment" (see above), since this would result in correcting the gray balance twice. If your printer does not support this option, checking this will have no effect.

PostScript Printer settings
For PostScript printers, the following additional options apply:

Horizontal image size (inches)
Image ratio (y/x)
- The output will be scaled accordingly to shrink or enlarge the image to the specified size.

Rotation (Degrees) - The printout will be rotated counterclockwise by the specified angle. The angle is centered at the lower left corner of the paper. Note that a rotation may cause part of the image to be off the page unless 'horizontal position' is also adjusted.

Interpolate
- If checked, and if the output resolution of the printer is high enough, additional pixels will be added to smooth the output.

NOTE: *PostScript Level 2 or above is required.*

8.1.3.2 Color printing

Color printing uses the same parameters as B/W printing, except you must select RGB, CMY, or CMYK color instead of grayscale. Color printing can take a much longer time than B/W printing, and requires more printer memory if you are using a laser printer. Use B/W mode whenever possible. The choice between the color types is subjective; however, CMYK generally gives darker blacks.
NOTE: You do not have to convert your image to CMYK format to print it in CMYK mode.

Color type - Selects color printing mode.

B/W (grayscale) - Recommended for non-color printers and for monochrome images. The pixel values are sent to the printer without filtering them through the colormap. Thus, if you made the image lighter or darker by dragging the colormap palette, these changes will not be reflected in the printout. This setting should not be used for the following types of images:

1. Images that have been converted to a lower bit/pixel depth, e.g. from 24 bits/pixel to 8 bits/pixel.
2. Images containing color.
3. Images such as GIFs which have a discontinuous colormap.

RGB/indexed color - Not recommended for PCL inkjet printers, because some PCL printers insist on interpreting this command to mean that all pixels not explicitly defined are to be printed as "black". This causes a wide black stripe to be printed next to the image, and causes printing to take a much longer time.
For PostScript printers, this is a good setting to use for both grayscale and 8-bit color images.
If the image is 8 bits, the colors or gray levels are determined by the colormap. If it is a true-color image, the RGB values are used directly.
Prints using red, green, and blue inks if available (not supported by all printers).

CMY color - Recommended selection for PCL color printers. Not recommended for black & white printers.

CMYK color - For color PCL printers - gives darker blacks and brighter colors than CMY but takes 33% longer. For PostScript printers, this option is the same as CMY.

Printer color adjustment - Adjusts each color to allow you to match the printer output with the screen. For each color, a value of 128 (the default) is "normal". Increasing the value will increase the intensity of that color. If CMY or CMYK is selected, the cyan, magenta, and yellow inks are changed. If RGB is selected, the red, green, and blue inks are changed. If B/W-grayscale is selected, the black value is taken as the average of the three color values. **NOTE:** For CMYK printing, it is important to keep the 3 colors balanced so that the average is 128. Otherwise, the black ink, whose value is derived from the 3 pigments, will also become lighter or darker.

8.1.3.3 Printing under Unix

The Unix version of TN-Image has the additional option *Printer Name* . By default this is set to /dev/lp2. If you have multiple users on your system, or if you do not have write permission for /dev/lp2, it is recommended to change this to a regular file, e.g., "temp.print" and print the file later using `lpr` .

Warning: If a device is specified that is not a printer or a file, bad things will happen.

8.1.3.4 Printing to a file or another printer

A 'print file' can be created by entering a filename instead of a printer name under *Printer device/file name* in the "Print..." menu. This will create a print file which can be sent to the printer later, such as at night when it is less busy.

For example, in DOS, printing of a file can be done using the command:

`copy /b print.tmp lpt1`

However, `copy /b` does not work correctly on some printers. In this case, you can use `print.exe` , which is a replacement for DOS's `print.exe` . This program is available at the ftp site. Print.exe is also useful for printing large print files, such as those created by Ghostscript.

In Unix, printing of a file could be done using the command: `lpr -Pmyprinter print.tmp`

To schedule the printing at a specific time, use a program such as `tnshell` in DOS, or `cron` or `at` in Unix.

If a printer device is entered, the image will be printed on that device. *Printer device* refers to the printer name as it is known to the operating system, for example:

DOS version: lpt1 lpt2 prn

If this doesn't work try adding a colon after the name.

Unix version: /dev/lp0 /dev/lp1 /dev/lp2 /dev/printer, etc.

In Windows and Windows95, it is possible to print to any network printer provided the printer has been set up correctly with the Print Manager. Typically, this would be lpt2, lpt3, etc. In Unix, any command can be entered, such as `lpr -P`*printer* .

8.1.4 Change Title

Changes the name of the image. This must be a valid filename. If the title contains illegal characters (such as spaces or control characters in the DOS version), they are automatically removed and an error message is displayed.

8.1.6 Create/Resize Image

You can create a new image by clicking and dragging with the mouse, setting a fixed size and position, copying another image, or resizing another image.

For *fixed size* , you must enter the x and y size (in pixels), and the x and y position for the upper left corner of the image. The screen contents at the specified location will be copied into the new image.

For *use mouse* , use the mouse to select the region for the new image. The screen contents at that location will be copied into the new image. The other parameters will be ignored.

For *copy another image* , enter the image number of the image to duplicate and the x and y position for the upper left corner of the new image.

For *resize another image* , enter the image number of the image to duplicate, the new x and y size (in pixels), and the x and y position for the upper left corner of the new image. Any space beyond the copied image will be set to black.

8.1.7 Switch to

Make some other image the currently-selected, foreground image. This option has been replaced by "About the program...", which can also switch images.

8.1.8 Create file format

Defines a new image file format. This allows you to add up to 100 new formats to TN-Image, or create your own customized format. Once defined, the new format is automatically recognized by TN-Image and can be loaded and saved without any special action on your part.

If you know certain basic details about the image format, or have a sample image file already in that format, you can easily create an image file in almost any file format imaginable, which will be readable by any Intel-based PC, Macintosh, IBM mainframe, and many UNIX systems.

Custom formats are particularly useful if reading medical images from an X-ray scanner, which vary from one manufacturer to the other. Currently, only uncompressed custom formats are available.

Of course, with this much flexibility it is impossible to test every possible combination of parameters on every destination platform, so you should always make a test image before proceeding to make sure the file is readable on your non-PC system.

IMPORTANT *Always test to make sure your custom file is readable on the target system before erasing the original!*

The information you need to know is:

1 Bits/pixel that the destination system expects. This can be calculated from the number of colors on the screen, using the formula

$$\text{No. of colors} = 2^{(Bits/pixel)}.$$

Thus, if there are only 2 colors (black and white), there is 1 bit per pixel.

2 Destination system - If the destination computer is not a PC, Mac, or IBM mainframe, pick whichever seems closest. Many UNIX systems use "big-endian"-type processors similar to the Mac. VMS systems use "little-endian" processors similar to the PC.

3 Size of the image file header. To get this information, you can either guess, or view your sample image with a hex editor. Often it is a power of 2 (32, 128, etc).
4 Offset of the x and y size - This is the most difficult step if you are unfamiliar with hex notation. If you can't make a guess, if you are a registered user you can send us a copy of your sample image and we will determine these numbers for you.
5 The no. of primary colors (1 for grayscale or 3 for color).

Example 1: Creating a file format for images from a Lumisys X-ray scanner. *No sample image file is needed.*

1 Select "File...Create file format".
2 Set the following settings in the dialog box:

Target platform	- Mac
Bit packing	- None
Format Identification	- By Extension
Extension	- LUM
Identifier	- *(leave blank)*
Bytes to skip	- 2048
Use header	- (not checked)
Header file	- *(leave blank)*
Header bytes	- 0
Default bits/pixel	- 16
Default No.of colors	- 1

3 Set the following file offsets:

x size	- 806
y size	- 808
Bits/pixel	- 810
All others	- -1 *(or 65535)*

4 Then click on "OK". The new file format has been created.
5 Reading and creating images in the new format will now be transparent.

Care must be taken not to allow the offsets (which take 2 bytes each) to overlap with each other or with your identifier. The identifier itself cannot exceed 40 characters. If an identifier is specified, the image file must contain it at the specified offset. If an identifier is not specified, the image file must have the specified 3-letter file extension ("LUM" in this case).

"Bytes to skip" must be a multiple of 2 in this case, because there are 2 bytes (16 bits) per pixel. If you skip an odd number of bytes, the image will look strange because the light and dark areas are partially reversed.

Similarly, if the wrong target platform is selected, the image could look posterized or grainy, because the bytes are being put into the wrong pixels. It is sometimes necessary to experiment if you have an unknown image format.

Example 2: Creating an IMDS file. *IMDS is a little-known and rarely used monochrome format similar to GEM's IMG format, except that IMDS was used on IBM mainframes running MVS, and there seems to be no documentation for it.*

1 Select "File...Create file format".
2 Set the following settings in the dialog box:

Target platform	- MVS
Bit packing	- TIF-like
Format Identification	- By Extension
Extension	- IMG
Identifier	- (none)
Bytes to skip	- 0
Use header	- $\surd$(checked)
Header file	- *(Name of a sample IMDS file)*
Header bytes	- 32
Default bits/pixel	- 1
Default No.of colors	- 1

3 Set the following file offsets:

x size	- 12
y size	- 14
All others	- –1 *(or 65535)*

4 Then click on "OK". The new file format has been created.
5 Click on an image, or select something on the screen, and save it in the new IMG format (by clicking on "Format" then the last "IMG" item. Your sample IMDS file must always be present to create image files in this format.
6 Test to make sure the image is readable. Since TN-Image can already read this format, simply select "File...Read" and press *Enter* . If you set the above settings correctly, the image should appear as a black-and-white version of your original.

The default bits/pixel and default no.of colors are needed only if the these values are not in the header.

Example 3: Define a file format for raw byte images.

1 Select "File...Create file format".
2 Set the following settings in the dialog box:

Extension	- RAW
Target platform	- PC
Bit packing	- None
Format Identification	- By Extension
Identifier	- (none)
Bytes to skip	- 0
Use header	- (unchecked)
Header file	- (none)
Header bytes	- 0
Default bits/pixel	- 8
Default No.of colors	- 1
Default x size	- 382 *(substitute actual size)*
Default y size	- 362 *(substitute actual size)*
Default red bpp	- 0
Default green bpp	- 0
Default blue bpp	- 0
Default black bpp	- 0

3 Check the file offsets to make sure they are all either –1 or 65535.
4 Then click on "OK". The new file format has been created. Because "by extension" was specified, the raw image must have the extension .RAW to be identified.

8.1.9 Save FFT

Saves the currently-selected FFT matrix to disk in ASCII format. This allows you to precisely change any desired frequencies with a text editor, then reload the FFT and reverse-transform. **Warning:** *These files can be quite large.*

8.1.10 Erase FFT

Erases the matrix used in storing the FFT, if a Fourier transform has been performed on the image, thus freeing up a considerable amount of memory. It will not erase the Fourier transformed image that appears on the screen. If no FFT's have been performed, this has no effect.

8.1.11 Unload image

Removes the currently-selected image from the screen and frees up its memory. Also erases the image's backup and its FFT if present. If your image is large, and there are other images above it in RAM, on rare occasions it may not be possible to free the memory right away. In this case, it is occasionally necessary to select it unload image a second time. Unloading an image may take several seconds because TN-Image performs extensive garbage collection to defragment memory as much as possible after an image is unloaded.

8.1.12 DOS Command

Shell to DOS to execute a command or run a different program. Or, to obtain a DOS command line, enter `Command`. Type `Exit` to return to TN-Image. DOS requires a small amount of memory below 1 megabyte to exit commands. Thus you could get an "insufficient memory" error even if there is a lot of high memory.

This function is, of course, not available in the Unix version.

8.1.13 Quit

Return to operating system. If any images have been modified, you are given an opportunity to save them. Alt-X also can be used to quit.

8.1.14 Load FFT

Reads a Fourier-transformed image stored in ASCII format. The file format is as follows:
FFT of (image name)
xsize (x size in pixels)
ysize (y size in pixels)
Real
(Real frequencies from row 1)
...
(Real frequencies from row n)
Imaginary
(Imag frequencies from row 1)
...

(Imag frequencies from row n)

This format differs from the format used in TN-Image prior to version 2.18. The header in these earlier files must be changed before they can be loaded.

8.1.15 Acquire

(Unix version only) Acquires an image from a H/P compatible scanner. Currently only HP-compatible scanners are supported.

Setting up a scanner

Here is a brief outline of the procedure for attaching a scanner in Linux on an x86 system. For more details, consult the *Linux SCSI-HOWTO*. For Sun and SGI systems, these steps should not be necessary.

1 Install a supported SCSI-2 card and H/P scanner. One combination known to work is an Adaptec AHA-1542CF card and H/P 4C scanner.

2 Throw away the cheap printer-type cable and the SCSI card supplied with the scanner and use a good quality SCSI cable (Centronics-type connector at both ends) and a good SCSI card to connect the scanner.

3 Recompile your kernel if necessary to add "generic SCSI" support and support for the low-level driver for your SCSI card (see the *Linux Kernel-HOWTO*).

4 Shut down your system and make sure the scanner and the SCSI card are both properly terminated. Set the SCSI ID of the scanner to some known value less than 7. Power up the scanner before turning your computer back on. The scanner must be connected and powered on before booting the computer in order to be recognized.

5 The SCSI card should display a message at boot-up indicating its presence. Most Adaptec cards can be configured for IRQ, SCSI ID, etc. at this point by typing Ctrl-A during boot-up. Be warned that the card will also try to write to your BIOS, which on some older computers doesn't work properly and can cause a loss of your computer's configuration accompanied with various unusual beeping sounds. Therefore, it is prudent to record the BIOS values before starting. On some computers, after adding a SCSI card, it may take several tries with cold booting before the computer will boot up again. If you get a message such as "CMOS Memory size mismatch" after installing a SCSI card, power the system off and try again a few times before giving up. This is not an OS or TN-Image problem but is dependent on the hardware and BIOS.

6 At boot-up, if the SCSI card is recognized, you will see a message such as:

```
kernel:  scsi0 :  Adaptec 1542
kernel:  scsi :  1 host.
```

If your scanner is hooked up correctly, you will also see a message such as:

```
kernel:  scsi:  type is processor
kernel:  Vendor:  HP Model:  C2520A Rev:  3503
kernel:  Type:  Processor ANSI SCSI revision:  02
kernel:  Detected scsi generic sga at scsi0, channel 0, id 5, lun 0
kernel:  scsi :  detected total.
```

If this message does not appear, the most likely cause is that the scanner is not terminated or an incorrect cable was used (or, quite possibly, you don't actually have a scanner). Remember the device name (in this case "sga"). It may be helpful to create a link to this device named "scanner" in /dev.

7 As a last check, " `cat /proc/devices` " should list " `21 sg` " as one of the character devices. This device will be listed only if the scanner device is detected at boot-up. If it is not listed, it may be necessary to create a device file using MAKEDEV and then change the permissions on the device file. It should look something like this:

```
crwxrwxrwx 1 root root 21, 0 Feb 9 17:30 /dev/scanner
```

Scanning an image

1 Select "File...Acquire.." and change the scanner device name, resolution, brightness, contrast, etc. as desired. The scanner should immediately begin to scan a small, temporary, preview image. (The preview image is scanned at 50 dpi).

2 The dialog box will appear again. Change the contrast, brightness, resolution, etc. if necessary and click on “Image scan” and “OK”. Although it is possible to enter any number for resolution, some scanners may only accept specific values, such as 50, 75, 100, 150, 300, 600, or 1200 dpi. Entering a resolution inappropriate for a given scanner may result in the parameter being ignored by the scanner.

3 Select a region with the mouse in the preview image to scan. During this phase, the mouse is constrained within the preview image to prevent scanning of impossible coordinates. The selected region will be outlined with a “crawling box” and, when the mouse button is released, scanned at the selected resolution and placed in a permanent image buffer. Additional regions may be selected and scanned as many times as desired to create more images.

4 To scan a new original, click “Preview” again to create a new preview image, or click Cancel if finished. The temporary image is automatically erased.

NOTE: Scanner support has not been tested in the Irix or Solaris versions. Information as to whether this works will be appreciated. The scanner interface is not supported in MS-DOS or ConvexOS.

WARNING: If TN-Image detects an unsupported type scanner, it displays the message:

```
Not an HP scanner
Continuing may cause a lockup
Do you want to continue?
```

Click “OK” to attempt to use the scanner. *Do this at your own risk.*

Notes:

1. ADF, transparency adapters, and the ScanJet Button Manager on the HP5c are not currently supported.
2. Not all scanners support all scanning modes. For example, the HP4c handles 8 and 10-bit B/W and 24 and 30-bit color, but not 12 bit B/W or 36 bit color.
3. 30- and 36-bit/pixel images are stored internally as 48 bits/pixel but currently are handled in a pseudo-24 bits/pixel format with the low bits discarded. These images must be converted to 24 bits/pixel before they can be saved. A future version of TN-Image will correctly handle 48 bit/pixel images.
4. Brightness and contrast settings have no effect on 10 bit/pixel images.

8.1.16 Creating, executing, and testing plugins

In the event that specialized features not included in TN-Image are needed, it is possible to create a "plug-in". TN-Image can send data to an external program and retrieve it after processing.

Running plug-ins

1. Create a text file in the start-up directory named "plugins" containing a list of plugins, each on a separate line, for example,
   `plugin`
   `/usr/local/bin/myplugin`
   `./joes_plugin`
2. Select "File...Execute plugin" and select the desired plugin.

Creating plug-ins

The plug-in interface is still experimental and may change slightly in future versions.

1. The files "plugin.cc" and "plugin.h" provide a template for creating new plugins. TN-Image passes the data for all images as well as a large amount of configuration data to the plugin through a stream pipe, then reads it back afterwards. Stream pipes are used because the amount of shared memory in most versions of Unix is quite limited. All data shown in "plugin.cc" must be sent back, regardless of whether it has been changed. In addition, it is necessary to set the flag variable 'g–>changed[image_number]' for each image that has been changed to cause it to be redrawn.
2. A message of up to 1024 characters may be sent back to the parent. No information should be sent to stdout. Error messages can write to stderr if necessary.
3. The new plugin may be compiled with the command line:
   `gcc -o plugin -O3 -Wall plugin.cc` (use `-O2` on Irix).

Testing plug-ins

To debug a plug-in, create a macro containing the following line:
`executeplugin` *plugin_name* `0`
or equivalently,
`testplugin` *plugin_name*
The '0' causes the plugin to be executed in 'debug mode', i.e., its stdout is not redirected, whereas '1' causes it to be executed normally.

8.2.0 Image menu

8.2.1 Delete region

Erase part or all of an image or background. After selecting 'delete region', move to one corner of the region to erase, and click and drag to the other corner. This rectangular region will be set to the background color. (If there is another image behind the topmost image, the obscured part will be unaffected.)

Pressing the `Del` key after selecting a region has the same effect.

8.2.2 Crop

Similar to 'delete region', except erases everything except the currently-selected region, including the background and any portions of any image currently visible on the screen. If an image is obscured by another image, the obscured part is not cropped.

8.2.3 Erase background

Removes everything on the screen that is not a part of an image, and sets it to the background color.

8.2.4 Copy/Move

Copy or move part of an image or drawing to another region. After selecting 'copy/move', click and drag to select the desired region. The region is copied and pasted in the new location as soon as you release the mouse button. If the pasted portion falls partly on an image and partly on the background, the portion that falls on the image sticks to the image and the part that falls on the background sticks to the background.

Clicking on "move" causes the original area to be replaced with the current background pixel value.

You can change the mode of interaction of the moved region with the background or other images by changing the "Pixel interaction mode" from the "Config" menu. For example, if the pixel interaction mode is "subtract" the moved region will be subtracted from whatever is there. (See *Pixel interaction mode* below).

The source and destination do not have to be in the same window. To copy or move an area from the main window to an image in another window, continue pressing the mouse button and move the mouse cursor to the new window. The copied area will be invisible while the cursor is outside one of TN-Image's windows and will reappear when the cursor moves to the new window.

The copied region is converted to the image depth and color type of the destination. Thus, a region moved from a 32-bit color image and pasted onto a grayscale image will be converted to grayscale values. Pixels copied onto indexed-color images are converted to the pixel value with the closest matching color so as not to disturb the existing colormap. The tradeoff is that the copied region may appear slightly different; thus it is recommended that indexed-color images be converted to 24 bits/pixel before cut/paste operations. This feature can be disabled by un-checking the "Remap pixels" button. If "remap pixels" is unchecked, the pixels will be pasted without modification, and pixels pasted onto an indexed-color image having a different colormap will only appear normal when the original image is selected.

8.2.4.1 Transparent Copy

If the “Transparent copy” button is checked, only pixel values not between the specified “Minumum transp. pixel” and “Maximum transp. pixel” values will be copied to the new location. Transparent copying is considerably slower than opaque copying. It may be necessary to keep the cursor at the destination point for several seconds after clicking to allow the screen display to catch up.

You should un-click the ”Remap pixels” button when performing transparent copies; otherwise, some of the pixels may get remapped into or out of the transparency range (see *Transparency, Sec. 8.2.12.1 below)* , causing unexpected results.

Examples

Example 1. *Pasting a white text label onto an image.*

1. Select “Color..Foreground color” and set the color for the label to 255. Select “Draw..Font..” to change the font if desired.
2. Move the mouse cursor to a region in the background or in an unwanted area of the image and type the label. The label can actually be anything, including parts of images, different fonts, and graphic elements.
3. Select “Copy/Move”, click “Transparent copy” and adjust the Minumum and Maximum transparency values. For example, if the label contains colors 253, 254, and 255, set the minimum to 0 and the maximum to 252. (This assumes you are working on an 8-bit display).
4. (Optional). Un-click the “Remap pixels” button.
5. Click Ok and select the label with the mouse.
6. Move the mouse to the desired location and click the left mouse button.
7. Click the “Cancel” button in the information area when finished.

Example 2. *Creating and pasting a cutout image.*

1. Select “Image..Backup” to make a backup copy of the image in case you make a mistake.
2. Select “Color..Foreground color” and set the drawing color to 0 (or some other color not contained in the desired region of the image). (Note: if the image contains every color, it may be necessary to first remap one of the colors in the image, see *Remap, Sec. 8.4.5*).
3. Select “Draw..Fine spray” and drag the mouse cursor around the outside of the area to be cutout, to create a region of uniform color around the outside.
4. Select “Copy/Move”, click “Transparent copy”, make sure “Remap pixels” is unchecked, and set the minumum and maximum transparent values to 1 and 255, respectively (This assumes you are working on an 8-bit display. For a 16-bit display, the maximum should be set to 65535).
5. Click Ok and select the entire region (including the blacked-out area) with the mouse. When the mouse is clicked again at the destination point, the cutout will be pasted in the new location.

8.2.6 Change size

Creates a new image of a different size than the currently-selected image. You can specify different size factors for the x and y dimensions. However, both x and y factors must be either greater than or less than 1.0. For example, setting the x factor to 1.1 and y factor to 4.78 creates a vertically elongated image.

If the image does not contain fine detail, it is often convenient to shrink the image to x and y sizes of 0.5 or less before saving it. Setting the x and y factors to 0.5 decreases the file size by 75%. Conversely, enlarging the image allows you to fine-tune each pixel value before shrinking it back to normal size. (Note that in this case, you will have 3 images in memory: the original, the enlarged image, and the new shrunken modified image. It is recommended to delete the enlarged images as soon as they are not needed, to avoid running out of memory.)

8.2.7 Rotate image

Creates a new image identical to the currently-selected image, except that it is rotated by 90.

8.2.8 Flip horizontally

Converts the currently-selected image or region into a left-right mirror image of itself. For images ¿ 8 bits/pixel, only the selected color planes are flipped. Color planes can be selected in the "Config" dialog box.

8.2.9 Flip vertically

Converts the currently-selected image or region into a vertical mirror image of itself. For images ¿ 8 bits/pixel, only the selected color planes are flipped. Color planes can be selected in the "Config" dialog box.

8.2.10 Backup

Creates a backup copy of the current image in memory. This is recommended before manipulating the image or adding text, in case you don't like the results. Selecting "Restore" will retrieve the screen back onto the screen.

8.2.11 Restore

Replaces the current image with the backed-up copy if one exists.
Note: if you change the depth of an image, the original backup is no longer valid and is automatically discarded.

8.2.12 Image properties

Sets a variety of modifiable properties for each screen object or image.
Copy tables - Copies the colormap, gamma table, or calibration parameters from some other image.
Color type - Sets the 'colortype' flag for the image to Grayscale, Indexed, or Color. **Warning:** Changing color types is not always a reversible process.
Image Number - Sets the source and destination image numbers for the 'copy tables' option.
Image attributes - Sets the title, position, image depth, and transparency (see *Sec. 8.2.12.1) for the image.*

8.2.12.1 Transparency

Checking the "Transparent" button in the "Image properties" dialog causes pixels in the image whose values lie between the 'minumum' and 'maximum' transparency values to be treated as transparent. This means that images behind the transparent image or on the background will show through in those regions marked as transparent. This feature greatly facilitates pasting of labels and creating composite images and cutouts. Clicking the "Paste" button in the information area at the left causes the opaque pixels in the currently-selected region to be pasted onto whatever is behind it (*i.e.,*onto the background or the image behind the transparent image).

Copying and pasting of transparent images is also supported. See "Transparent Copy (sec. 8.2.4.1) for more information.

Note. The transparency feature is still under development and still has some minor limitations:

(1). Currently, only the raw pixel value is used in determining transparency. For indexed-color images, you should sort the color palette by selecting "Color..Colormap..Sort colormap" to achieve good results. This will not be necessary in future versions.

(2). If the image does not appear transparent after performing some operation, moving the image by clicking on the arrow buttons should restore the transparent effect.

(3). Currently, transparency extends only to the image immediately underneath the transparent image. The background image is treated as opaque even if it is actually transparent.

(4). No conversion between pixel types or image depths is currently performed by the "Paste" button.

8.3.0 Process menu

8.3.1 Filter

Modifies the currently-selected image, or the selected screen region, without creating a new image. The original image should be backed up before filtering it, in case you don't like the results. The amount of filtering is adjustable from 1 to 10 (maximum).

For images ¿ 8 bits/pixel, only the selected color planes are filtered. Color planes can be selected in the "Config" dialog box.

8.3.1.1 High-pass filter (Sharpening)

Extracts only the highest spatial frequencies in the image. More low frequency components are saved if a larger 'kernel' is selected. If the image contains few high-frequency components, and you selected too much sharpening, the result may appear dark or black. You can compensate for this by increasing the contrast of the image after filtering it.

8.3.1.2 Low-pass filtering

Low-pass filtering eliminates sharp edges from the image, causing a blurring effect. The total intensity is unchanged, but is spread throughout the neighboring pixels.

8.3.1.3 Background subtract

This is similar to high-pass filtering except it removes only the lowest frequencies. This has the effect of removing uneven background in the image. As with high-pass filtering, it can make the image appear darker. Selecting a larger kernel removes less of the low frequencies, but will require much more processing time. A preferred method is to use the "kernel multiplier". Selecting a multiplier of 5 with a 3x3 kernel produces results similar to using a multiplier of 1 with a 15x15 kernel, but is many times faster. For this reason, it is recommended to set the kernel to 3x3 for background subtract.

You can specify whether "black" or "white" pixels should be considered as the background. If you select "white", the image will generally get lighter in regions of unvarying pixel intensity. If the background value is "black", the image will get darker wherever the pixel intensity does not vary. You can compensate for this by increasing the contrast.

Background subtraction will also trash any text in the image.

See *Background flatten* below for an alternative (and faster) way to remove background gradients.

8.3.1.4 Background Flatten (de-trending)

This filter removes large-scale gradients from the image or selected region by measuring the average pixel value in each corner and then adding or subtracting a value to equalize the overall intensity. This could also be done manually, by creating a gradient region on the screen and adding the image to it (see *Gradient fill*). However, the manual method is not 2-dimensional.

In contrast to Background Subtraction, this filter does not trash text.

8.3.1.5 Noise filtering (median filtering)

Median filtering removes extraneous pixels from the image. This is useful if the image contains noise which consists of little dots that are clearly outside the range of the other pixels. If a given pixel varies by more than a certain amount from the pixels around it, median filtering substitutes the median of the neighboring pixels, thereby eliminating noise from the image. The image is otherwise unaffected. The range in +/- pixel value units, outside of which a value is to be considered noise, can be changed. A higher value results in less noise removal. Excessive noise filtering can make an image appear posterized. A setting of 0 will create a smoothing effect.

8.3.1.6 Laplace edge enhancement

This filter finds any edges in the image whose length is equal or greater than the kernel size. The edges are then increased in intensity while non-edge regions are eliminated. The effect on text is to create an outline of the text.

8.3.1.7 Sobel edge enhancement

This filter is similar to Laplace edge enhancement except that the effects are gentler. A Sobel filter enhances the color or intensity gradient, so that areas of constant color become black.

8.3.1.8 Edge detection and edge sharpening

Edge detect —
Edge detect – Detects and enhances edges in the image preferentially in the horizontal or vertical direction.

Sharpen —
Sharpen /
Sharpen –
Sharpen \
Sharpens the selected region or image preferentially in the indicated direction, creating a 'freeze-fracture' 3-D effect. This is particularly useful for images of biological specimens that have low contrast, since it highlights the overall shape of the cells.

8.3.1.9 Adjustable parameters

Kernel The kernel is the number of pixels used in calculating a pixel in the new image. The processing time needed increases with the square of the kernel size.

Kernel multiply factor A *kernel multiply factor* allows you to select an arbitrarily large convolution kernel without an increase in computation time. This is possible because usually only a small sample of the surrounding pixels are really needed to calculate the new pixel value. For most types of filters, a 3x3 kernel with a kernel multipier of 3 gives the same results as a 9x9 kernel, but is 3 times faster. For sharpening and blurring, this doesn't work, and the factor is automatically set to 1.

Amount of filtering The amount of filtering applied to the image, from 1 (minimal filtering) to 10 (maximal filtering).

Range (median filter) For median filters, you can specify a range of pixel values outside of which the pixel will be considered to be a noise pixel. For instance, if the median value of all the pixels in a given area is 123, and the range is set to +/- 10, then the pixel will be replaced with the median value (123) only if its value higher than 133 or less than 113.

8.3.2 Warp

Corrects (or adds) distortion in the image. Currently works in vertical direction only.

1. Select a series of control points to define the distortion to be corrected. For example, if you have an SDS gel in which the bands are U-shaped, trace out a U-shaped curve somewhere on the image that follows the U shape.
2. Press any key. This fixes the curve in place (it becomes invisible).
3. With the mouse, select a y-value somewhere below the lowest point in the curve which you traced out.
4. Click the left mouse button at the desired y-value.
5. Each vertical line on the screen will be shifted up or down so that each point on the curve you traced out is lined up with the selected y-value.

Future versions of TN-Image will have a more elaborate, 2-dimensional distortion-removal feature. Contact the author for availability dates.

8.3.3 Measure...

8.3.3.1 Distance measurement

Measure distance between two points. Click the left mouse button, move to the end point, and release the mouse. Click on the top menu bar or press *ESC* when finished.

Before making distance measurements, you can calibrate your image as described in Sec.8.3.9, using "2D linear calibration" mode. This will cause the results to be in known units (such as centimeters) rather than pixels.

If the mouse button is clicked inside an image, the mouse is grabbed by TN-Image and prevented from being moved outside the image (*Unix version only).* This prevents inaccurate calibration results. If the mouse button is clicked while on the background, or the image has been calibrated in a "1D" mode,the results are reported in uncalibrated pixel units.

8.3.3.2 Angle measurement

Measure the angle between 2 lines. Same as distance measurement except you must click and drag twice. The angle is always given as the most acute of the two angles between the two lines.

8.3.4 Calibrate

Calibrates the image or screen x and y coordinates. To calibrate an image, select "New calibration" from the menu, then click on the known calibration points in your image and enter the calibration values. The calibration points (which appear as small squares) can be dragged to new locations if desired. When finished, press any key. A dialog box will appear; select "linear" or "logarithmic" calibration, and change the title if desired. A small window will appear displaying the calibrated value for the current mouse position. The calibration does not have to be vertical or horizontal, but can be in any direction on the screen.

To end calibration mode, select "Calibrate" again and select "Hide calibration". To restore the previous calibrations, select "Unhide calibration".

Calibrating an image affects distance measurements and strip densitometry area calculations.

Each image, as well as the background, can be calibrated separately and can have a different title.

Four types of calibration are possible:

1. 1-D linear calibration: Measures the distance from a line perpendicular to the best-fit line passing through your calibration points. This calibration is useful for images of isoelectric focusing gels, or other situations where the distance in one direction is the parameter of interest.
2. 1-D logarithmic calibration: Same as (1) except distances are logarithmic (For example, if 10 pixels corresponds to 1 unit of distance, 20 pixels would be 10 units, and 30 pixels would be 100 units). This calibration is suitable for acrylamide and agarose gel electrophoresis images.
3. 1-D 2nd-order polynomial calibration: Same as (1) except distances are fitted to a quadratic equation. Not really very useful, but it was easy to program.
4. 2-D linear calibration: Distances are calculated as the distance from the point (0,0). This calibration type is suitable for calibrating to objects of known size on the image (Sec. 8.3.4), for example if a ruler was included in the image.

EXAMPLE: Calibrate an SDS-PAGE gel for molecular weight standards.

1. Select "New calibration".
2. Click on "OK" to start calibration.
3. Click on each size standard in the image, then enter the corresponding molecular weight. Each point will be shown by a small box. If you make a mistake, you can go back and drag any of the boxes to a new location. A best-fit line is automatically drawn connecting the boxes. Make sure that this line is in the same orientation as the lanes in your gel (i.e., vertical or near vertical if your lanes are straight).
4. When finished, press a key. The boxes and line will disappear.
5. Select "logarithmic" calibration from the dialog box.
6. Change title to "Molecular weight" (optional).
7. The molecular weight is now displayed continuously. You can move the display window to any location by clicking on its edge and dragging to the new location.

Example 2: Calibrate coordinates on the image to centimeters using a ruler in the image.

1. Select Process...Calibration...New Calibration.
2. Click OK.
3. Click on the ruler markings on the strip in your image. A small box indicates the calibration point. Move the box by clicking-and-dragging if necessary. After releasing the mouse button, enter the centimeter value. Repeat for at least 2 more calibration points. The program uses least squares calculations to find the best calibration fit to your points.
4. When finished, press *ESC* .
5. Select "2D Linear" from the menu, change the title to "Centimeters", and click OK.
6. The image is now calibrated. Each image, as well as the background, can have a different calibration. The distance is measured as the distance from 0,0 as defined by your calibration points. You can now perform calibrated distance measurements.

8.3.5 Spot Densitometry

Performs densitometric analysis on parts of the image. See also *Strip densitometry* . For a tutorial, view the image DENSITOM.PCX.

In high-color and true color modes, the image is treated as a 15, 16,or 24-bit deep monochrome image during densitometry. This is the traditional method of densitometric analysis (as opposed to analyzing each color separately). **WARNING:** If a monochrome or 8-bit image is converted to color, the original correspondence of pixel values to optical density (if one existed), may be lost.

Pixel compensation - If checked, this will cause TN-Image to use in its calculations the actual optical density value that corresponds to each pixel, instead of the raw pixel value. This information is often provided by digital scanners in the form of a 'gray response curve' that is embedded in the TIF file. It is recommended that pixel compensation be checked $\surd$ for all densitometry.

Pixel compensation is not applicable for color (15,16,24, or 32-bit/pixel) images.

Maximum signal - Selects whether pixel value corresponding to 'black' or 'white' (0 or 255 in 8 bpp mode) is to be considered the strongest signal. If you have an image of a protein gel, for instance, the bands appear black and maximum signal should be set to "black". For DNA gels, the bands appear white and maximum signal should be set to "white".

NOTE: Selecting "Black" as the maximum signal will cause the reported values to be calculated as 1 - (measured value). Thus, if the average uncorrected pixel intensity of a spot is 0.25, the density (with "pixel compensation" off) will be 0.75.

Area selection

- *Automatic:* Automatically finds the boundary of the region. Move to a point near the middle of the region to be analyzed and click the left mouse button. TN-Image will automatically determine the boundaries of the area to be densitometrically measured. This boundary is defined by the set of contiguous pixels whose value is between the maximum value (which can be selected above as "black" or "white") and the background value (which can be selected to any value). It is important that there is no unbroken trail of pixels in this range that extends out of the region of interest, otherwise an area larger than desired may be selected. As long as you continue clicking, new areas will be selected and analyzed. To stop densitometric analysis, either click on the right mouse button, or click somewhere on the menu bar at the top of the screen. If the background is set inappropriately, the quantitated region may be too small or too large. The densitometric operation can be aborted by pressing the *ESC* key.

If there is no clear boundary around the region of interest, the region can be traced out beforehand by sketching a black or white border around it.

Manual: In this mode, you must select (by clicking and dragging) a rectangular region to be analyzed each time.

Fixed size: In this mode, you select (by clicking and dragging) a rectangular region the first time. From then on, as long as densitometry is active, when you click on a point, a region of size and shape identical to the first region will be analyzed. This region will be centered at the point where you click.

Background - Select the fractional pixel value (between 0 and 1) which is to be considered the 'background level'. The background level is important in automatic area selection as described above. The background value can also be automatically subtracted from the results if desired.

Calibration factor - If a value is entered here, the result is multiplied by that number. This is useful in converting to micrograms of protein, for example, on an image of an SDS gel.

Subtract background - If checked, the background value will be automatically subtracted from each pixel during calculations.

After each analysis, a message box appears with the results. This is : (1) The area (total number of pixels) analyzed; (2) The total signal measured (either in total pixel values or total O.D. units, depending on whether pixel compensation is active); (3) The average signal, i.e., the quotient of (2)/(1); (4) The corrected total signal - background. For most purposes, including gel analysis, the number of interest is (2) or (4), because you need to measure the total amount of absorbing (or fluorescing) material in the entire band. For other purposes, you may be more interested in the signal density or concentration per unit area on the image. The area is of interest in photomicrographs.

NOTE: See the warning under *Contrast* .

WARNING: Pixels beyond the edges of the screen are not included in the area or density calculations.

8.3.5.1 Area measurements

Making area measurements:

1. Before starting, obtain a histogram on the image to find the desired background value for use with automatic spot detection (select "Color...Histogram"). Alternatively Use "Draw...Sketch" before starting, and completely encircle the objects to be measured with a white line. Outlining the objects manually will obviate the need to select an appropriate background value.
2. Select "Image...Spot densitometry". Leave all the settings at their defaults except for the Background Value.
3. If you wish TN-Image to identify the spot automatically, set the background value to the pixel value that corresponds to the brightest pixel in the background. Otherwise, if you have outlined the regions beforehand, set the background value to any large number (for example, if you outlined the areas with white (=255), set the background to 254).
4. Click on OK, then click again to dismiss the message box.
5. Click anywhere inside the object to measure. The area being measured will temporarily be painted in black, then a list box will appear displaying the area.
6. Click on the background (or the upper left corner of the list box) to hide the list box. Then click on the next object to measure.
7. Press *Esc* when done.

8.3.6 Strip Densitometry

See also *Spot densitometry* For a tutorial, view the image file DENSITO2.TIF.

Strip densitometry is not as exciting as it sounds. It is similar to spot densitometry, but is easier to perform and interpret because it is not necessary for TN-Image to find the edges of the object.

If the image has been calibrated, moving the cursor over the plot area of the graph causes two different x-values are printed. The upper x value is the data point number, and the lower x value is the calibrated value for the center pixel of the line along which the strip densitometry was performed. If the image has not been calibrated, the two x values will be identical. Clicking-and-dragging within the plot selects a portion of the graph for area calculation. The selected area is highlighted in reverse color. If the image has been calibrated, this area (printed at the lower right of the graph) is also calculated from the calibrated values.

To obtain a densitometric tracing of a trapezoidal region, select “Strip densitometry” from the “image” menu. Do not confuse this option with obtaining a scan from a scanner, which would require a hardware interface, which is not provided with TN-Image. The options are:

Select coordinates - If ‘select coordinates’ is checked, you must select the region to scan each time.
Repeat prev. scan - If ‘repeat previous scan’ is checked, the same region as the last time will be re-scanned without you having to select it. This is useful if you modified the image in some way, such as by filtering it, in order to see the effects on scanning.
Maximum signal - select whether a “black” or “white” pixel is to be regarded as the most intense value. Note: in 8 bit/pixel modes(monochrome/indexed color), this will be affected by the optical density table which is often included in TIF files, if ‘pixel compensation’ is set to ‘on’. Most scanners set their optical density table so that ‘0’ is the maximum optical density. (To find out whether your image file has an O.D. table, select “Configure... Show O.D. table”.)
Pixel compensation - if set to ‘on’, the optical density table in the image file is used to correct the pixel values from a range of 0,255 to values that are proportional to the actual optical density of the original image. This table is usually generated by a scanner and is found mainly in TIF files. It is recommended to set pixel compensation to ‘on’ when analyzing images from a scanner. This setting is automatically turned “off” in the color modes, because these modes have enough dynamic range that a gray scale table is not needed.
Scan type - This option determines what type of region you can select for scanning. Selecting ‘snap to 90 deg ’ causes the starting and ending edges of the scan to “snap” to either vertical or horizontal, whichever is closest. This is fastest because it does not require any of the anti-aliasing calculations which are needed when you scan diagonally. However, if your image contains objects that are oriented diagonally, some resolution would be lost in the scan because the objects will be scanned at an angle to their true orientation.

The first two points always determine the orientation of scanning. Scanning is always done along a line parallel to these 2 points. The 3rd and 4th points determine the direction and shape of the region to scan. The area being scanned is indicated by a sweeping wave of temporarily inverted pixels.

Selecting *permit diagonal scan* allows you to select any trapezoidal area with no restrictions on the starting angle. However, the angle of the far side of the trapezoid is always adjusted to make it parallel to the starting side. This avoids confusion that would otherwise be caused by having a small ‘tail’ at the end if the starting and ending sides were not parallel.

Because of the grid nature of the screen, this option is slower because it is necessary to correct for ‘aliasing’ caused by pixels being at unpredictable distances from the starting point. However, you can scan objects that are oriented in any direction. To compensate for the slower speed, the pixels are no longer inverted as they were in earlier versions of TN-Image.

Fixed width only requires that you select the two end points instead of 4. Densitometry is performed in a rectangular region between the two points using the specified width in pixels (which can be 0 to 200). If the region is not perfectly vertical or horizontal, anti-aliasing is performed.

This method is the most useful for obtaining results which need to be compared to each other, or when the density of a very narrow region (such as a line) is desired. Of course, a narrower region will tend to be noisier than a wide one.

Fixed width densitometry is slower than the other two methods because more floating point calculations and memory accesses are needed. However, it may be more accurate. Using fixed-width densitometry with a width of 1 gives a "transept line".

Options

Automatically save scan - If this option is checked, each scan will automatically be saved in an ASCII file.
Filename for scan - A default filename of "1.scn" is provided. If the 1st 8 characters of the filename consist entirely of digits, the program will automatically increment the filename after each scan (For example, if the starting filename was " 1000.dat", subsequent scans would be saved under 1001.dat, 1002.dat, etc.). If the filename contains letters, the filename must be typed in each time.
Plot results - If checked, the scan results will automatically be plotted on the screen after each scan. Clicking the "OK" button on the graph makes the graph disappear and returns you to scanning mode. The graph is always automatically scaled in the Y direction to fill the entire box. When the graph is visible, the data can be saved to disk, a background curve can be subtracted from the data, or the graph can be captured into a new image (See "Plotting densitometry results and other data").
Pause to show region- If checked, the program pauses after drawing the 4 boxes, allowing you to verify that you selected the correct region. Press a key to continue.

Procedure:

1. Select "Image...Strip densitometry" from the menu.
2. Click on "Maximum signal=black" or "Maximum signal=white" depending on whether the features of interest are darker or lighter than the background.
3. Click on "Snap to 90 deg" , "Diagonal scan", or "Fixed width" (see above). If you select "Fixed width", enter the desired width in pixels.
4. Click on "OK", then click anywhere to start.

5a. Click once on each corner of the rectangular area to be scanned, in a clockwise direction, so that 4 boxes appear on the screen. The region will be scanned from the first 2 to the last 2 boxes.

5b. For 'Fixed-width' densitometry, click at the center of the starting and ending points, so that 2 boxes appear on the screen.

6. If any of the boxes are in the wrong position, or the lines connecting them are crossed, click and drag the boxes to the correct position. (NOTE: if the lines are crossed, the algorithm automatically swaps the coordinates to un-cross them).
7. Press any key, or click anywhere to start scanning. The scan results will be automatically plotted if "plot results" is checked. The densitometry scan can be saved to disk or captured into a new image from the plot window.
8. Click on "Save to disk" to save the densitometry tracing in an ASCII file.
9. Click on "OK" to scan the next region, or press *ESC* or click the right mouse button to stop. **NOTE:** See the warning under *Contrast* .

8.3.7 Plotting densitometry results and other data

There are several useful options available in the plot mode:

Save to Disk – Saves the currently-displayed graph into an ASCII file.

Smooth – Performs Gaussian smoothing on the data being displayed.

Auto Baseline –
Automatically calculates an optimal curved baseline and subtracts it from the data. The s-moothness of the calculated baseline can be changed by clicking on "BL smoothness". The calculated baseline is displayed for 1 second before subtracting it.

Manual Baseline –
Allows you to select a baseline manually. Click at several locations on the graph where you want the baseline to go. Small squares will appear to indicate where you clicked. You can click-and-drag

these squares to move them. When finished, press a key to subtract the baseline. The baseline curve is constructed using a B-spline (see 'B-spline curve'). The squares can be anywhere on the screen, and do not have to be inside the plot. Also, you can subtract a baseline from only a portion of the data by placing boxes only under the portion you wish to change. However, any negative numbers created by baseline subtraction are truncated to 0's. Up to 200 boxes ('control points') can be used.

Capture Image –
Clicking 'capture' allows you to capture all or part of the graph into a new image. After clicking on 'capture', use the mouse to select the desired portion of the graph. A new image which includes that region is then automatically created. The new image is put into the background, behind the image you are currently scanning, so that you can continue with the next scan.

Help – Calls a help screen.

OK – Ends plotting, returns you to densitometry mode.

8.3.8 Peak Areas

Finds the x and y coordinates of each peak and calculates the peak area. The integration limits are shown as short black lines on either side of each peak. No baseline subtraction is carried out before calculating peak areas. Thus, best results are usually obtained if you first subtract a baseline by clicking on 'Auto.baseline' or 'Manual baseline'.

When the list of peaks is displayed, most of the click buttons on the left side of the plot are still active, but now apply to the peak list. This includes:

Save to disk
Capture image
Help
OK

The other buttons ('peak areas','smooth', 'manual baseline', and 'auto baseline') are inactivated while displaying the list.

You can also close the peak area list by clicking on the '-' symbol in the upper left corner.

Area calculations: While the graph is displayed, you can also manually measure peak areas by selecting the desired region of the graph. To select a region, click with the left mouse button and drag horizontally within the graph area. When the mouse button is released, the total area of the selected region is automatically displayed.

8.3.9 Trace curve

If you have an image of a graph, chromatogram, etc., TN-Image can convert this into an ASCII file. Currently, TN-Image only traces in 1 dimension, and from left to right. Contour tracings will be implemented later.

Procedure:

1. First, clean up the image to remove any stray specks, labels, or other points that could be confused with the graph. The entire image must be clean, including the edges. The trace will jump to the darkest y-value point for each x value, regardless of where it is located on the image, even if it is not visible on the screen. Use "Paint region" if necessary to eliminate white areas from the image.
2. Select "Image...Trace curve".
3. If you want the trace to be saved automatically, check "Save trace".
4. If you check "Plot trace", the data will be displayed. You will then be able to click on the "Save" button to save it. While the graph is visible, you can smooth it, subtract a background, measure areas, etc. (See "Plotting densitometry results").
5. Find the pixel value of the curve to trace by moving the mouse onto the desired area. The pixel value is displayed in the information box on the left after "i=". Set "Color to track" to this value.
6. Click on "OK", then move the mouse cursor to the left end of the curve and click the left mouse button.

A cross-hair cursor indicates what is being traced out. Click on "Cancel" when finished.

Sometimes, sharpening or thresholding the image can improve the tracing. If there are extremely sharp peaks in the image, it may be necessary to manually create a channel between the ascending and descending parts of the peak to force the trace to follow to the top. This can be done by selecting "Draw" from the menu, or pressing *F2* (=manual draw), and carefully moving around with the cursor keys (Be sure to back up your image before starting).

Checking "Debug" waits for a keypress after each x increment and prints the x, y, and the pixel value being tracked. This is helpful if stray noise pixels are accidentally getting included in the scan.

Only pixels on the selected image are included in the trace. Thus, in order to trace something in the background, you must convert it to an image first (use "File...Create/resize image"). The tracing algorithm tracks whatever pixel is closest to the selected tracking color for each x value. Thus, if the image contains a pixel closer to the tracking color than any pixels on the curve, the cursor will jump to this area instead of tracing your curve. If the pixel is beyond the edge of the screen, the cursor will jump to the edge of the screen. If this occurs, it will be necessary to delete the offending area before tracing anything (The "backspace" key is the most convenient way to do this).

8.3.10 Mathematical pixel operations (Image Algebra)

Although it is possible to add or multiply pixel values by any factor by using the "brightness" or "contrast" menu items, TN-Image also has a more powerful tool – mathematical pixel operations.

Using the "math" menu, you can enter any mathematical formula to transform each pixel value in one pass. This formula could be any legal mathematical equation consisting of constants, variables, and operators from the following list:

Constants - any real number (floating point or integer)

Variables - one of 4 pre-defined variables:

i = intensity (total pixel value)
r = red component of the pixel
g = green component of the pixel
b = blue component of the pixel

Operators -

() = parentheses
* = multiplication
/ = division
+ = addition
- = subtraction

Integer operators -

NOTE: The operands are truncated to integers before integer operators are applied.

^ = bitwise XOR
& = bitwise AND
| = bitwise OR
~ = bitwise NOT

Single parameter functions

sin cos tan
sinh cosh tanh
asin acos atan
sqrt abs
log *(natural logarithm)*
ln *(natural logarithm)*
log10 *(base 10 logarithm)*
exp
pi
rand *(random number based on specified seed, scaled 0-255.0)*

The following 4 functions are only available on Linux:

asinh
acosh
atanh
cbrt *(cube root)*

Two-parameter functions

max
min
pow *(pow(x,y) = x raised to the power y)*

For example, if you entered the following equations:

r=r+3
g=(r/4)+1.2345
b=g-pow(b,2)

each pixel would have its red component increased by 3, its green component would be set equal to red/4 + 1.2345, and blue would be set equal to green minus (blue squared).

To edit the equation, use the mouse or arrow keys to highlight the desired row. Press *Enter* and edit the equation. Click on *OK* or press *Enter* again when finished.

To perform "gamma correction" to your image, enter the following equations:

r = pow(r,1.8)
g = pow(g,1.8)

b = pow(b,1.8) ,

where 1.8 is the gamma correction factor. For monochrome, a higher value (e.g., 2.35) is often used.

To eliminate all pixels below 100 and above 200:

i = min(200,max(i,100))

Using data from other images

Mathematical operations can also be performed using data from other images, other frames, or other regions in the same image using the [][][][] operator:

Unix version:

image[image_number][frame][x][y]
red[image_number][frame][x][y]
green[image_number][frame][x][y]
blue[image_number][frame][x][y]

DOS version:

image[image_number][x][y]
red[image_number][x][y]
green[image_number][x][y]
blue[image_number][x][y]

where:

image_number is the number assigned to the source image by `tnimage` (This number may change unexpectedly when images are unloaded).

frame is the frame number of the source image (3D images only). For non-3D images, the frame number must be 0. It may be convenient to create an image with 2 or more frames to hold intermediate calculations. By default, no intermediate values are stored; therefore, an equation such as

i = image[0][0][x-1][y-1]

will overwrite its own source data.

y and x are the coordinates of the source pixel. The coordinates are relative to the upper left corner of the source image.

All numbering of frames, images, and x and y coordinates starts with 0. An invalid coordinate, frame, or image does not cause an error but returns a value of 0.0. The formula is iterated over every (x,y) in the selected destination image or region.

If this form is used, all 4 bracketed parameters must be specified even if only one frame exists.

Since 3D images are not supported in the DOS version, only the image number and x and y coordinates need to be specified.

Example: Subtracting 2 images with a small offset and increase the brightness of the result by a factor of 2.5.

1. Click on destination image. (Assume source image is #1).
2. Select "image math".
3. i=2.5*(i-image[1][0][x-2][y-2])

Example: Making all the pixel values in image #0 an even number:

`i=image[0][0][x][y]&254`

Mathematical formulas may also be entered in the macro editor as single-line formulas such as

`math` *formula*

or multiple line formulas such as:

`math 1` *(starts image math mode)*
formula1
formula2
...
`math 0` *(ends image math mode)*
... *other macro commands* ...

This has the advantage that multi-line formulas may be used and saved to disk or copied from the X Window clipboard using the mouse.

8.3.11 Transform (FFT)

Performs a Fast Fourier Transform on the image or selected region. This can use a lot of memory because the frequencies are stored as double-precision complex numbers, which require 16 bytes for each pixel. Thus, an FFT is 4 times as expensive as a 32-bit image. Additionally, the mathematics of the FFT requires that the image be first enlarged so that each dimension is the next higher power of two. For example, if your image is 129 x 67 pixels, TN-Image has to create a new buffer of 256 x 128 pixels (524,000 bytes) to carry out the calculations.

The FFT result is a matrix which is displayed as a new 128 bit/pixel image. This new image can be saved, unloaded, annotated, filtered, and manipulated like any other image. Any changes you make to this image (such as adding text) are also converted to the appropriate floating point numbers and inserted at the appropriate position into the displayed component (real or imaginary) of the FFT matrix. Therefore, changing pixels on the displayed image could change the real component of the FFT, the imaginary component, or both. After editing the image to enhance or eliminate specific spatial frequencies, you can then perform a reverse FFT to obtain the filtered result.

Forward/Reverse/Change display only

Selects whether to carry out a forward or reverse FFT, or to merely change which component (original image, imaginary, real, or power spectrum) is being displayed. No actual change is made to the FFT data.

Real/Imaginary/Power spectrum

Selects whether to display the real, imaginary, or power spectrum component of the transformed image, or only the original image.

NOTE: If you select "imaginary" or "power spectrum", the displayed image will appear black if you perform a FFT followed by a reverse FFT. This is because the original data do not have an imaginary component. The original data are not lost!

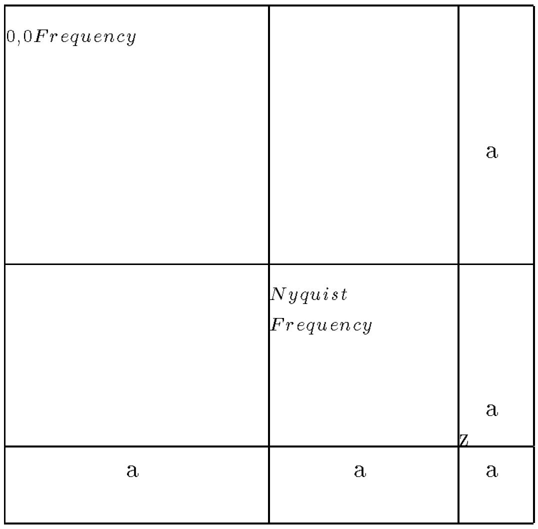
Although a complete description of the many applications of FFT's and deconvolution is beyond the scope of the manual, there are a few TN-Image- specific points worth remembering:

1. Regardless of the screen mode or color depth of the image, the FFT and deconvolution algorithms treat all pixels as monochrome. Thus, a 24-bit/pixel image is treated as a 24 bit deep grayscale image. In other words, the colors are not deconvoluted separately in the current version of TN-Image.
2. The grayscale mapping algorithm sets the most negative FFT result to black and the most positive FFT result to white. Thus, zero will be some shade of gray.
3. Editing power spectra will lead to unpredictable results in your image.
4. Select "About...About the image" to view some of the FFT parameters. These include:

Minimum FFT value (which is mapped to black)
Maximum FFT value (which is mapped to white)
FFT=0 color value (the color to which FFT values of zero are mapped)
FFT=0 RGB values (the corresponding red, green, and blue components of the FFT=0 color value).

These numbers can be used to calculate the color values needed to edit the image in the frequency domain to remove or accentuate specific fequencies. The filtered image can then be reverse- transformed to obtain the result.

5. FFT's are displayed in the conventional manner, i.e. with lowest positive frequencies at the top and left, lowest negative frequencies on the right and bottom, and Nyquist in the center, with the exception that only the real or imaginary components are shown, as illustrated in the diagram below:



In this diagram, 'z' marks the lower right corner of the original image. The 0,0 frequency is in the upper left corner, and the f=0 frequencies run vertically along the left and top edge, from f=0, f=1/N, ... f=n, f=-n, ... f= -1/N.

If the x or y size of the image is not a power of 2, the portion of the FFT from the original size of the image up to the next power of 2 is not visible in the displayed result. These regions, which consist of the lowest negative frequencies, are marked 'a'. The Nyquist frequency will also be off-center in this case. It is possible to change the image size to make its dimensions a power of 2 before calculating the FFT with the "File...Create/resize image" option. This will greatly facilitate interpretation of the results and also facilitate frequency-domain filtering.

6. FFT's should be done with as few other images present as possible. Because an FFT is extremely memory-intensive, if TN-Image is forced to use virtual memory, the FFT may take a very, very long time.
7. When deconvoluting or convoluting, the two images should be approximately the same size for optimal results.
8. Avoid image sizes that are just larger than a power of 2, such as 129 x 129 pixels. This will cause the complex array for FFT to be allocated as the next higher power of 2 (i.e., 256 x 256). The additional pixels will also be set to solid black, which will create artifacts in the FFT.
9. The screen mappings of FFT intensity values are automatically rescaled whenever the FFT image is redrawn. Thus, changing the contrast of an FFT'd image will appear to have no effect.

8.3.11.1 Convolution

View the image DECONVOL.TIF for a quick tutorial on convolution and deconvolution.
Convolution -
Convolutes two images. Convolution is the same as multiplication in the frequency domain. Therefore, the resultant image will have the characteristics of both images. In the simplest possible example, a sharp image convolved with an image of a blurred point will become blurry. An image convolved with a single point is unchanged.

8.3.11.2 Deconvolution and image reconstruction

Deconvolution is a form of image reconstruction which was made famous by successfully being used on the distorted images from the Hubble space telescope. As with convolution, two images are required. Typically, one of the two images is a *point spread function* , or psf, which represents the effect of distortion on a single pixel, and the other is the image from which this distortion is to be removed. The two images must be approximately the same size. For example, if your image is blurred by spherical distortion from a bad lens, you would create an image the same size as your blurry test image, but consisting of a single point in the upper left of the image on a black background, subjected to the same blurring effect. If the point spread function is known accurately, after deconvolution the blur will be removed. In effect, a priori knowledge from outside the image is used to remove the distortion.

In principle, any degraded image can be reconstructed by deconvolution if the point spread function is known. If a photo is blurred due to movement in one direction, the point spread function would be a line in the direction of motion whose length depends on the amount of movement. In practice, deconvolution will not work for every image.

This method is far more powerful than using a “sharpening” filter, because any arbitrary type of degradation of the image can be eliminated. In practice, noise (especially noise in the psf) or low precision in the FFT will cause inaccuracies in the recovered image. For this reason, FFT’s in TN-Image are maintained as double-precision numbers. Also, if the spatial frequency of the psf at any point happens to be zero, it will also be impossible to reconstruct that point (since it would require dividing by zero). Adding a little noise to the psf will ensure that all frequencies are non-zero. Thus, sometimes it is necessary to tolerate some noise in the psf to get good image recovery.

Important: The point spread function must be centered at the upper left corner of the image to be used as a psf. Otherwise, a translation effect will also be convoluted into or out of the image.

Exercise: Try deconvoluting fft1.tif and fft2.tif. It should be possible to reconstruct the original image in fft1.tif, which was a small square, despite the complicated point spread function in fft2.tif which renders the distorted image unrecognizable. The more complicated the point spread function, the more difficult it is to recover a noise-free image.

8.3.11.3 Digital Filtering of images using the FFT

Digital filtering can be easily done while the FFT spectrum is being displayed, by changing the pixels which correspond to the frequencies you wish to change. This is most conveniently done by setting the background color to "black" and using *delete* or *backspace* to erase the frequencies you wish to remove; or by selecting "sketch" (*F2*) and adding points at the desired frequencies by drawing with the mouse. It is necessary to change both the real and imaginary components as well as the positive and negative frequencies to achieve good filtering. This means the entire FFT matrix must be visible, i.e., the original image must be close to a power of 2 in each dimension.

Example: High-pass filtering.

1. Make sure the original image size is a power of 2.
2. Set background color to black by right-clicking on "black" in the colormap palette.
3. Forward-FFT the image.
4. Delete the low-frequency regions (as shown with a 'L') with the 'delete' key.
5. Alternatively, use the mouse to select these regions and use "paint region", "change contrast" or "color/intensity" to make them darker.
6. Optionally, you can also enhance the higher frequencies by using "enhance contrast" in the high-frequency region (shown by 'H'.
7. Drawing on a FFT'd image only affects the component being displayed ("real" by default). Apply the same filtering procedure to the imaginary component by selecting "FFT... change display...imaginary" and repeat the changes.

```
.LLLL---------------------LLLLL
LLLLL..........|..........LLLLL
|..............|..............|
|..............|..............|
|..............|..............|
|..........HHHHHHHHH..........|
|----------HHHHHHHHH----------|
|..........HHHHHHHHH..........|
|..............|..............|
|..............|..............|
|..............|..............|
LLLLL..........|..........LLLLL
LLLLL---------------------LLLLL
```

8. Reverse-FFT to obtain the filtered image. *Note:* Changing the zero-frequency pixel (at the upper left corner of the FFT) will have drastic effects on the image.

8.3.12 Macros

TN-Image can execute a series of predefined commands. This is particularly useful when a large number of images need to be processed in an identical manner. Technically, the macros in TN-Image are not macros but small programs. The macro editor can also edit small text files (up to 255 lines), making it useful as a clipboard for making notes.

Macro commands consist of the text of one of the menu items, followed by a series of parameters which are usually numeric. A number of other commands, not visible in the menus, are also available. Any menu item from any menu can be part of a macro, with the following caveats:

1. Spaces should be replaced by underlines (_) or omitted.
2. Periods and check marks should be omitted.
3. Capitalization is not significant.

The numbering of command parameters corresponds to the order in which the item would appear in the menu or dialog box. It is not necessary to give all the parameters. If a parameter is not given, it will be unchanged from the last time the command was executed. Macro names include:

```
3d
aboutthefile
abouttheimage
abouttheprogram
acquire
addborder
arrow
automaticundo
backgroundcolor
backup
beep
border
box
brightness
calibration
changecolordepth
changepalette
changepixelvalues
changesize
changetitle
circle
color
color->grayscale
colorbrightness
colormap
configure
contrast
convert
copy
createfileformat
createimage
createresizeimage
crop
curve
deleteregion
diffusespray
erasebackground
erasefft
executeplugin
exit
```

fft
fileformat
fill
fillregion
filter
finespray
fliphoriz
flipvertically
font
foregroundcolor
grayscale->color
help
histogram
howtoregister
image *(select an image)*
imagemath
invertcolors
line
loadfft
loadimage
macro
math
measure
move
paint
paintregion
palette
pixelinteractmode
printimage
print
quit
remapcolors
repair
resizeimage
restore
rotate
rotateimage
save
savefft
saveimage
savescandata
select *(select a region)*
selectaregion
selectregion
selectimage
testplugin
windows *Toggles separate window mode for new images*
windowborder *Toggles window manager border for new images*
showodtable
showpalette
size
sketch
smooth
spotdensitometry
stripdensitometry
testplugin
textdirection
tracecurve
undo

```
unloadimage
unload
unloadall
warp
```

Of course, interactive commands (such as `sketch` and `help`) are not too useful in a macro.

You can cause the macro to ask for any parameter by substituting the value with a question mark followed (with no spaces) by a prompt string. For example, for the 'load' command, the first parameter is the filename. If instead of putting an actual filename in the macro, such as

`load myimage.tif`

you use

`load ?Enter_some_kind_of_filename`

the program will ask you to enter a filename each time, by presenting a message box like the following:

```
-----------------------------------
|Enter_some_kind_of_filename.......|
|---------------------------------|
|.................................|
|.................................|
|.................................|
|.................................|
-----------------------------------
```

At this point, you can type the filename and press *Enter* to continue. The prompt string cannot contain spaces, because a space is interpreted as the beginning of the next parameter. There can be any number of prompts for each command.

NOTES: No checking is done on the response to make sure it is a valid answer. In the case of a filename, the macro interpreter itself does not check whether the answer is a valid filename or even that a filename is actually required for this parameter. Similarly, no checking of your commands is done to make sure the macro is a valid command. A command that is invalid, for example, by being misspelled, will either be skipped, or if it generates a fatal error, will cause the macro to be stopped.

This is a partial listing of commands which require parameters. Parameters must be specified in the indicated sequence and separated by spaces. All parameters must be on the same line as the command. Each command must be on a separate line.

Anything that appears in any of the menus may also be used as a command. Those commands that do not require parameters are not listed here. Some, such as 'automatic_undo' toggle a feature on or off. For these commands, use the same command a second time to turn the feature back on.

Unless noted otherwise, all parameters can be omitted. This causes the current default setting to be used. However, parameters cannot be skipped. Thus, if you wish to set parameter #3, for example, you also must set parameters #1 and #2.

If a fatal error occurs, the macro is automatically terminated and an error message is displayed showing what line caused the error.

If images are in separate windows, the desired image should be selected before selecting coordinates. Otherwise, the coordinates may be calculated relative to some other image. These coordinates could be well off screen and result in unknowingly corrupting some other image. For example:

```
image 2
select 100 100 200 200
```

Command	Parameter#	Refers to	Value	Meaning
filter	1	filter type	0	low pass
			1	high pass
			2	laplace
			3	background subtract
			4	background flatten
			5	noise (median)
			6	sharpen /
			7	sharpen |

		8	sharpen –
		9	sharpen \
		10	edge detect –
		11	edge detect |
		12	sobel
2	kernel size:	1	3x3
		2	5x5
		3	9x9
		4	15x15
3	amount of filtering	(1-10)	
4	range (median filter)		
5	kernel multip.	(any integer)	
6	max background	0	black
		1	white

Examples:

`filter 5 1 3 10 1 1`

Filters the currently-selected image or area using a 3x3 median filter, with a filtering level of 3, a range of +/-10, kernel multiplier of 1, and white declared as the background.

`filter 11 2`

Filters the currently-selected image or area using a 5x5 Sobel filter.

Command	Parameter#	Refers to
select_region	1	upper left x coord.
	2	upper left y coord.
	3	lower right x coord.
	4	lower right y coord.

Sets boundary for other operations such as contrast. The coordinate values are relative to the upper left corner of the screen (= 0,0). Select_region is cancelled by select_image and vice versa. All 4 parameters must be given.

Example:

`select_region 100 100 200 200`

This has the same effect as clicking-and- dragging the mouse from (100,100) to (200,200).

Command	Parameter#	Refers to
select_image	1	image no.

NOTE: Image numbering changes unpredictably when an image is unloaded. This is because images are rearranged to compact the free space.

Example:

`select_image 5`

Has the same effect as double-clicking on image #5.

Command	Parameter#	Refers to
load	1	filename (can include wildcards)
	2	x position for upper left corner
	3	y position for upper left corner
	4	x size (0 to 1) (1=full size)
	5	y size (0 to 1)

The remaining arguments (6 to 15) are used only for reading raw images.

Command	Parameter#	Refers to	Value	Meaning
load	6	platform	0	PC
			1	Mac
			2	IBM

7	color type	0	RGB color
		1	grayscale/indexed color
		2	CMYK color
8	bit packing	0	TIF-like
		1	GIF-like
		2	none
9	x size in pixels		
10	y size in pixels		
11	No.of bytes to skip at start of file		
12	image bits/pixel		
13	red bits/pixel		
14	green bits/pixel		
15	blue bits/pixel		
16	black bits/pixel		

Examples: `load myimage.tif 100 100 1 1`
Reads myimage.tif from disk, positions it at (100,100), at full size.
`load *.gif`
Reads all .GIF files from disk. Since no position or size is specified, the values set by the previous command will be used.

The most recently loaded image becomes the currently-selected image for other operations.

Example: Load an image of raw bytes.
`file_format 9`
`load raw.img 0 0 1 1 0 1 0 382 362 10 8`
The first command is necessary to override the automatic file detection, which would otherwise display a message "Invalid file type".

The second command loads the image at x=0, y=0, x size=100%, y size=100%, platform=PC, color type=indexed color, x size=382 pixels, y size = 362 pixels, skip 10 bytes, and interpret data as 8 bits/pixel.

If a large number of raw byte images having identical parameters are to be read, it is easier to create a custom file type and define these values as the defaults. This will eliminate repetitive retyping of the arguments.

Command	**Parameter#**	**Refers to**	**Value**
save	1	filename	
	2	file format	see under "file_format" for permissible values
	3	bits/pixel	(Any value between 1-32).

The bits/pixel be a legal value for the specified format otherwise it is a fatal error. If omitted, it uses the image's current bpp.

Example:
`save test.tif 0`
Creates a TIF file named "test.tif" using the currently-selected area or currently- selected image.

If no arguments are given, the image's original filename and format will be used. Use 'file_format' to override the default image format. You must change the extension manually in case the file is to be read by file viewers, which may require a specific file extension. If the image was created within TN-Image it will not have a filename until you save it. If a macro tries to save a file without specifying a filename, a fatal error occurs, terminating the macro.

Command	**Parameter#**	**Refers to**
color, brightness		
	1	change in brightness for monochrome

	portion of selected area if any (If the entire area is color, this parameter is ignored).
2	change in red for color portion
3	change in green for color portion
4	change in blue for color portion If the entire area is monochrome, parameters 2-4 are ignored.

Example: To increase the red in a color image by 10:

```
color 0 10 0 0
```

The color, brightness, and color_brightness commands are synonymous.

Command	Parameter#	Refers to
contrast	1	change in contrast for monochrome portion if any (1 = no change)(If the entire area is color, this parameter is ignored).
	2	change in red contrast for color portion
	3	change in green contrast for color portion
	4	change in blue contrast for color portion If the entire area is monochrome, parameters 2-4 are ignored.

Example:
To increase blue contrast in a color image by a factor of 1.5:
`contrast 0 0 0 1.5`

Command	Parameter#	Refers to
convert, change_color_depth		
	1	bits/pixel to convert image
	1	to (must be 8, 16,24, or 32).

Command	Parameter#	Refers to	Value
change_palette, palette	1	Palette number	1 - gray scale
			2 - spectrum
			3 - multi colors 1
			4 - multi colors 2
			5 - multi colors 3
			6 - RGBI
			7 - black to green
			8 - zebra
			-1 - Other (random)
			0 - Other (e.g., inverse)
pixel_interact_mode			
	1	Pixel inter-	1 Overwrite
	2	action mode	2 Maximum
	3		3 Minimum
	4		4 Add
	5		5 Subtract new - old
	6		6 Subtract old - new
	7		7 XOR
	8		8 Average
	9		9 Superimpose

Command	Refers to
unload	(No parameters, unloads currently selected image, Use 'select_image' command to select an image.)
unload_all	Unloads all images. If 'messages' is 'on', you are prompted to save any image that has been modified.
quit	Quits the program and asks if you want to save your changes.
exit	Quits the program *without* asking if you want to save your changes. Useful when running TN-Image macros in batch mode (See "Batch-mode processing").
loop	Causes the macro to be repeated. Each time a message box appears asking if you want to

repeat the macro - you must type a 'y' or 'n'.

Example:
`dos pkunzip image.zip`

Command	Parameter#	Refers to
goto	1	line number in macro to execute next. A jump to a lower line number causes an infinite loop. Press *ESC* to stop the macro.
math	1	1=activates math mode 0=deactivates math mode Any other string=a formula In math mode, all macro commands are interpreted as image math formulas. If a formula is given, it must start with the variable i,r,g, or b.
dos dos_command	1-5	Execute a DOS command with up to 5 parameters (not available in Unix version)

Command	Parameter#	Refers to	Value
macro	1 Macro file name.	Control is transferred to the first line of the new macro. After the new macro is finished, the old macro continues. There is no limit on the depth of nested macros except as imposed by available memory. Do not create recursive macros (macros which call themselves directly or indirectly).	
messages	1	Disables messages, including all requests for confirmation and requests for filenames. Messages are automatically re-enabled after the macro ends. Useful in batch mode. Turning messages off is dangerous and should only be used in fully-debugged macros. If messages are turned off, a macro could overwrite files, unload images, create a file in a non-standard format, or exit to DOS without asking for confirmation.	0 Messages off 1 Messages on

Example: `messages 0`

Command	Parameter#	Refers to	Value
fft	1	Direction	1 Forward 2 Reverse 3 Convolute 2 images 4 Deconvolute 2 images 5 Change display only
	2	Display	1 Real 2 Imaginary 3 Power spectrum
	3	Image #1 (may be left blank for FFT of currently-selected image)	
	4	Image #2 (required for deconvoluton)	

Examples:
`fft 1 1` (forward fft)
`fft 4 1 7 8` (deconvolute images 7 and 8)

Command	Parameter#	Refers to	Value
file_format	1	Sets the default file format for loading and saving images.	
			-1 (automatically detect) 0 NONE 1 TIF 2 PCX 3 IMA 4 IMG (Frame grabber) 5 GIF (GIF87a) 6 IMM 7 GEM 8 IMDS 9 RAW 11 JPG 12 TARGA (Targa RLE) 16 BMP (Windows bitmap) 23 ASCII 100 first custom format 101 2nd custom format ...etc. This will supercede the image's existing default file format for the duration of the macro.

Example:
`file_format 5`
= sets default format to GIF

Command	Parameter#	Refers to	Value
create_image resize_image			
	1	Method for obtaining image coordinates.	
			1 Use mouse 2 Use specified coordinates 3 Copy another image 4 Resize another image using specified coordinates
	2	Border	0 No border 1 Add border
	3	x size (in pixel units)	
	4	y size (in pixel units)	
	5	x position (0,0 = upper left)	
	6	y position (0,0 = upper left)	
	7	No. of image to copy. Remember that the image number changes unpredictably if an image is unloaded. If the image no. does not exist, it is an error.	

Command	Parameter#	Refers to
windows	1	0=images are placed on main window 1=images are placed in separate windows

Command	Parameter#	Refers to
windowborder	1	0=minimal border 1=images are given a full border

If windowborder is 0, images are given a minimal border and positioned according to the coordinates specified as "x position" and "y position" in the "load" command. If windowborder is 1, images are positioned interactively and are given a title bar. This parameter only has an effect when windows=1. The actual behavior depends on the window manager.

8.3.12.2 Macro Programming Guide

Here is a brief tutorial on some of the finer points on creating useful macros. In general a macro should reset the program to its original state. If a macro does something different the second time it is executed, the cause is almost always a failure to reset the original conditions. In a real macro, you should also always execute "select_image" or "load" first to make sure the operation is performed on the correct image.

Example macro #1. *Nested macros*

Macro "beep.mac"
Line # Command
——— ————

```
1      beep
2      beep
3      beep
```

Note: the words "Line #" and "Command" and the numbers 1,2, and 3 are not part of the macro. In this example, the macro would consist of only 3 words ("beep"), one on each line.

Macro "test.mac"
Line # Command
——— ————

```
1      macro beep.mac
2      beep
```

Executing "test.mac" should cause a total of 4 beeps. A macro must never call itself - this would cause a system hang (at least in DOS).

Example macro #2. *Converting GIF image to TIF format interactively*

Line # Command
——— ————

```
1      load ?Filename
2      messages 0
3      file_format 0
4      save
5      messages 1
6      loop
```

Line 1 - Prompts you for a filename each time (because of the question mark).
Line 2 - Resets default file format to 0 (TIF). If this line is omitted, the file format would default to the original format of each image.
Line 4 - Saves the image in TIF format. Don't forget to rename the file extension to TIF later. You could also use:
`save ?Filename_to_save_as ?Format`
which would ask you for both the filename and the format each time.
Line 5 - Resume error messages
Line 6 - Unconditional loop back to line 1. Press *ESC* to stop.

Example macro #3. *Converting GIF image to TIF format in batch mode*

Line # Command
——— ————

```
1      messages 0
2      load *.gif
3      file_format 0
4      save
```

This macro could be executed at 3 a.m. by setting the following timed events in `tnshell` or other command scheduler:

Event 1: `cd c:\ tnimage` 3:00am
Event 2: `tnimage -macro convert.mac` 3:01am
Event 3: `ren *.gif *.tif` 4:00am
Event 4: `cd c:\` 4:01am

Event 3 could also be replaced by a new line in the macro:
`dos ren *.gif *.tif`
Make sure there is enough free disk space before starting this macro.

Example macro #4. *Subtracting two images*

```
Line # Command
—— ———
1      pixel_interact_mode 1
2      load cells.tif 0 0 1 1
3      pixel_interact_mode 5
4      load cells.tif 1 1 1 1
5      pixel_interact_mode 1
6      contrast 1.85
```

This macro loads an image, then subtracts the same image after offsetting it by (1,1), then increases the contrast. All 6 lines are essential for a good macro.

Line 1: The pixel interaction mode is set to 1 (overwrite) in case a previous operation changed it.

Line 2: All 4 parameters (x offset, y offset, x size, and y size) must be given. Otherwise, if the macro was executed again, the default parameters would be 1,1,1,1 because of line 4. This would cause the image to be placed at (1,1) and then subtracted from itself, giving solid black.

Line 3: The pixel interaction mode is set to 5 (subtract). It is usually helpful to change the screen background color to 0 (black) before doing this.

Line 4: Load the image to subtract.

Line 5: Reset the pixel interaction mode to overwrite.

Line 6: Increase the contrast by a factor of 1.85.

Be careful using “DOS command” in combination with “messages 0”. If there is insufficient low DOS memory to execute the command, “messages 0” may cause you to miss the fact that the command was not executed.

Example macro #5. *Multiple image math formulas*

```
Line # Command
—— ———
1      selectregion 50 50 100 100
2      math 1
3      i=i+5
4      i=i+image[2][0][x][y]
5      r=r*1.23
6      math 0
7      math i=i-5
```

Line 1: Select a region to modify. If this line is omitted, it would modify the entire image.

Line 2: Start math mode. Lines between “math 1” and “math 0” do not need to begin with “math”.

Line 3: Lighten the image by 5 intensity units.

Line 4: Add the corresponding region from image #2.

Line 5: Increase the red contrast by 1.23 fold.

Line 6: End math mode.

Line 7: Subtract 5 intensity units from the selected region. Since math mode is turned off by line 6, the formula must be preceded by the word “math”.

8.3.13 3-D Controls

This pops up a small slider bar that allows you to scroll through the 3-D image. On slower computers, it is helpful if `tnimage` is started in a screen mode that has the same depth as the image.

8.4.0 Color menu

Colormaps are only needed for indexed-color (8-bit/pixel) images. If an 8-bit (256-color) image which lacks a colormap of its own is loaded and converted to color, the most recently-selected colormap will be used to perform the conversion.

8.4.1 Invert colormap

Switches the colormap so that all images become a negative. Changes the appearance only, and has no effect on the actual pixel values in the image.

8.4.2 Color intensity / brightness

There are 3 ways to change the brightness: you can drag the colormap palette bar to change the color LUT, or you can select "Color intensity" or "Change pixel values" from the menu.

8.4.2.1 Changing brightness using the colormap palette bar

This method is very fast, but only works on images that have a continuous colormap, and only in 8-bit/pixel screen modes. Files with a discontinuous colormap should be adjusted using the "Color intensity" menu option instead of the colormap palette bar.

Click on the top part of the bar and drag down to "squash" the colors downward, or click on the bottom part of the bar and drag up to squash the colors upward. This increases the contrast in all images of the screen.

Then, click in the middle of the bar and drag up or down to adjust the brightness as desired. The currently-selected image will be set to contain the new colormap.

If you change the colormap from the menu, or select "restore original colormap", the brightness and contrast settings return to normal.

8.4.2.2 Changing brightness and color using the menus

This method is also fast, and allows you to change the red, green, blue, and intensity values independently. The action is different depending on the screen mode.

For 8 bit/pixel modes, the colormap (palette) of the image is changed. The pixel values in the original image is unaffected. It is not possible to change the color of only part of the image with this method. To change only a portion of the image, you must either use "Change pixel value" or convert the image to 24 bits/pixel first.

The clickbox that is presented will depend on whether TN-Image thinks the image is monochrome or color. This information can be found by selecting "About...About the Image". Any image can be converted to monochrome or color by selecting "Color...Color to Gray scale" or "Color...Gray scale to Color" from the main menu, respectively. If TN-Image thinks the image is gray scale, only one slider (Brightness) will be presented. Otherwise, four sliders will be presented, permitting independent adjustment of red, green, blue, and brightness.

In true-color screen modes, the action is the same as "Change pixel value" (see below). A value is added or subtracted for the red, green, and blue components of the currently-selected image or screen region, making it darker or lighter or altering its color balance. The original colors can be restored by selecting "Image..Restore".

8.4.3 Contrast

There are also two ways to change the contrast: you can drag the colormap palette bar to change the color LUT, or you can select “Contrast” from the menu.

Changing the LUT is much faster, but only works in 8-bit (indexed color) screen modes, and it always changes the entire screen. Selecting “Contrast” from the menu works in all screen modes, and can be used to change contrast in selected regions of an image.

8.4.3.1 Changing contrast using the colormap palette bar

Click on the top part of the bar and drag down to “squash” the colors downward, or click on the bottom part of the bar and drag up to squash the colors upward. This increases the contrast in all images of the screen.

Then, click in the middle of the bar and drag up or down to adjust the brightness as desired. The currently-selected image will be set to contain the new colormap.

If you change the colormap from the menu, the brightness and contrast settings return to normal.

8.4.3.2 Changing contrast using the menus

For 8 bit/pixel images:

Multiplies all pixels in the currently-selected image or screen region by a value (100=no change), increasing the contrast. Note that if the contrast or brightness is increased or decreased too much, information will be lost from the image due to saturation.

NOTE*WARNING**

When using 8 bit/pixel modes, adjusting the contrast, or making the image lighter or darker, may invalidate the correspondence between pixel values and the original optical density in the image. This will occur if the O.D. table for the image is non-linear and densitometry is done with ‘pixel correction’ set to ‘on’. The numerical results obtained by scanning under those conditions could be scientifically invalid.

If you plan to quantitatively analyze your image after altering its contrast or brightness, first check that the O.D. table for the image is a straight line (Select ‘Configure...Show O.D. table’). Alternatively, set ‘pixel compensation’ to ‘off’ before any quantitative analysis.

This does not apply to changes made by dragging the colormap bar.

For color images:

Multiplies the r,g, and b components of all pixels in the currently-selected image or screen region by separate values (100=no change), increasing the contrast.

If the selected region has both color and monochrome pixels, you can select independent contrast factors for the monochrome intensity and the red, green, and blue components of the color region.

8.4.4 Change colormap

In 8-bit/pixel modes, each pixel value is translated through a "colormap", a look-up table which you can easily modify in TN-Image. The new table is saved along with the image (for TIF,BMP,and TGA files) so the next time you load the image, the display changes to the modified colormap. Changing the colormap has two advantages over other methods of changing brightness or color: (1) it is much faster, and (2) it is always reversible since it never affects the original image data. The disadvantages are that changing the colormap only works in indexed color screen modes, and it always changes the entire screen. If you need to brighten just a portion of the screen, use the "color intensity/brightness" menu option.

In color modes, the current colormap table is used as a guide to determine how an monochrome image is converted to color when it is loaded from disk, but does not otherwise affect the display.

8.4.4.1 Select colormap

You can select from a variety of different color colormaps. Changing the colormap has no effect on the image when it is stored or densitometrically analyzed. However, it can be used to enhance the visibility of details in the image. Each image can have a different colormap.

The following pre-set colormaps are available:
Gray scale - continuous shading of 256 levels of gray.
Multi-color 1 - a continuous blend of colors useful for enhancing low-contrast images.
Multi-color 2 - a discontinuous sequence of short color gradients
Multi-color 3 - a discontinuous sequence of color gradients arranged oppositely from multi-color 2.
RGBI - 4 continuous gradients, 0-63=red, 64-127=green, 128-192=blue and 193-255=gray scale.
Spectrum - A single continuous gradient from blue through the colors of the spectrum to red and then white.
Black to green - Same as gray scale except black to green instead of black to white.
Zebra - Alternating black and white - useful for finding very subtle patterns in the image. Creates a contour-line effect.
Brightness - Lightens or darkens colormap, increasing or decreasing color saturation.
Other - User-selected colormap. Select the desired number with the mouse to select from a wide range of different computer-generated colormaps.

1-100 = Various gray scales
101-1000 = randomly-generated gradients. The amount of color gradually increases in intervals of 100.
1000-10000 = continuous, smooth gradients without sharp breaks in the colors. The number of light and dark cycles varies from 1 upwards. Some are a single color, others are gray scales, and others are multiple colors.

Example: 2345 = shades of 'gold'

8.4.4.2 Grayscale intensity mapping

Grayscale images of greater than 8 bits/pixel often contain subtle details which would not ordinarily be visible. This option permits interactively changing the way the pixels are mapped to the screen, creating, in effect, a "sliding scale".

This sliding scale uses 4 parameters: the maximum and minimum values in the image to display, and the maximum and minimum values on the screen to which these are mapped (these latter 2 do not normally need to be changed). When a monochrome image is first loaded, TN-Image automatically determines the maximum and minimum values in the image to allow the entire image to be viewed.

By selecting "Grayscale brightness", you can use the mouse to select the actual range of values to be displayed.

For example, if the image has 12 bits of grayscale depth, it will be possible to set the maximum and minimum to any number between 0 and 4096. Setting the numbers close together enhances the contrast in that intensity range. Similarly, making the numbers small enhances the contrast in the darker areas of the image. To make the change visible, click on "Preview".

The maximum can also be lower than the minimum, creating an inverse image. Each image on the screen can have a different brightness/contrast level.

Note: Color images must be converted to monochrome before this feature can be used.

8.4.4.3 Read colormap

Reads a colormap file from disk. Colormap files are ASCII text files which can be created with a text editor, or created graphically within TN-Image (see *Create colormap*).

If you create a colormap file manually, your colormap file should consist of 4 columns of up to 256 rows. The first column is the color number or 'index', an integer between 0 and 255, indicating which color. The other 3 columns are integers between 0 and 63, which define the amount of red, green, and blue respectively for each color. For example:

```
0 0 0 63
1 63 63 63
255 7 7 7
```

This file would set color 0 to light blue, color 1 to bright white, and color 255 to dark gray. All other colors would be unchanged (Normally, a colormap file would have 255 rows instead of only 3).

8.4.4.4 Save colormap

Saves the current colormap into a disk file.

8.4.4.5 Create colormap

Allows you to graphically create a custom colormap. There are 3 boxes, one for red, green, and blue, which graphically represent the red, green, and blue intensities of each color in the colormap. To change the colormap, click on the graph corresponding to the desired color and trace out the desired new graph while holding the left mouse button down. The graph and colormap will both adjust in real time to reflect the new values.

Clicking 'smooth' causes the computer to automatically smooth out the newly-drawn curve to create a more even dispersal of colors in your colormap. When you are satisfied with the new colormap, click on "OK".

8.4.4.6 Invert colormap

Inverts the color look-up table so the image appears as a negative. This differs from "invert colors" in that inverting the colormap has no effect on the actual image data. The two extreme colors (black and white) are not switched.

8.4.4.7 Rotate colormap

Rotates the colormap table through all 255 colors. This effectively increases the number of predefined colormaps to 2.5 million. Useful in achieving fine control of the appearance of the image and enhancing subtle details.

If you find a number that gives a useful effect, write the number down for future reference or save it using "Save colormap". The actual pattern of colors in the colormap is not easily predictable from the color number. (Saving the currently-displayed screen or a portion of it as a TIF or PCX file, or selecting 'Save colormap' will also save the colormap.)

8.4.4.8 Restore original colormap

Restores the colormap the image had when it was originally loaded from disk. Useful when you accidentally rotate the colormap of a GIF file.

8.4.5 Remap colors

Changes the colors in an image by substituting from a map file. It acts differently on indexed color and color images.

8-bit/pixel images:

Changes the pixels in the image or screen region by substituting from a set of values specified in an ASCII file. This file should consist of a list of 2 columns of numbers. The 1st column is the pixel value to change, the 2nd column should be the desired new values. For example:

```
1 255
2 200
3 180
4 175
255 0
```

This file would change all pixels with a value of 1 to pixels with a value of 255, those with values of 2 to 200, 3 to 180, 4 to 175, and 255 to 0. Any other pixels would be unaffected. Typically in a remap file, you would remap all 255 colors, but this is not essential. Be sure colors 0 and 255 do not accidentally get remapped to the same value, otherwise it will be impossible to use the menus.

The most common use of this is to reduce the number of separate intensity values in an image, by eliminating those values in regions that are not of interest. This can greatly improve the compressibility of an image.

Another use is to stretch the contrast. Since the new intensity values can be known in advance, contrast enhancement can be done on multiple images in an exactly reproducible manner.

The Macro Editor can be used to create remap files without leaving TN-Image.

Color images:

Interchanges r,g, and b color values. This could be used, for example, to convert an image to a single color or to correct for color errors in a corrupted image file.

8.4.6 Invert colors

Changes the image into a negative. This differs from "invert colormap" in that the pixel values themselves are changed.

8.4.7 Change color depth

Converts the selected image to a different number of bits per pixel. This option only works on entire images. When working with indexed-color images, it is advisable to use this option to convert them to color images before filtering them (see "Filtering color images") or using other operations that assume the image is color. Images can be converted from any depth (8, 16, 24, or 32 bits per pixel) to any other depth.

If the starting image is an 8-bit image with a colormap, the colormap colors are used to select the appropriate colors for the new image. These can be easily changed (see *Change colormap*).

If the starting image is a color image, and it is being converted to 8 bits/pixel, the currently-selected palettization method is used to calculate the colors. The default method is "quantization". This can be changed (see *Color Settings*). 3D images are always converted using the closest-fit method.

Once converted, writing the image to disk will cause it to be saved in its new depth.

8.4.8 Color – Gray scale

Converts the image from color or indexed-color to gray scale (luminosity). The relative contributions to luminosity from the red, green, and blue components are determined by the "Luminosity factors" which can be changed by selecting "Color...Color settings".

The default is:

$$value = .299 * r + .587 * g + .114 * b$$

The results for 8-bit images may be different from the results of merely changing the colormap to gray scale, because for 8-bit images, the conversion creates a new colormap to match the luminosities in the image as closely as possible.

8.4.9 Gray scale – color

Deactivates grayscale mapping, reactivates color manipulation features, and tries to restore previous color information if possible.

WARNING: Converting color to grayscale and back is not always a reversible process.

8.4.10 Histogram

Plots a histogram of the no. of pixels with a given value within the selected area vs. the pixel value. Quite useful when trying to optimize the contrast or brightness of an image. Clicking on the edge of the histogram allows you to move it to some other screen location in the same manner as moving the dialog boxes and click boxes.

Clicking *capture* allows you to capture all or part of the graph into a new image. After clicking on *capture* , use the mouse to select the desired portion of the graph. A new image which includes that region is then automatically created.

Clicking *subtract baseline* allows you to subtract a baseline from the histogram. Select the desired baseline by clicking as many times as desired to create the baseline curve. The baseline curve is constructed using a B-spline (see under *B-spline curve*). You can modify the curve as desired by clicking and dragging the small boxes (which represent control points for the curve). Up to 200 control points can be used. The control points do not have to be within the graph region; however, any negative numbers created by baseline subtraction are truncated to 0's.

See *strip densitometry* above for more details on the plot functions.

Note: When a graph is being displayed, smoothing, subtracting baseline, etc., affect the displayed data only, and have no effect on the image.

8.4.11 Change pixel value

This menu option was previously called *Change brightness/contrast* . The effect is consistent across all image types and screen modes, but is slower in 8-bit modes than the *Change brightness* option.

For 8 bit/pixel images:

This adds a value (-255 to 255) to all pixels in the currently- selected image or screen region, generally making it darker or lighter. (The actual effect on the image will depend on the colormap).
NOTE: See the warning under "Contrast".

For color images:

This adds or subtracts a value for the red, green, and blue components of the currently-selected image or screen region, making it darker or lighter or altering its color balance.

8.5.0 Draw menu

Most of the drawing operations listed below put TN-Image in the drawing mode, in which each mouse click creates another graphic element. To return to normal mode, click anywhere on the top menu bar or the *Cancel* button.

8.5.1 Set color

Allows you to change the foreground and background colors. The foreground color is used for all text, lines, circles, spray, arrows, etc. The background color is used for the backspace and delete keys, and when erasing an image from the screen.

You can also change the foreground color by clicking the left mouse button when the mouse cursor is pointing to the desired color in the 'colormap display' (the long vertical bar or square at the right of the screen). Similarly, the background color can be changed by clicking the right mouse button on the colormap display.

8.5.2 Line

Draws lines. Click at the starting position, drag to the end position, and then release to draw a straight line. Click anywhere on the top menu bar to return to normal mode.

8.5.3 Circle

Draws circles of the specified size.

8.5.4 Box

Draws boxes by the click-and-drag method.

8.5.6 Curve

Draws a curve or line defined by user-selected control points.

8.5.6.1 Bezier curve

Draws a smooth curve. Click on the desired locations for the control points. At least 3 points are required to draw a curve. The position of each control point is indicated by a small box. The control points can be moved interactively by clicking on an existing box and dragging it to a new location. Clicking outside a box creates a new control point. When you are satisfied with the shape of the curve, pressing any key erases the small boxes and makes the Bezier curve permanent. You can have a maximum of 199 control points.

8.5.6.2 B-spline curve

Similar to Bezier curve, except has a maximum of 196 control points. B-spline curves differ from Bezier curves in that the curve tends to be closer to the control points and sharper in appearance.

8.5.6.3 Least-squares line

Fits a straight line between the control points using a least-squares algorithm.

8.5.6.4 Polygon

Draws a polygon through the control points.

8.5.7 Text direction

Toggles between normal and 90 deg rotated text.

8.5.8 Font

Currently, fonts are only available on the Unix version. You can select from any font available in X Windows. See the X man pages for additional information. If you add new fonts, delete the file "fonts" so that the font list will be regenerated.

8.5.9 Sketch

In sketch mode, whenever the left mouse button is pressed, a continuous line is drawn on the screen. Sketch mode is also toggled on/off by the F2 key.

8.5.10 Fill region

Flood fill
Fill type
Solid - fills a region with a constant color
Horiz.Gradient - fills a region with colors increasing or decreasing left to right
Vert.Gradient - fills a region with colors increasing or decreasing top to bottom
Solid fill color - Used for 'solid' fills only. Specifies the color to be used when filling.
Max border color, Min border color

In a flood fill, all pixels in a given region bounded by a "border color" are changed. Outside the border, the image is unchanged. In TN-Image, instead of one single border color, you can select a range of colors. Any pixel within that range will act as a border. For example, if you set Max. border color = 200 and Min. border color = 127, then only the region containing pixels less than 127 or greater than 200 will be filled. This is useful since many real-world images do not contain a single continuous line of pixels which could serve as a "border".

If you try to fill a bounded region (such as a box), the color of the boundary must be between the minimum and maximum border colors. Otherwise, the color will spill out of the region and possibly ruin other images on the screen.

8.5.10.1 Gradient fill

Grad start coordinate, Grad end coordinate -

Specifies the starting and ending reference coordinates that will be used to calculate the color. The closer the starting and ending coordinates are to each other, the steeper the gradient. The "Start Gradient Color" will be used at the Start Coordinate and the "End Gradient Color will be used at the End Coordinate. All other colors will be calculated from these 2 points. Note that filling itself is bounded by the Border Color and not by the Start and End coordinates.

For horizontal gradients, use x values for the start and end coordinates; when making vertical gradients, use y values.

For 8 bit/pixel screen modes:
Start gradient color
End gradient color - Selects the intensity value that is to be used at the starting and ending coordinates, respectively.

For other bit/pixel screen modes:
Start gradient red
End gradient red
Start gradient green
End gradient green
Start gradient blue
End gradient blue - Selects the RGB color value that is to be used at the starting and ending coordinates, respectively.

These parameters specify the color values to use at the gradient starting and ending coordinates. Note that the "starting" color can be larger or smaller than the "ending" color. This gives greater flexibility, especially in true-color modes, for creating a blend of one color into another.

Sometimes, as when filling the inside of letters in text, it is desirable to have the appearance of the same gradient extending out of sight between the letters. This can be done easily in TN-Image, simply by not changing the starting and ending gradient colors. Clicking inside each area to be filled sequentially will cause the same colors to be used as if the entire region had been filled with a gradient.

Special care should be given to starting and ending r,g, and b values when working in 15- and 16-color modes. You should specify slightly different starting and ending values for each color in order to avoid a "stepped" appearance of the gradient. This prevents all 3 colors from being incremented at the same place on the screen, due to the fact that each color only has 31 or 63 discrete values.

Example 1. *Creating a rectangular area with a gradient increasing in brightness from left to right.*

1. Start TN-Image in mode 103 by typing: `tnimage -mode 103` *(DOS version)*
2. Click on the colormap palette to select a light color, e.g., 250.
3. Select "Draw...Box" and draw a box. Note that the box is drawn in color 250.
4. Make a note of the starting and ending x coordinates of the box (Shown on the menu bar).
5. Select "Draw...Fill region".
6. Click on "Horizontal gradient".
7. For "Grad start coordinate" enter the leftmost x position of the box.
8. For "Grad end coordinate" enter the rightmost x position of the box.
9. Enter 251 and 249 for "Max border color" and "Min border color", respectively. The flood fill will stop at any pixel that is a 249, 250, or 251.
10. For "Start gradient color" and "End gradient color" enter 0 and 255, respectively. This will cause the color to change from 0 to 255 as x changes from the starting to ending coordinate of the box.
11. Click on "OK".
12. Move the mouse to any point inside the box and click. The box should fill up with the gradient.

Example 2. *Removing a gradient background from an image (flattening the background).*

If an image is too light on one side and too dark on the other, one way to fix it is by adding or subtracting an artificial gradient. In the Registered version, this can be done automatically, by selecting "Filter...Background Flatten".

1. Move all images off to one side to create a blank area on the screen.
2. Select "Color...Set colors" and change the background color to black (0) and the foreground color to white (e.g.,255).
3. Draw a box as in Example 1, slightly larger than the image that has the uneven background.
4. Set the Grad Start and Grad End Coordinates to match the position of the box.
5. Set the Max and Min Border Colors so that the color of the box is between the Max and Min Border Color.
6. Set the Start and End Gradient Colors to values which, when added to the corresponding parts of the image, will equalize the intensity. For instance, if the image colors are mostly 10-20 on the left and 90-100 on the right, set the Start and End Gradient Colors to 80 and 0, respectively. The imarge should be dark enough so that adding these colors will saturate the image. If the image is too light already, you should set the Start and End Gradient Colors to 0 and 80, respectively, and use "Subtract" instead of "Add" below.
7. Fill the box with the gradient.
8. Move your image back onto the screen (don't cover the gradient).
9. Select "Configure...Set pixel mode" and click on "Add".
10. Select "Image...Copy" and click-and-drag to copy a region from your image. Paste it on top of the gradient. The image will be "added" to the gradient.
11. Select "Configure...Set pixel mode" and set the pixel mode back to "Overwrite".
12. Select "File...Create Image" and select the area you just pasted. This will put the modified area into an image buffer.
13. Select "Image...Erase Background" to clean up the desktop.

8.5.11 Paint Region

Sets a rectangular region to the foreground color. After selecting 'paint region', move the mouse cursor to one corner and click and drag to the other corner. The selected area will be painted.

8.5.12 Diffuse spray

Creates a spray-paint effect. Click the left mouse button at the center of the region to be sprayed. The area covered is determined by the "spray factor" in the "configuration" menu.

8.5.13 Fine spray

Creates a solid painting effect. Click the left mouse button at the center of the region to be sprayed. The area covered is determined by the "spray factor" in the "configuration" menu.

8.5.14 Add border

Puts a border around the current image. The border color is selectable.

8.6.0 About menu

8.6.1 About the program

Displays the version number, operating system, amount of free memory, the number of images currently loaded, the number of images that have been backed up, and the x and y starting position of the current (top) image. You can also use this option to switch to a different image, by selecting the desired image from the list with the arrow keys or mouse, and pressing *Enter* or clicking on *OK* .

8.6.2 About the file

Displays a variety of technical information about your image file. This is useful in diagnosing problems with reading a possibly corrupted file or in getting parameters from an unknown file format such as that produced by certain specialized frame grabbers.

8.6.3 About the image

Displays a variety of information about the currently-selected image, including whether it is backed up, has an FFT, its original filename and image depth, etc.

8.6.4 How to register

Displays vital information concerning how to register your copy of TN-Image and obtain a more powerful version along with technical support. *(DOS version only)*

8.7.0 Configure menu

8.7.1 Show menu bar (DOS)

If checked, the menu bar at the top will be continuously visible. Sometimes it is convenient to make it invisible, as when photographing the screen. Even when invisible, clicking on the appropriate region will still activate the menu (*DOS version only*).

8.7.2 Show menu bar 2

Displays additional information. Toggles the second menu bar on/off (*DOS version only*).

8.7.5 Redraw colormap

Click the left mouse button to indicate where the new colormap strip should go. The colormap strip is redrawn in a window of its own, separate from the images. The colormap can be used to select the foreground and background colors (by clicking the left or right mouse buttons, respectively, on the desired color).

8.7.6 Show O.D. table

Draws a graph showing the correspondence between pixel values (0 to 255) and optical density, as calculated by the scanner. Typically, only TIF files from scanners have an O.D. table (referred to in TIF files as a 'gray response curve'. If the image does not provide one, TN-Image will create a linear O.D. table. (**Note:** most Macintosh TIF files do not have O.D. tables.)

The O.D. table is only meaningful in monochrome/indexed-color modes (8 bits/pixel). It is also known as a "gamma correction table". Each image can have a separate O.D. table.

Changing this O.D. table is possible but not recommended.

8.7.7 Pixel interact mode

Selects how 2 pixels interact with each other when you copy and paste parts of an image, read an image from disk, or add graphical elements.

Overwrite - Default mode. The new pixel erases the old pixel. This is by far the fastest mode.
Maximum - The larger of the 2 values is used.
Minimum - The smaller of the 2 values is used.
Add - The 2 values are added (up to the maximum value).
Subtract - The new value is subtracted from the old value (with a minimum result of 0).
XOR - The 2 values are XOR'd with each other.
Average - The 2 values are averaged.
Superimpose - The new pixel replaces the old pixel unless the new pixel's value is 0, in which case the old pixel is unaffected (allows superimposing images with parts "masked out").

Example 1. *Finding subtle differences between two images (also creates a silhouette effect).*

1. Load an image into TN-Image.

2. Select "Pixel interaction mode...Subtract".
3. Select "Load image" and change "x position" and "y position" to 2.
4. Click on "OK".
5. You now have a subtracted image. (It may be necessary to make it lighter or increase its contrast.)

Example 2. *Creating contour maps of an image.*

1. Load an image into TN-Image.
2. Select "Pixel interaction mode...XOR".
1. Select 'copy', and click-and-drag to select a portion of the image.
1. Release the mouse button.
1. Move the mouse to a location 1 pixel to the right and 1 pixel below the original position and click the mouse button to put the copy in place.
1. You now have a crude contour plot of your image. The gradient sensitivity of the contour plot can be decreased by using an offset of 2 or more pixels in step (5). You can also "threshold" the plot by subtracting a value ("make darker") and then adding it back("make lighter").

Example 3. *Reducing chunkiness in image.*

1. Read an image into TN-Image.
1. Select "Pixel interaction mode...Average".
1. Select "Load image" and change "x position" and "y position" to 2.
1. Click on "OK".
1. You now have an image that is smoother without becoming blurred.

Don't forget to change "Pixel interact mode" back to "Overwrite" afterwards.

NOTE: Don't forget that, when loading an image, unless the interact mode is "overwrite", the image will interact not only with other images but also with the background in areas where no image is present. Thus it may be helpful to set the background color to black first, to avoid unexpected results.

8.7.8 Configure...

Configures the following options:

8.7.8.1 Automatic undo

If checked, automatically creates an "undo buffer" when a new image is read. This can also be done manually, by selecting "Process...Backup image". If you make a mistake when filtering or adding text to the image, you can restore the most recent backup from the undo buffer by selecting "Process...Restore".

8.7.8.2 Spray factor

Controls the area affected by "fine spray" and "diffuse spray" (in "Draw" menu).

8.7.8.3 Cursor movement rate

Controls (a) distance moved by the mouse cursor when the arrow keys are pressed, and (b) the distance which an image moves when you click one of the 4 arrows at the top of the screen.

8.7.8.4 Color settings

Changes the default parameters used by TN-Image when converting images.

Color reduction method - used when converting a color image to indexed-color (8 bit/pixel) modes.

Quantization - (Default) Calculates the optimal set of 256 colors to match the image as closely as possible.

Fit current colormap - Calculates the closest match to the currently- selected colormap. This method can give a smoother result than quantization or it can give garbage, depending on how closely the colors in the colormap match the image.

If there are several images that need to be converted to the same colormap, the best procedure is to convert the first one using quantization then convert the rest by fitting to the current colormap.

This method is used automatically for 3D images.

8.7.8.5 Significant digits

Changes the number of significant digits to display when using a floating-point number.

8.7.8.6 Crawl delay

Selects the speed of the "crawling" of the box that indicates the selected area. A value of 4000 disables crawling. A lower value causes faster crawling, but too low a value will cause flicker on some displays, and slows down the mouse cursor on slower machines.

8.7.8.7 Crawl density

Selects the number of dots in the "crawling box" that indicates the selected area. A smaller value makes the box easier to see, but slows down the mouse cursor on slower machines.

8.7.8.8 Active color planes

Selects which colors (red, green, or blue) are capable of being modified. For example, if "red" and "green" are un-checked, smoothing the image would only smooth the blue component, while the red and green components were unaffected. Using this method to sharpen one color, while leaving the other colors unaffected, or warping a single color, can create an unusual artistic effect.

This feature only works for color images greater than 8 bytes/pixel. To use color planes on an 8 bit/pixel image, select "Color...Change color depth" and convert the image to 24 bits/pixel.

8.8.0 Help menu

Displays the Help screen. Context-sensitive help is also available for several topics by clicking on the "Help" button.

8.9.0 Miscellaneous features

8.9.1 Frame rate test

Alt-T - Test video Tests the maximum frame rate of your video system.

Here are some typical frame rates (fps) in DOS on a 80486 33MHz PC with ISA:

			Screen mode						
Video card	mode	100	101	103	105	107	111	112	115
	xres	640	640	800	1024	1280	640	640	800
	yres	400	480	600	768	1024	480	480	600
	bpp	8	8	8	8	8	16	32	32
#9GXE64-2MB VRAM S3		–	7.69	4.54	4.34	3.33	2.63	2.50	1.00
ATI Expression Mach64		12.5	9.09	5.26	5.55	1.27	2.63	1.59	0.89
Kelvin 64 (Cirrus) 2MB		16.7	12.50	8.33	5.00	3.33	3.22	1.89	2.00
Tseng ET4000 8-bit*		4.3	3.57	2.22	1.61	–	–	–	–
Trident 8900 1MB		10.0	8.33	4.34	–	–	–	–	–
Realtek 1MB RTG3106		8.3	6.66	4.00	2.85	–	–	–	–

* = Card in bad shape – = Unable to set mode

Speed is not the most important parameter, however. On a high-quality monitor, cheaper cards may appear fuzzy or jittery or have weird- looking fonts. PCI bus video cards are in general about 5-10 times faster. Frame rates will be much lower in Unix X11 versions and Windows versions (if one becomes available available) of the program.

8.9.2 Emergency image repair

Alt-R - Rebuild screen display If for some reason the display is incorrect, Alt-R will cause it to be rebuilt.

8.9.3 Erase image

Alt-E - Erase image Erases the currently-selected image (after asking you). Useful if memory somehow gets filled with images and there is insufficient memory to open a window. This can sometimes happen in a Windows DOS box but should not happen in DOS or Unix.

8.9.4 Sketch mode

F2 - Toggles Sketch mode on/off

9.0.0 Windows and OS/2 compatibility

It is recommended to use the included PIF file (TNIMAGE.PIF) when running TN-Image under Windows.

The suggested procedure is:

1. Copy and unzip TN-Image in the desired location, e.g., C:\ TNIMAGE.
2. In Windows, Select "File...New program item"
3. Set "Description" to "TN-Image".
4. Set "Command line" to C:\ TNIMAGE\ TNIMAGE.PIF
5. Set "Working directory" to C:\ TNIMAGE
6. Set "Shortcut Key" to "none"
7. Leave "Run minimized" unchecked.
8. Select "Change icon" and enter "C:\ TNIMAGE\ TNIMAGE.ICO"
9. Click on "OK".

Virtual Memory

Because Windows takes over virtual memory, running TN-Image under Windows will affect virtual memory usage. Before starting TN-Image, make sure the amount of Virtual Memory selected in the Windows Control Panel is greater than the amount of RAM in your computer. Failure to do this can result in frequent "Out of memory" errors. Windows' virtual memory is much slower than the VM built into TN-Image. Hence, there is no particular advantage to running TN-Image under Windows. Also, as with all applications, speed under Windows will be markedly slower than in DOS.

A peculiarity of Windows is that if you have the wrong mouse driver installed in Windows, you can lose control of the mouse when you run a mouse-based DOS program such as TN-Image. If this happens, run the "setup" program in Windows to ensure that Windows is set up to use the mouse driver that is appropriate for your mouse. For example, if you have a Logitech mouse, using the Microsoft mouse driver may cause the mouse to become immobilized when you return from TN-Image. Because Windows uses a different mouse driver from DOS, the mouse may work under Windows but not in a DOS box. If the mouse doesn't work right when running under Windows, you almost certainly need a new (or different) mouse driver. An alternative approach which sometimes works for some reason is to change Windows from its default VGA screen mode to a 256 color mode.

Windows 3.1 also has an "unexpected feature" of sometimes not redrawing its own screen when returning from DOS graphics programs such as TN-Image. One solution is to "minimize" the Windows screen after returning from TN-Image and then immediately "Restore" it. This forces Windows to redraw its screen.

Computers with ATI Mach 32 cards have problems running TN-Image in true-color mode from within a DOS box. In this case, the only solution is to run TN-Image from DOS, or use TN-Image in an 8 bit/pixel mode (e.g., mode 103). (See "Command-line options" above). Mach 64 cards are a little better (they can handle 16 bit/pixel modes, but still can't handle 24 bit modes in a DOS box). Most other cards have no problems.

For both OS/2 and Windows, TN-Image must be run in "full screen" mode. For OS/2, it may be necessary to change the DOS box parameters to get TN-Image to run properly. TN-Image may not run on all OS/2 configurations, because it needs to access the hardware.

Note: *No technical support is available for TN-Image running under OS/2.*

NOTE: In a Windows DOS box, the virtual memory manager in TN-Image sometimes gets confused if Windows is set up for a small amount of virtual memory. This causes the "Free Memory" display to be incorrect, and more importantly, allows you to completely fill up memory with images, making it impossible to use the menus. If this happens, you can still erase an image by clicking on the image you want to erase and pressing Alt-E. We are trying to find a better solution for this problem. In the meantime, it is recommended that Window's virtual memory be set to a size greater than the amount of RAM in your computer.

10.0.0 Changing Computers

If you experience problems after moving TN-Image to a different computer, or after changing video cards, erase the file TNIMAGE.INI. This file contains TN-Image's video mode selection, and may inhibit automatic detection of the video chip in your new computer. TN-Image will revise the file automatically if it detects an incompatibility.

11.0.0 Problems

Problem: Strange colors on screen or TN-Image only using top 1/12 or 1/7 of the screen.

Solution: Some other Super VGA programs and communication programs (such as some versions of Carbon Copy) contain an "unexpected feature" that results in the computer being left in a state that prevents proper functioning of TN-Image with certain video cards. The DOS shell program 1Dirplus and one HPLC data-acquisition program also have a similar feature which can interfere with the colormap registers. If TN-Image suddenly begins to run incorrectly after running one of these programs, reboot your computer and start TN-Image again. This can also occur when running TN-Image as a DOS box in OS/2. Change the DOS box parameters to correct the problem.

Problem: Entire screen compressed into upper 1/7 of the screen.

Solution: (1) Try starting TN-Image with the command line:
`TNIMAGE -OLDVESA`
(2) If that doesn't work, you probably are using an outdated VESA VBE TSR (Terminate-and-stay-resident program). Obtain a new version from the video card manufacturer. Note that most new video cards already have VESA BIOS built in, and don't need a TSR. Try running TN-Image without it. If nothing works, contact the author for assistance.

Problem: Lower part of screen flickering (upper 2/3 of screen is okay, lower 1/3 is "snow" or "static".

Solution: This occurs when the video card reports to TN-Image that it is OK to set the specified high-resolution screen mode, but in fact the card has insufficient video RAM to handle it. This will occur on certain Cirrus-based cards. To solve the problem, it is necessary to install additional memory in your video card. Using TN-Image when this problem occurs could result in a system crash.

Problem: Screen is completely white.

Solution: This occurs when using one of the "experimental" Tseng modes, if the video card is unable to handle the specified screen mode. Press Alt-X two or three times to return to DOS, then use the "mode" command line option to run TN-Image in a different resolution.

Problem: Multiple copies of Menu Bar.
Solution: This is usually caused by an old video card with VESA 1.0 BIOS. Start TN-Image again using the command line:
`TNIMAGE -OLDVESA`
This can also happen if the `UNIVBE` TSR is present. `UNIVBE` must be removed in this case.

Problem: Printer prints part of image, then gives an error message or goes into a "form feeding frenzy".

Solution: This can occur on laser printers if your printer has insufficient internal memory to handle the image. You will have to install additional printer memory, print a smaller image or print at a lower resolution or dither size. Generally, 4 MB is required to print a 8x10 inch page in black-and-white at 600 dpi. Color printing requires 3 or 4 times as much. Unfortunately, there is no way for TN-Image to test how much memory the printer has. For some reason, printer manufacturers have also made it impossible to print an image in small segments. This problem does not occur on inkjet printers.

This will also occur if printing is attempted on a dot-matrix printer.

Problem: Mouse gets "lost" when running TN-Image from a Windows DOS box.

Solution: This occurs with some Microsoft and possibly other mouse drivers. Exit Windows, and replace your mouse driver with a newer version or with a Logitech mouse driver. Then use Windows' Setup program to change to the new mouse. Alternatively, use Windows' Setup program to change Windows' screen display to 256 colors (It's not known why this helps). These problems have not been observed in Windows 95.

Problem: Screen is not restored correctly after running TN-Image from a Windows DOS box.

Solution: Install a different video driver in Windows using Windows' Setup utility.

Problem: Mouse jumps around on the screen, or exhibits jerky movement as if trapped in a grid.

Solution: Obtain a new mouse driver. This can usually be obtained from a bulletin board or ftp site operated by the mouse manufacturer. Alternatively, Logitech mouse drivers can work on many mice. Older mouse drivers often have trouble in SVGA modes. Microsoft mouse drivers are particularly prone to these sorts of troubles. Some old SVGA cards, such as Realtek video cards, create difficulties with the mouse, making it possible to reach only x and y coordinates that are divisible by 4. In this case, the video card must be replaced.

Problem: Screen is garbage when running TN-Image from a Windows DOS box, even though there is lot of video RAM.

Solution: This is a problem in computers with ATI video cards in Windows for Work Groups for some screen resolution modes. Run TN-Image at a lower color depth by changing the "Command Line" entry in Windows' "Properties" menu to:

```
C:\TNIMAGE\TNIMAGE.PIF -mode 103
```

Alternatively, run TN-Image from DOS.

Problem: Unusual behavior or display colors immediately after upgrading from a previous version of TN-Image.

Solution: Delete the configuration file "tnimage.ini".

Problem: Colors appear posterized.

Solution: This will happen on 8-bit displays if other applications (such as Web browsers or certain window managers) allocate a lot of colors, This can also happen after using certain other image viewing programs, particularly if they crash and fail to release their allocated colors. If closing other applications or restarting the X server doesn't help, try starting the X server in 16- or 24-bit mode. If this is not possible, it may be necessary to switch to a different window manager.

Problem: Operations such as inverting colors, etc. on the main window give a solid color instead of the expected inverted text.

Solution: This occurs when foreground and background colors are adjacent numerically (e.g., 40 and 41) but their actual colors (determined by the colormap) are different. Inverting the colors makes the color values 215 and 214, which map to similar colors. Change the foreground or background color to something else.

Problem: Message "Invalid image file" appears after transferring an image file from a Unix or mainframe system.

Solution: The most common cause of this problem is the failure to use "binary" mode when sending the image file over the network. If you are using Kermit, give the command

```
set file type binary
```

before getting the image. If you are using ftp, give the command

```
binary
```

before getting the image. It is very difficult to fix an image file that has been corrupted by sending it in text mode.

Problem: Loading or processing of images is slow.

Solutions: (1) Speed can be greatly increased by starting TN-Image in a screen mode that has the same color depth as the images. Analyzing 24-bit color images in 8-bit mode, for example, will be slow because the entire image projected to the screen has to be re-palettized every time any operation changes one or more pixels.

(2). If your hard disk light goes on during an image processing operation, this means TN-Image is paging out to disk. This can be reduced by installing more memory in your computer.

(3). Speed can be approximately doubled by running TN-Image from DOS instead of in Windows, or by removing any expanded memory managers such as 386 Max or (especially) EMM386, which slows down math operations by over 50%.

Problem: Colormap rotation in startup screen is slow or jerky.

Solution: If you are running the Unix version, this can happen if another copy of tnimage is running, or if the mouse is moved suddenly during startup. In the DOS version, this is usually caused by a slow video card.

Problem: "Insufficient memory" message occurs even though "About the program..." indicates there should be enough memory.

Solution: Turn "Automatic undo" option off. This will cut the storage requirements in half. Also, a certain amount of memory is also reserved by TN-Image for dialog boxes, etc. and is unavailable. If this happens in Windows, you must increase the "Virtual Memory" setting in Windows ("Control panel..386 Enhanced..Virtual memory.)".

Problem: Video card won't go into desired screen mode, even though video card manual states that mode is supported.

Solution: (1) If ATI card: Run ATI's "Install" program again to verify the specified video mode is activated. (2) Run TN-Image's diagnostics by typing: tnimage -diag to determine the problem, which is usually caused by insufficient RAM or a monitor limitation. (3) Another possibility is that the computer was turned on before turning on the power to the monitor. Some video cards only examine the monitor type at power-up, will become confused if the monitor is off during a cold boot-up, and refuse to set high-resolution modes.

Problem: Monitor makes a buzzing sound and fails to sync on startup (causing jagged diagonal lines on the screen).

Solution: Turn the monitor off immediately and press Alt-X several times to stop the program. Restart TN-Image using a lower screen mode. This problem could occur if your video card reports that it is safe to set a given screen mode when in fact it is not safe. Only one card has been found so far that does this, when setting a 1280x1024 resolution mode. Prolonged operation in this condition could harm your monitor.

Problem: A grayscale image appears completely black or white.

Solution: This is usually caused by the automatic grayscale mapping feature misinterpreting the upper and lower gray levels of your image. If the image is being read as "raw bytes", make sure you have selected the correct number of bits/pixel, x size and y size. If the y size you entered is too large, TN-Image may read beyond the end of the image and incorrectly estimate the maximum and minimum levels. To correct this, select "Color...Set colormap...Grayscale mapping" and change the maximum and minimum values to correspond to those in the image. (For example, if the image is known to be 12 bits deep, the maximum should be approximately 2^{12} or 4096.)

Problem: "Mouse required" message occurs when starting TN-Image, even though Windows runs OK with the mouse.

Solution: Windows has its own separate mouse driver. It is still necessary to load a mouse driver for DOS applications. Run the program "mouse.com" that came with your mouse.

Problem: When typing text on the screen, it comes out in the wrong color.

Solution: The available colors are determined by the color depth, the gray scale mapping parameters and colormap (if present) of the image you are typing on. For example, if an 8-bit image with a particular colormap is loaded, you can only add colors that exist in that colormap, even if TN-Image is in a 24-bit color mode. This prevents you from accidentally adding a color which is impossible to save with the image. If all else fails, press Alt-R to rebuild the screen display.

Problem: The message "Converting from 24 to 8 bits/pixel" stays on the screen for a long time.

Solution: Select "Color...Color settings" and make sure "Color reduction method" is set to "Quantization" and not "Fit current colormap" which can be slow.

Problem: When reading color images, the colors are wrong, or it takes a long time.

Solution: Select "Color...Color settings" and make sure "Color reduction method" is set to "Quantization" and not "Fit current colormap" which may give incorrect colors.

Problem: After reading a GIF file or a color image, subsequent images in other formats appear to be "garbage".

Solution: This only occurs in 8-bit/pixel screen modes. When an image that does not have its own colormap is loaded, the colormap is not automatically changed. If the current colormap is discontinuous, the new image may appear to contain garbage (of course, it is not really garbage). Simply click anywhere on the background, or use the "Change colormap" menu option to change to a continuous colormap.

Problem: Medical grayscale images appear grainy or posterized; or appear as strange shades of blue instead of gray.

Solution: The wrong target platform may have been selected. Select "File...Create custom format" and change the "Target platform" and/or "Bytes to skip" for the specified format until a smooth image is obtained.
If you are using the Shareware version, you will need to read the image as a "raw" file and tweak the image parameters manually.

Problem: Deconvolution result is completely black, completely white, or garbage.

Solution: This can be caused by (a) using an inappropriate point spread function, (b) using a point spread function that has zero or near-zero intensities at one or more frequencies, or (c) wrap-around effects. Sometimes, adding noise to the point spread function will increase the intensity at the missing frequencies and solve the problem. Alternatively, try a less ambitious point spread function. Try dumping the FFT data to disk and reading it with a text editor. If the numbers are all "-nan" 's, this is a sign that the intensities were too low and a different psf must be used. Some images simply don't work well with deconvolution.

Problem: Spots floating across screen, or jagged flickering lines.

Solution: You are working too hard, go lie down.

Problem: "Fill Region" was selected, but nothing happened when mouse was clicked on the region to fill.

Solution: Make sure the area being filled is darker (lower intensity value) than *both* the Max. Border Color and the Min. Border Color. Filling will stop whenever any color between these two values is encountered.

Problem: Mouse cursor moving by itself.

Solution: Make sure mouse is on a level surface.

Problem: "out-of-memory" problems running TN-Image in a Windows DOS box.

Solution: This is usually caused by an incorrect setting in your virtual memory. Try the following procedure to fix it:

1. Click on Windows Control Panel
2. Click on "386 Enhanced"
3. Click on "Virtual Memory"
4. If the size of the Virtual memory is less than the amount of RAM in your computer, problems may occur. Change the amount of Virtual Memory to the maximum recommended by Windows; or exit Windows and run TN-Image from DOS.

Problem: M-x psychiatrist doesn't work.

Solution: You must be thinking of some other program.

12.0.0 Limitations and known bugs

In the Unix version, the width or height of the viewable area cannot be made larger than the width or height of the screen. Color sharing with other applications could also be friendlier in the Unix version.

When an FFT is present, it is impossible to flip the image.

When selecting a line or an area (e.g. for copying), the drag box cannot leave the image in which it was started. To include parts of two images or an image and background, it is necessary to start in the main (background) window.

Chinese, Japanese, Arabic, and Hebrew fonts are still not handled correctly in Linux.

In mwm (Motif Window Manager), the arrow keys do not move the image the correct distance for independent windows.

It is necessary to quit and restart the program to get the menu bar to wrap around onto multiple lines when the main window is made smaller than the menu bar width in fvwm and olwm.

In fvwm, if an image in a separate window has scrollbars, the "copy" and "move" functions don't work on the main window.

Focus does not return to the previous window after the program exits. This appears to be the case for most Motif applications.

Densitometry does not work correctly on a Fourier-transformed image.

Gradient fills need to be easier with true-color images.

Plugins do not work in Solaris or ConvexOS. Feedback on this problem will be appreciated.

13.0.0 Error messages

All versions

———–

Insufficient conventional memory to run program
Insufficient extended memory to run program
These errors usually mean an extended memory manager is required but not present. The simplest solution is to find the file HIMEM.SYS (which comes with DOS) and install it in your CONFIG.SYS file, e.g., add the line

```
C:\DOS\HIMEM.SYS
```

to CONFIG.SYS (make sure HIMEM.SYS is in the DOS directory before doing this).

Also, check to see if you have an expanded memory manager installed. These programs sometimes block access to portions of video memory or high memory.

Not enough memory
Insufficient memory to perform the requested action (see "Operating under low-memory conditions" above). This message should not occur in the Registered version of TN-Image, unless there is insufficient disk space.

Insufficient memory to convert to 8 bits/pixel
A color map table could not be generated for the image. When this happens, the image cannot be converted to the screen resolution, leaving "garbage" on the screen. Try changing 'color reduction method' to "fit current colormap". This method uses less memory. Alternatively, start TN-Image in a color mode and try again. This message should not occur in the Registered version of TN-Image, unless there is insufficient disk space.

Internal error [...]
Contact author for assistance, specifying the exact message and the circumstances under which it occurred.

Can't compact free space
This can occur when you try to unload an extremely large image. The only consequence is that the maximum amount of free memory could not be recovered. Usually, erasing the image again will free up the space.

Too many images
The limit of 512 images (or 2 images for the Shareware version) was exceeded while attempting to read an image from disk or create a new image. Don't forget that a new image is also created when you try to rotate or resize an image or carry out an FFT.

Image was not backed up
This only occurs when you select "Restore" when the "Auto undo buffer" option was unchecked, so that new images were not automatically backed up. Although un-checking 'auto undo buffer' creates more free memory, it means that it will be impossible to undo any changes by selecting "restore".

Function not available in shareware version
The function is only available in the Registered version of the program.

Function not available
The function has not yet been implemented. Contact the author for availability dates.

Error - mixed expand and shrink operations
You cannot shrink an image in one dimension and enlarge it in another simultaneously, it must be done in two passes.

Error: Bad OD table, Turn pixel compensation off
Densitometry could not be performed because part or all of the selected region was on an image whose O.D. table mapped two or more pixel intensity values to the same O.D. You must either repair the OD table, or select "No pixel compensation".

Bad scan parameters
This occurs if the starting and ending points of your densitometry scan are the same, or if the region could not be scanned for some reason. Select the region again.

Can't create file!
An invalid file name was specified, or the filename was the same as some existing file that DOS has marked as "read-only", or a "directory".

Can't find file!
The specified filename does not exist, or is marked by the operating system as "hidden". Use a utility such as NSHELL to un-hide the file.

Only the 1st image in your file will be displayed
Your TIFF file contains more than one image.

Sorry, can't read xxx compressed TIF images
TIF files are sometimes compressed using a weird form of compression not supported by TN-Image.

Not a valid TIF file
The TIFF file is corrupted and unreadable, or is an unusual non-standard TIF format.

Warning: File transfer aborted
You aborted the operation of saving the image to a file by pressing *ESC* or clicking on "Cancel"; or, saving of the file was aborted by the program for some reason.

An error occurred
A "Critical error" occurred in connection with a file transfer. This normally leads to the message "Abort, Retry, Ignore?". This occurs if you try to save a file to a floppy drive that does not exist, does not have a disk in it, has an open door, etc. It can also happen if a problem is found with your disk.

No images to save
You selected "Save image", but no images were currently loaded.

Printer not responding!
Printer I/O error!
Printer out of paper!
lp0 on fire (Unix only)
The printer is off-line, powered off, on fire, or something.

Problem: When printing a grayscale image in PostScript mode, changes in the contrast, brightness, or colormap are not reflected in the printout.

Solution: Set "Color type" to RGB/indexed color instead of BW/grayscale.

Unable to read disk
The specified drive letter referred to a non-existent disk; or there was a disk drive failure. Occasionally, CD ROM drives will spuriously give this error.

Invalid GIF file
Error decoding GIF file
Unable to read GIF file
The GIF file is corrupted and unreadable. The most common reason for this is that, when you downloaded the file, you forgot to set the communications package to "binary" mode. For example, in ftp, before getting the file, type:
`binary`
In Kermit, before telling the remote Kermit to send the file, type:
`set file type binary`
You may also need to make sure your local computer is set to "binary" mode. The command for this differs for each communications package.

Number of colors doesn't add up
Change the bits/pixel on a color or number of primary colors
You have selected an incompatible combination of options. The number of primary colors must correspond to the number of colors which have non-zero bits/pixel. For example, if you select "1"

as the number of primary colors, only one of the 4 entries (red, green, blue, or black) can have a non-zero number of bits. The rest must be 0.

RGB bits/pixel don't add up to total
Change total bits/pixel or number of colors
You have selected an incompatible combination of options. The sum of the red, green, blue, and black bits to be used to save an image must be equal to the total bits/pixel selected. For example, if you select to save the image as 17 bits/pixel, the red + blue + green + black bits must also total up to 17. If you are reading a raw 8-bit monochrome image, the "color type" must be set to "Gray Scale/Indexed".

You must have only 1 primary color to save data as grayscale
You have selected an incompatible combination of options. If you want to save the image as "Gray scale" image data, you must also change the "no. of primary colors" to 1.

Non-standard image format - is this ok?
This means the file format selected is not standard, and some other programs may have difficulty reading the file that is created.

Not enough bits for CMYK
You must either select 32 bits/pixel mode, or "other bpp" mode, in order to create a CMYK file. If you select "other bpp", you need to specify the number of bits to use for black as well as red, green, and blue.

You must select CMYK to use black bits
Setting a non-zero value for "black bits/pixel" is only allowed if you have also selected "CMYK".

Must have 4 colors for CMYK
If you selected "other bpp", you need to also select "4" as the number of primary colors in order to create a CMYK file.

PCX files must be 8 bits/pixel
TN-Image can only create 8 bit/pixel PCX files. You must convert your image to 8 bits/pixel before saving it as a PCX file.

IMG files must be 1 or 8 bits/pixel
TN-Image can only create 1 or 8 bit/pixel IMG files. You must convert your image to 8 bits/pixel before saving it as an IMG file, or select "monochrome".

File is an unsupported type of PCX file.
The PCX file had too many bit planes, or was not 1 or 8 bits/pixel.

No header file specified
This only occurs when "Create custom file" is selected. If you specify a non-zero number of header bytes to copy from a file, you must also specify a file name.

Specified header bytes exceeds length of header file
This only occurs when "Create custom file" is selected. You selected a number of bytes to copy into the header of a custom file format which exceeded the file size of the specified file.

Bad gradient parameters
One or more of the coordinates specified for a gradient fill, or one of the boundary colors, was bad. Reselect another similar area and try again.

Invalid parameters, Setting kernel multiplier to 1
For some types of filtering, the kernel multiplier must be set to 1. TN-Image has done this automatically.

Kernel size is larger than selected area
The size of the kernel to be used for for filtering, multiplied by the kernel multiplier, is larger than the image. This would result in no filtering, so the filtering was stopped. You may have accidentally click-and-dragged a 1x1 area. Try re-selecting the area to filter again.

Bad scan parameters
A trapezoidal region selected for scanning happened to have an illegal combination of values. Select a slightly different region and try again.

Error converting image
Contact the author for assistance.

Too many peaks
The number of peaks exceeded the size of the list TN-Image allocated for them. Contact the author to obtain an upgrade which can handle more peaks.

Can't find help file
The help file, TNIMAGE.HLP, was not in the starting directory.

Bad regression order
This is usually caused by trying to draw a curve or calibrate an image using only one calibration or control point. At least 3 control points must be selected.

No unique solution
Division by zero
These messages indicate that it was impossible to calibrate the image using the existing calibration points. Calibrate the image again using slightly different control points.

Error: negative value in logarithm
When calibrating an image in logarithm mode, all calibration values must be positive.

You must select "Other" or "Custom" to save an image with non-standard parameters
TN-Image detected a non-standard value entered for bits/pixel or number of colors. To protect against accidentally creating non-standard files, you must specifically check the "Custom" file format or the "Other" bits/pixel selection.

Error: need two images to convolute
Convolution or deconvolution of images was selected, but less than 2 images were present.

nn Divisions by zero detected
During deconvolution of two images, if the frequency of the 2nd image is zero at any point, division by zero occurs. If there are a large number of these, it usually means the 2nd image is not entirely appropriate to use for deconvolution.

Can't open list file
A file containing a list of images was expected, because of the "-FILES" option, but either no file list name was given or it was an invalid file name.

Extension must be TGA for Targa format
Since there is no foolproof way to determine whether a file is really in TGA format, TN-Image will classify any file with a TGA extension as a Targa file. If you specified some other extension, the file would be unreadable. Thus, TN-Image does not allow you to save the file with any extension other than "TGA".

Unknown error - nothing was saved!
This message should not occur in normal use. Contact the author for assistance.

Selected bit/pixel values will be ignored
Images are automatically converted to 24 bits/pixel before saving in JPEG format. Other values are illegal and are ignored.

Color information will be lost!
You should convert image to 8 bits/pixel first
You are about to save a color image in a file format that does not have color information. When loaded back, the new image might not have the same colors as the original. Select "Change image depth" and quantize the image first by converting it to 1 byte per pixel.

Error: overlapping offsets
While creating a custom image format, you cannot set two or more file offsets to overlap the same byte position. Each offset occupies 2 bytes.

Error: offset exceeds 1024
While creating a custom image format, you cannot set a file offset to a number greater than 1024.

Macro terminated at line xxx
A fatal error occurred while executing a macro. The macro was terminated at the specified line. Commands following the offending line were not executed. A fatal error can include the following:
Out of memory
File not found
No images available for the operation
Can't create file
Critical error (e.g., disk drive door open)
File was zero length (after creating an image file, the resulting file was checked and found to be empty).

DOS/Windows-specific error messages

Fatal error, DPMI host does not support 32 bit applications
Fatal error, 80386 processor is required
Fatal error Previously installed software is neither VCPI nor DPMI compatible
Fatal error allocating DOS memory
16 bit code and data are too large
Fatal error, insufficient conventional memory
Cannot enable the A20 line, XMS memory manager required
FATAL error, XMS memory corrupted
16 bit code is too large
DPMI failed to enter protected mode
DPMI operating system error
One or more of these messages will occur if you do not have an 80386 or higher processor, or if some other program is providing DPMI services in a way that is incompatible with TN-Image. This might occur if you are running some unusual type of memory manager or have an incompatible type of CPU chip. Certain hardware problems can also cause these messages. Try booting from a floppy or removing memory managers from AUTOEXEC.BAT.

Fatal error reading disk
FATAL error during virtual memory disk IO
These messages mean that something bad happened to your disk or to the swap file used for virtual memory. Try to free up more disk space and try again. This can also happen if you run TN-Image Registered version from a floppy, and then remove the floppy.

Mouse required
No mouse driver was found. Run the file "MOUSE.COM" or "MOUSE.EXE" (a file that came with your mouse) and try again.

VESA not present
VESA BIOS not found
These messages mean that no VESA driver was found. This driver is a file that should come with your super VGA card, with a name like "VESA.COM". Install the VESA driver and try again. This message will also occur if you do not have a super VGA card.

Can't set VESA mode
Unsupported VESA mode
These messages mean that even if you have a VESA-compatible card, it cannot handle the selected screen mode. See under "Command line options" above for instructions on setting other screen modes.

Unsafe/unable to set VESA mode
Your monitor reported that it is unable to handle the scan rate for the specified resolution, or the video card refused to set the video mode for some other reason.

Trident card not found
This only occurs if you specified "Trident" on the command line and no Trident card was present.

Unsafe to test for Tseng chip

This occurs if you specified “Tseng” and no Tseng Labs chip was found. Certain non-Tseng chips cause a system lock-up if you try to check for a Tseng mode, thus the program did not try to set the Tseng mode.

VGA mode set OK - Unrecognized SVGA chip
TN-Image found that you have a VGA card, but it is not VESA-compatible and not a Tseng or Trident card. Probably it is not capable of super VGA modes.

Can't open graphics device
No grapics card was found.

Unable to set video mode
You specified a video mode on the command line that is not supported. See “Supported video modes” above.

You either have insufficient video memory or an ET3000 chip
You need 1MB of RAM and an ET4000 chip
A Tseng Labs card was detected, but it is either too old (ET3000 chips are not supported) or does not have enough video RAM. On most cards, it is a simple matter to purchase and install an additional video RAM chip.

Error: Monochrome chip
A monochrome Tseng Labs chip was found on your video card.
You need to upgrade to a newer card.

Error: ET3000 chip
An ET3000 Tseng Labs chip was found on your video card. You need to upgrade to a newer card.

Error: S3 not currently supported, use VESA
Error: ATI chip not supported, use VESA
The “-S3” and “-ATI” options for directly programming these chips are not available yet.

****Warning: unusual value****
An unexpected value was obtained from the VESA BIOS in your video card. TN-Image may not function correctly.

Unsupported Tseng mode
A Tseng mode was specified which could not be set by your video card or is not supported by TN-Image.

Unsupported Trident mode
A Trident mode was specified which could not be set by your video card or is not supported by TN-Image.

Wrong switch setting on Trident video card
Check your manual to ensure your card is configured correctly
A Trident card was detected, but was configured incorrectly. Please consult your video card manual or computer dealer.

Insufficient video memory in Trident card
1MB video ram required
A Trident card was detected, but was found to have less than 1 MB of video RAM. Take the card to your dealer to have additional RAM installed.

Unable to set video mode on Trident card
(Error code=%x)
A Trident card was detected, but the video mode could not be set for an unknown reason. Consult the author or your computer dealer.

Sorry, your type of SVGA card is not supported
TN-Image does not support your type of SVGA card; or, you did not load your VESA BIOS before running TN-Image. This is a file that should come with your super VGA card, with a name like “VESA.COM”. Run this program and try again. This message may also occur if you do not have a super VGA card.

DPMI host can't lock error handling code!

The DOS protected mode interface supplier (i.e., Windows, 386^Max, etc) made an error. The simplest solution is to find the file HIMEM.SYS (which comes with DOS) and install it in your CONFIG.SYS file, e.g., add the line

`C:\DOS\HIMEM.SYS .`

Then, run the program from the DOS command line instead of within Windows.

UNIX-specific error messages

——————————-

There are a huge number of these. Below are the most common.

Can't open display

X11 must be running. If running tnimage remotely, xdm must be running on the host machine. It is also necessary to have the remote computer's name in your xhosts by typing the following local command:

`xhost +` *Remote-system-name*

No visuals found
No appropriate visual

X11 is running in an unsupported screen mode.

Error allocating size hints
Error allocating class hint
Error creating XTextProperty
Error allocating Window manager hints
XCreateImage failed
error in dialogbox
Segmentation fault
Bus Error

Please send a complete bug report to the author if any of these messages occur.

Can't allocate colors

Another application may be using all the available colors; or another copy of xtnimage may be running. Try closing some applications.

14.0.0 Trademark disclaimers and acknowledgements

Graphics Interchange format and GIF (SM) are service marks of Compuserve Incorporated.

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TIFF reading/writing routines are based on information provided in the document "TIFF Revision 6.0 Final Q June 3, 1992" from Aldus Corporation.

PostScript is a trademark of Adobe Systems, Inc. The PostScript writing routine is based on information provided in the document "PostScript Language Reference Manual, 2nd Edition" from Adobe Systems Inc.

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