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SPECTO User's Guide

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ABSTRACT

SPECTO is a computer program for generating spectrographic displays from digitized acoustic waveforms stored in data files, such as the commonly used ILS sampled-data file format. This program currently runs on PC compatible computers, NeXT workstations, and a VAX/UNIX system. The output can be directed to the console display (CGA, HGC, EGA, VGA, or NeXT) or to a printer (HP LaserJet, Imagen, Epson FX, or Postscript). Many of the parameters used to generate the spectrogram can be modified by the user by means of a parameter file. This document describes version 2.11 of the SPECTO program.

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Introduction

The SPECTO program was designed to provide the equivalent of a traditional speech spectrogram to someone with digitized speech files and a dot-matrix or laser printer. In order to preview the spectrogram before printing, the program also can generate a lower resolution version of the spectrogram on the console screen of the PC (or NeXT). In addition to the spectrogram, the program displays the associated waveform and relative signal energy, as well as labels and annotations for the time and frequency axes.

Gray levels are generated on the printer with an error-diffusion dithering algorithm that makes optimal use of the available resolution of the printer. SPECTO was written to emphasize image quality over speed. The laser printer output reproduces well and should be better suited for publication than a spectrogram printed on special paper with intermediate gray levels.

The generation of the spectrogram makes intensive use of floating-point computations, mostly in the computation of numerous Fourier Transforms. On a 20-MHz 386/PC computer with a numeric coprocessor, a typical, full-page spectrogram output takes about 45 seconds for an EGA display and about 8 minutes for a 300 dpi laser printer.

Much of this document assumes that the SPECTO program is installed on an IBM-PC. The VAX/UNIX and NeXT versions differ only in their support of the console display.

The SPECTO program will run on any IBM-PC compatible computer and supports all standard PC graphics adaptors (CGA, HGC, EGA, and VGA). A numeric coprocessor is strongly recommended, and a faster processor clock rate makes the program much more convenient to use.

Installation of the program is simple: just put the file SPECTO.EXE into any directory included in the current "path".

Tutorial

The easiest way to use the SPECTO program on a PC is to type

```
specto sp11.ils
```

where *sp11.ils* is a data file containing a digitized acoustic waveform. SPECTO will recognize this file as an ILS sampled-data file by examining the file header. A few other data file formats are also supported.

By default, the SPECTO program outputs the spectrogram to the console display after automatically detecting the presence of a CGA, HGC, EGA, or VGA graphics adaptor. To direct the output to an HP LaserJet printer on LPT1: at 150 dpi, just add the option `-Plj` to the command line.

```
specto -Plj sp11.ils
```

Or, use `-Plj300` for 300 dpi resolution. A complete list of command line options appears in the next section.

The alternative way to use SPECTO is to prepare a parameter file which includes the sampled-data filename and which also may modify the SPECTO parameters, add messages, etc. The SPECTO parameter allows much greater flexibility in the appearance of the output. The parameter file is an ordinary ASCII text file which should have a `.SPC` filename extension. The simplest SPECTO parameter file would be a single line which specifies the name of a sampled-data file. For example,

```
sdfile sp11.ils
```

indicates that the sampled-data file *sp11.ils* is to be processed. If a file called *test.spc* contained this one line of text, then the spectrogram of *sp11.ils* could be displayed by typing

```
specto test
```

or sent to the printer by including the `-Plj` option described above.

The appearance of the SPECTO output is controlled by a set of parameters which are described in the next section. All parameters have reasonable default values, which can be modified by specifying new values in the parameter file. Only modified parameters need to be specified. For example, the "contrast" parameter has a default value of 1. The contrast can be reduced by putting the line

```
contrast=0.4
```

in the file *test.spc* before the "sdfile" line. Two examples of SPECTO parameter files are included in section 5 along with sample output from a 300 dpi printer.

The speed of output is dominated by the time required to calculate the Fourier transforms. Faster output can be obtained by setting the parameter

```
ftpi=1
```

to limit the number of Fourier transforms per inch to 1. The default setting is `ftpi=64`.

Functional Description

There are two ways to use the SPECTO program:

```
specto [-options] sd_file
```

or

```
specto [-options] spc_file [arg1 arg2 ...]
```

where the options are:

-a	sampled data file is ASCII format
-c	use colors on EGA or VGA display
-d	debug print (for programming)
-h N	header of sd_file is N bytes long
-n	network printer is connected to output
-o F	direct output to file F [default is LPT1]
-Pco	direct output to console screen [default]
-Pcga	use CGA (60x25 dpi)
-Phgc	use HGC (60x40 dpi)
-Pega	use EGA (60x40 dpi)
-Pvga	use VGA (60x60 dpi)
-Pfx	direct output to Epson FX compatible printer, draft quality (72x120 dpi), also -Pfxq for better quality (216x240 dpi)
-Pip	direct output to Impress printer (300 dpi)
-Plj	direct output to LaserJet printer (150 dpi) also -Plj75 and -Plj300 for other resolutions
-Pps	direct output to Postscript printer (400 dpi) also -Pps100 and -Pps300 for other resolutions
-q	quiet mode (fewer messages)
-r N	set sampling rate to N samples per second
-t N	trailer of sd_file is N bytes long

The -n option insures that at least one character is output every second. This is for use with shared network printers which may be disconnected if the output is idle for more than a few seconds.

Command line options which are used repeatedly may be placed in the environment variable SPECTO. The default value of any of the SPECTO parameters described below may also be set on the command line.

The sd_file is a sampled-data file containing the digitized waveform to be analyzed. The file formats that SPECTO is able to read include: (1) ILS sampled-data files, (2) NeXT sound (.snd) files, (3) ASCII text files containing one number per line, (4) MATLAB (.mat) data files, (5) other binary files containing 16-bit integer data with header and trailer size specified. The sampling rate should also be specified for ASCII or binary files other than ILS and .snd files.

The spc_file is a SPECTO parameter file with a .SPC extension. Parameter files are ASCII text files in which each line is either a comment, a parameter specification, a message, or a file specification. Comments begin with a semicolon and are ignored by the program.

Parameter lines start with the parameter name followed by an equals sign followed by the desired parameter value. There are two types of parameters: (1) byte parameters which have small integer values and (2) floating-point parameters. Only the first four characters of a parameter name are significant. Only one parameter may be specified on each line.

Message lines start with two values specifying the (x,y) position of the message relative to the lower-left corner of the page. The message follows these two values and must be enclosed in double-quotes. Only single-line messages are allowed. The message size, angle, horizontal alignment, vertical alignment, character height, and line weight of messages may be specified by parameters.

File specification lines start with either the word "sdfile" or "tsdfile" followed by the name of a file. The "sdfile" specifies the name of a sampled-data file. The "tsdfile" specifies the name of a time-step data file generated by a separate cochlear model program. The file specification line also initiates analysis of the file and generation of the corresponding spectrogram.

Message lines and file specification lines may refer to arguments on the command line by using the syntax %1 for the first argument, %2 for the second argument, and so on. Messages may also contain %d which is replaced by the current date and time; %p is replaced by the current page.

When the output is displayed on the screen of a PC and a mouse is installed. The mouse cursor will be displayed on the screen. When the mouse cursor is present, clicking on the left mouse button will cause the coordinates of the mouse cursor to be displayed in inches from the lower-left corner. If appropriate, the time and frequency coordinates of the mouse cursor will also be displayed. Clicking on the right mouse button will advance to the next page (or exit the program if there are no more pages).

The remainder of this section includes a complete list of parameters along with their default values and a brief description of how the parameter is used. Only the first four characters of the parameter name are needed in a parameter file.

GENERAL DISPLAY PARAMETERS

date (byte parameter)

When DATE nonzero the current date and input file name are printed at the bottom of each page. The default value of DATE is zero, which means that the date and file name information will not be printed.

newpage (byte parameter)

When NEWPAGE equals one, the default, each sampled-data file is displayed on a new page. Setting NEWPAGE to zero allows multiple files to be plotted on a page.

xpage and ypage (floating-point parameters)

These parameters allow the user to specify the size of the page on which the displays will be printed. XPAGE is the horizontal dimension and by default is set to 11 inches. YPAGE is the vertical dimension, and its default is 8 inches.

xlen (floating-point parameter)

XLEN controls the length, in inches, of the horizontal or time axis of the spectrogram, the waveform, and the energy displays. For an 8.5" x 11" page, this is the 11" dimension. This length does not include space for annotations or axis labels. Although the user can set XLEN to any value, the length of the plottable area on the page is about an inch less than XPAGE. The default time axis length is 9 inches.

xllc (floating-point parameter)

XLLC controls the horizontal position, in inches, of the lower left corner of time axis on the spectrogram, the waveform, and the energy displays. This point is where the time axis begins. The default value is 0.75 inch from the left edge of the page.

axlnwd, annlwt, and lablwt (floating-point parameters)

These parameters control the line width used to draw axis lines (AXLNWD), annotations (ANNLWT), and axis labels (LABLWT) on all of the displays. AXLNWD is the width of the axis line specified in inches, and its default value is 0.01 inch.

ANNLWT and LABLWT are line weight parameters, the actual line width will be one tenth of the character size (ANNSIZ or LABSIZ) multiplied by the line weight. Both ANNLWT and LABLWT have a default value of one. Values greater than one produce bolder characters, and values less than one produce lighter weight characters.

anssiz, labsiz, and ticsiz (floating-point parameter)

These parameters control the size of characters used for the annotations (ANNSIZ), labels (LABSIZ), and tics (TICSIZ) on all of the displays. Sizes are specified in inches; the default

values are 0.08 inch for ANNSIZ and TICSIZ, and 0.1 inch for LABSIZ. If ANNSIZ, LABSIZ, or TICSIZ is set to zero, the corresponding feature of the plot is eliminated.

WAVEFORM DISPLAY PARAMETERS

bits and **sign** (byte parameters)

BITS specifies the number of bits of precision in the A/D converter used to sample the waveform in the sampled-data file. Allowable values are 0, 8, 12, and 16. If **BITS** is set to zero (the default), then the number of bits will be determined automatically from the range of values in the waveform and the value of **SIGN** is ignored. If **BITS** is nonzero (8, 12, or 16), then the value of **SIGN** indicates whether or not the A/D values are signed: 0=NO (the default) and 1=YES.

rate (floating-point parameter)

RATE indicates the sampling rate of the sampled-data in samples/second. This value is overridden by the rate indicated in the sampled-data file, if present. The default value of **RATE** is 0. If a valid rate is not specified, the user will be prompted to enter a value for the rate at the keyboard.

head and tail (floating-point parameters)

swap (byte parameter)

If the input is a binary sampled data file with 16-bit integers and a format which is not recognized by SPECTO, then the data can still be read by SPECTO if the **HEAD**, **TAIL**, and **SWAP** parameters are set properly. **HEAD** indicates the number of bytes to be skipped at the beginning of the file, **TAIL** the number of bytes to be ignored at the end of the file and if **SWAP** is non zero, it indicates that the bytes within each integer should be swapped. The default values of **HEAD**, **TAIL**, and **SWAP** are zero.

prwave, waxis, and wlabel (byte parameters)

These parameters can be set to 0 (=NO) or to 1 (=YES). By default, they are equal to 1, meaning that the waveform, its axis, and its label are to be plotted. Setting all three parameters to zero eliminates the waveform plot entirely.

Setting one of these to zero turns off that particular feature. For example, when **PRWAVE** is set to 0, the waveform is not displayed, but the waveform axis and its label "waveform" are shown. When **WAXIS** is set to 0, the waveform axis line and ticks are not displayed, but the waveform itself and the label are plotted. When **WLABEL** is set to 0, this label is suppressed, but the waveform and its axis are displayed.

wlen (floating-point parameter)

WLEN controls the length, in inches, of the vertical or y axis of the waveform display. The default axis length is 1 inch; this allows sufficient space to plot the energy display and the spectrogram below the waveform.

wllc (floating-point parameter)

WLLC controls the vertical position, in inches, of the lower left corner of the waveform display. This point is where the waveform axis begins. The default value is 6.25 inches from the bottom of the page.

aswv (byte parameter)

ASWV controls the amplitude scaling of the waveform. When ASWV is set to 1 (=YES) the waveform scale factor will be increased so that the minimum and maximum values of the waveform completely span the vertical space set by WLEN. When ASWV is 0 (=NO), then the waveform scale factor is adjusted so that the full range of the A/D converter spans the vertical space. The default value of ASWV is 1.

invwav (byte parameter)

The default value of INVWAV is zero. When it is set to one, the display of the waveform is inverted (flipped vertically about the horizontal baseline).

rmdc (byte parameter)

When RMDC is set to 1 (=YES), the DC component (overall average value) is subtracted from the waveform. This affects the computation of the frequency spectrum and energy values when the DC component is nonzero. The default value of RMDC is 0 (=NO).

ENERGY DISPLAY PARAMETERS

prenrq, eaxis, and elabel (byte parameters)

These parameters can be set to zero (=NO) or one, and they equal one by default, meaning the energy display, its axis and its label "energy" are to be plotted. Setting all three parameters to zero eliminates the energy plot entirely, while setting one to zero eliminates only that feature.

When PRENRG is set to zero (=NO), the energy plot is not displayed, but the energy axis and its label are shown. When EAXIS is set to zero (=NO), the energy display is plotted without the left and right vertical axes and tick marks. When ELABEL is set to zero (=NO), this label is suppressed, but the energy plot and its axis are displayed.

elen (floating-point parameter)

ELEN controls the length, in inches, of the vertical or y axis of the energy display. The default axis length is 0.25 inch; this allows sufficient space to plot the waveform and the spectrogram on the same page.

ellic (floating-point parameter)

ELLC controls the vertical position, in inches, of the lower left corner of the energy display. This point is where the energy axis begins. The default value is 5.75 inches from the bottom of the page.

emin and emax (floating-point parameters)

These parameters specify the minimum and maximum levels of the energy display in decibels relative to the maximum possible energy. The default value for EMIN is -40, and the default for EMAX is 0.

eeeps (floating-point parameter)

EEPS specifies the number of times per second that the energy of the signal is computed for the energy display. The default value is 200 times per second or every 5 milliseconds.

SPECTROGRAM PARAMETERS

prspec (byte parameter)

The default value for PRSPEC is one, which means the spectrogram will be displayed. Setting PRSPEC to zero eliminates the spectrogram, but does not remove the axes, labels and annotations. To remove the spectrogram from the plot entirely, set all of the following parameters to zero: PRSPEC, FANNOT, FAXIS, FLABEL, GRID, TANNOT, TAXIS, and TLABEL.

fannot, faxis, and flabel (byte parameters)

These parameters control the appearance of the vertical frequency axis of the spectrogram. They can be set to one or zero, with one meaning the feature will be displayed and zero eliminating it. By default, these are set to one. Setting all three to zero removes the frequency axis and annotations from the plot.

Setting FANNOT to zero (=NO) removes the numeric labels for the major frequency intervals. The frequency axis, ticks, and label are displayed. When FAXIS is set to zero (=NO), the vertical axis and tick marks on the frequency display are not plotted. The label for the frequency display and the values of the major frequency intervals continue to be shown. When FLABEL is zero (=NO), the label "frequency, kHz" is removed from the plot.

grid (byte parameter) **and fgrid** (floating-point parameter)

When grid is zero (=NO), the horizontal lines marking frequency intervals are removed from the plot. The default value of grid is one (=YES). Use fgrid to specify the frequency intervals in Hz. The default value of fgrid is 1000.

tannot, taxis, and tlabel (byte parameters)

These parameters control the appearance of the horizontal time axis of the spectrogram. They can be set to one or zero, with one meaning the feature will be displayed and zero eliminating it. By default, these are set to one. Setting all three parameters to zero removes the time axis and annotations from the plot.

Setting TANNOT to zero (=NO) removes numeric annotations from the time display, which is the horizontal axis of the spectrogram. When TAXIS is zero (=NO), the time axis lines and ticks are deleted from the plot. The label "time" is removed from the plot when TLABEL is set to zero.

ylen (floating-point parameter)

YLEN controls the length, in inches, of the vertical or frequency axis of the spectrogram. The default frequency axis length is 4.5 inches to allow space for the waveform and energy displays to be plotted above the spectrogram.

yllc (floating-point parameter)

YLLC controls the vertical position, in inches, of the lower left corner of the frequency axis on the spectrogram. This point is where the frequency axis begins. The default value is 1.0 inch from the bottom of the page.

fmin and fmax (floating-point parameters)

These parameters specify the desired range of values for the frequency axis of the spectrogram. The minimum value cannot be less than zero and the maximum value cannot (by default) be greater than the Nyquist frequency (one-half the sampling rate). The default value for FMIN is 0, and the default for FMAX is 8000. The Nyquist frequency limit on FMAX can be disabled by setting NFLIM to zero.

foct (floating-point parameters)

If FOCT is positive, it indicates that the frequency axis will be logarithmic. If either FMIN or FMAX is zero then, FOCT also indicates the number of octaves to be represented by the frequency axis. The default value for FOCT is 0.

fpma, fpmb, and fpmc (floating-point parameters)

If FPMA and FPMB are positive, they specify a nonlinear frequency-to-place map for the frequency axis of the FFT spectrum. The place is computed according to the formula

$$\text{PLACE} = \text{LOG}_{10}(\text{FREQUENCY} / \text{FPMA} + \text{FPMC}) / \text{FPMB}$$

where PLACE is a fraction from zero to one and FREQUENCY is in hertz. This formula allows the specification of frequency-to-place maps which resemble the cochlea of many mammals. For example, the frequency-to-place map of the human cochlea can be represented with FPMA=0.1654, FPMB=0.021, and FPMC=0.990. The default value for FPMA, FPMB, and FPMC is 0.

nflim (byte parameters)

The value of FMAX is normally restricted to be no greater than one-half of the sampling rate. This frequency is known as the Nyquist frequency. The Nyquist frequency limit on FMAX can be disabled by setting NFLIM to zero. The default value of NFLIM is one.

tmin and tmax (floating-point parameters)

These parameters specify the range of values for the time axis of the spectrogram (as well as the energy and waveform displays) relative to the start of the sampled-data file. When the value of TMAX is zero it has the special meaning "until the end of the waveform". The minimum value cannot be less than 0 and the maximum value cannot be greater than the end of the waveform. The default value is zero for both TMIN and TMAX.

tpage (floating-point parameter)

If TMAX is positive and NEWPAGE is nonzero, then TMAX specifies the maximum time interval represented on each page of the spectrograph. For example, if the input file contains one second of sampled data and TMAX=0.1, then the output will consist of 10 pages with 0.1 seconds of data on each page. The default value is zero.

contrast and darkness (floating-point parameters)

These parameters control the contrast and darkness of the spectrogram. The default values are: CONTRAST = 0.5, DARKNESS = 0.5. Increasing the assigned value increases the corresponding feature; decreasing the value reduces the feature.

floor (floating-point parameter)

FLOOR provides an additional control on the contrast of the spectrogram. This parameter specifies the reciprocal of the minimum attainable intensity. The default value of FLOOR is 200. Setting FLOOR to a lower value will reduce the darkness of the lower intensity components of the spectrum resulting in a whiter background. Setting FLOOR to a higher value will darken the lower intensity components to reveal a greater range of spectral detail.

bandwidth (floating-point parameter)

The BANDWIDTH parameter specifies the approximate frequency analysis bandwidth of the spectrogram in hertz. The window width (in the time domain) is inversely proportional to the BANDWIDTH parameter. The window width also depends on the sample rate and the choice of window type (see WINDOW). The default bandwidth is 400 Hz.

ftpi, ftpw (byte parameter)

FTPI and FTPW limit the amount of overlap of successive analysis frames on which Fourier transforms are performed. Increasing these parameters will increase the number of Fourier transforms performed for a given spectrogram. The additional spectral information is obtained at the expense of additional computation time. FTPI specifies an upper limit on the number of

Fourier Transforms per inch and FTPW specifies an upper limit on the number of Fourier transforms per analysis window. The number of Fourier transforms performed is also limited according to the resolution of the graphics output device. The default values of FTPI and FTPW are 64 and 16, respectively.

hfemph (byte parameter)

HFEMPH controls whether or not the high frequencies are emphasized (by 6 dB/octave) in the spectrum. Setting HFEMPH to zero (=NO) usually results in loss of detail in the high frequencies of speech signals. The default value is one (=YES).

mfft (byte parameter)

MFFT determines the number of points (which must be a power of two) used in the Fourier transform computation. If MFFT is zero (the default), then the number of points will be chosen automatically to be at least twice the size of the analysis window. A positive value for MFFT specifies the power of two for the number of points. When the number of points in the Fourier transform exceeds the number of points in the analysis window, the excess values are set to zero.

agcsp (floating-point parameter)

AGCSP determines the amount of automatic gain control applied to each analysis frame when computing the spectrum. A value of zero means the average spectrum level will be proportional to the energy level in the signal. A value of one means that the average spectrum level will be constant (independent of variations in the signal level). AGCSP controls the variation in darkness of the spectrum with time. When AGCSP is one, the spectrum darkness will be independent of the energy in the waveform. The default value of AGSP is 0.5.

enrm (float parameter)

ENRM specifies the target energy value used when the automatic gain control parameter (AGSP) is nonzero. The spectrum level will be adjusted toward this target value. The default value of ENRM is 0.004.

window (byte parameter)

WINDOW indicates the type of analysis window function applied to each frame before the Fourier transform is computed. Allowable values are: 0=rectangular, 1=Hamming, and 2=Blackman (the default). These windows control the shape of the frequency-analysis filter. The rectangular window has the narrowest bandwidth, but the worst rejection of frequencies outside this band. The Blackman window has the widest bandwidth, but the best rejection of frequencies outside this band.

nlpc (byte parameter)

NLPC specifies the number of linear prediction coefficients to be used in the computation of a linear prediction spectrum. When NLPC is greater than zero, a linear prediction spectrum

replaces the normal spectrum. The default is zero (no linear prediction). A reasonable value for speech waveforms would be NLPC=20.

MESSAGE PARAMETERS

msgsiz (floating-point parameter)

This parameter controls the size of characters used for messages. The size is specified in inches; the default value is 0.1. If MSGSIZ is set to zero, the message is not displayed.

msgang (floating-point parameter)

MSGANG controls the angle at which a message is plotted, in degrees that move counterclockwise from the x (horizontal) axis. The default value is zero; the result is standard placement (left to right across the page). If MSGANG is set to 90, the message is oriented upward; at 180, the message is upside-down.

msglwt (floating-point parameter)

MSGLWT is a line weight parameter. The actual line width will be one tenth of the character size (MSGSIZ) multiplied by the line weight. MSGLWT has a default value of one. Values greater than one produce bolder characters, and values less than one produce lighter weight characters. When MSGLWT is set to zero, the message is eliminated.

mhal, mval (byte parameter)

MHAL controls the horizontal alignment of the message in relation to the specified message position. A value of 1 puts the left edge of the message, 2 centers the message, and 3 puts the right edge of the message at the indicated position. For example, if the message angle (MSGANG) is zero, the x coordinate of the message position is set to 5.5 (inches), and MHAL is set to 2, the message will be centered at 5.5 inches (the middle of the page).

MVAL controls the vertical alignment of the message in relation to the specified message position. The permitted alignments are: 1=TOP, 2=CAP, 3=HALF, 4=BASE (the default), and 5=BOTTOM.

mxtnt (byte parameter)

When MXTNT is set to one, a box is drawn around the message to indicate the extent of the message. The default value of MXTNT is zero.

List of Parameters

BYTE PARAMETERS

aswv	1	automatic scaling of waveform (0=NO)
bits	0	number of bits in A/D conversion (0=AUTO)
date	0	date and file name at bottom of display [0=NO]
eaxis	1	energy axis line and ticks (0=NO)
elabel	1	energy axis label (0=NO)
fannot	1	frequency axis annotation (0=NO)
faxis	1	frequency axis line and ticks (0=NO)
flabel	1	frequency axis label (0=NO)
ftpi	64	maximum number of Fourier transforms per inch
ftpw	64	maximum number of Fourier transforms per time window
grid	1	dots at 10 msec and 1 kHz intervals (0=NO)
hfemph	1	high-frequency emphasis by 6 dB/octave (0=NO)
invwav	0	invert waveform (0=NO)
mfft	0	power of 2 used as size of FFT (0=make FFT size at least twice the time window)
mhal	1	message horizontal alignment (1=left, 2=center, 3=right)
mval	4	message vertical alignment (1=top, 2=cap, 3=half, 4=base, 5=bottom)
mxtnt	0	outline the extent of each message (0=NO)
newpage	1	begin new page for each sampled-data file (0=NO)
nflim	1	enforces Nyquist frequency limit on value of fmax
nlpc	1	number of linear prediction coefficients
preng	1	print energy values at regular time intervals (0=NO)
prspec	1	print frequency spectrum for all times (0=NO)
prwave	1	print waveform as a function of time (0=NO)
rmdc	0	remove any DC component in the waveform (0=NO)
sign	0	A/D conversion values are signed (0=NO)
swap	0	swap bytes on input from custom binary file
tannot	1	time axis annotation (0=NO)
taxis	1	time axis line and ticks (0=NO)
tlabel	1	time axis label (0=NO)
waxis	1	waveform axis line and ticks (0=NO)
window	2	type of time window (0=rectangular, 1=Hamming, 2=Blackman)
wlabel	1	waveform axis label (0=NO)

FLOATING-POINT PARAMETERS

agcsp	0.5	automatic gain control for spectrum (0=none, 1=maximum)
annlwt	1	annotation line weight (scale factor)
annsiz	0.08	annotation size (inches)
axlnwd	0.01	axis line width (inches)
bandwidth	400	spectrograph analysis bandwidth (Hz)
contrast	0.5	contrast of spectrogram
darkness	0.5	darkness of spectrogram
eeps	200	energy evaluations per second

elen	0.25	energy axis length (inches)
ellic	5.75	energy axis lower-left corner (inches)
emax	0	energy axis maximum value (dB re max. energy)
emin	-40	energy axis minimum value (dB re max. energy)
enrm	0.004	target energy value for gain control (agcsp)
fgrid	1000	frequency grid interval (Hz)
floor	200	controls darkness of background detail
fmax	8000	frequency axis maximum value (Hz)
fmin	0	frequency axis minimum value (Hz)
foct	0	frequency axis number of octaves
fpma	0	frequency-to-place map parameter A
fpmb	0	frequency-to-place map parameter B
fpmc	0	frequency-to-place map parameter C
head	0	header size of custom binary input file (bytes)
lablwt	1	label line weight (scale factor)
labsiz	0.1	label size (inches)
msgang	0	message angle (degrees counter-clockwise from x axis)
msglwt	1	message line weight (scale factor)
msgsiz	0.1	message size (inches)
rate	0	default sampling rate (samples/sec)
tail	0	trailer size of custom binary input file (bytes)
ticsiz	0.08	tick size (inches)
tmax	0	time axis maximum value (seconds) (0=until end of waveform)
tmin	0	time axis minimum value (seconds)
token	0	token number for BTNI tokenfile
tpage	0	maximum time interval per page (seconds)
wlen	1	waveform axis length (inches)
wllc	6.25	waveform axis lower-left corner (inches)
xlen	9	time axis length (inches)
xllc	0.75	time axis lower-left corner (inches)
xpage	11	maximum page length (inches)
ylen	4.5	frequency axis length (inches)
yllc	1	frequency axis lower-left corner (inches)
ypage	8	maximum page height (inches)

Error Messages

"Bit block allocation error"

"No room to add text: %s"

Not enough memory is available to add the indicated message. Memory is required to bitmap each message and is released when the message printing is complete.

"Warning: bit block off page"

A message (or other text) is positioned such that part of it goes beyond the limits of the page.

"PC must have CGA, EGA, VGA or HGC"

The program tried to output to the PC console, but it could not detect the presence of a graphics adaptor. Use the -P option to specify the type of graphics adaptor (if present) or the type of printer.

"can't open %s"

An "sdf" line was encountered in the parameter file, but the indicated sampled-data file could not be found.

"ERROR(%s): x=%.1f and xllc=%.1f"

Something is beyond the left margin of the page. Check the value of xllc.

"can't open output file %s"

There was a problem opening the indicated file for output.

"can't open parameter file %s"

The indicated parameter file could not be found.

"WARNING: don't have arg #%d"

The indicated argument number was referenced in the parameter file, but was not present on the command line.

"Invalid printer selection: %d"

"Overlay pointer initialization error"

"Bit mask initialization error"

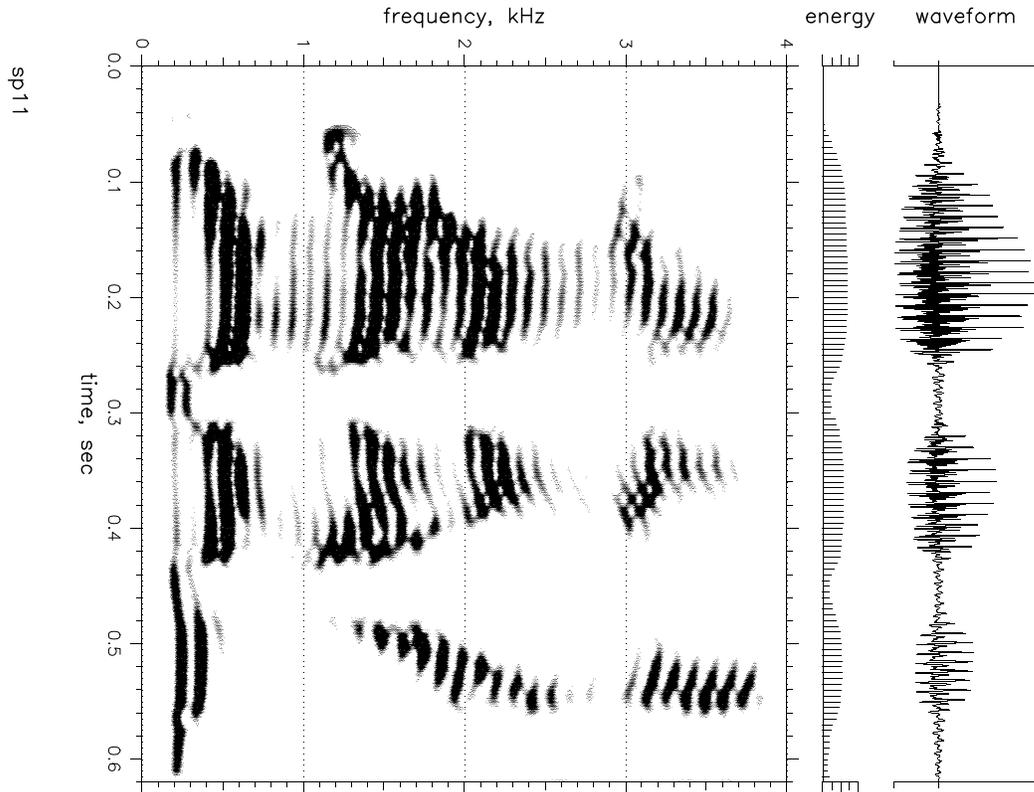
"Invalid character orientation"

"Overlay %d has null pointer"

Programming errors. Shouldn't happen.

Examples

```
; jasa79.spc  
;  
bandwidth=80  
contr=1  
dark=1  
floor=8  
xllc=3  
xlen=5  
tmax=0.62  
grid=1  
newpage=1  
sdfile sp11.ils
```

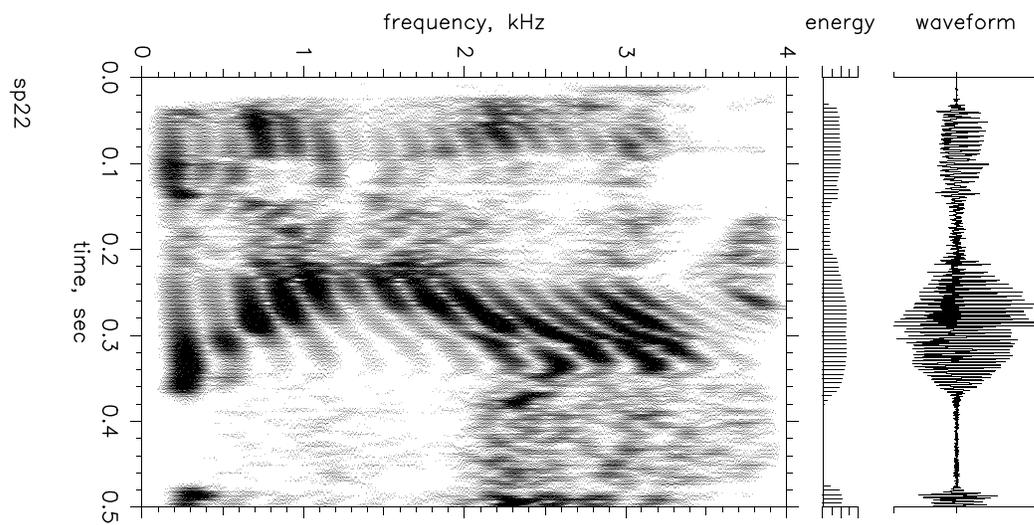
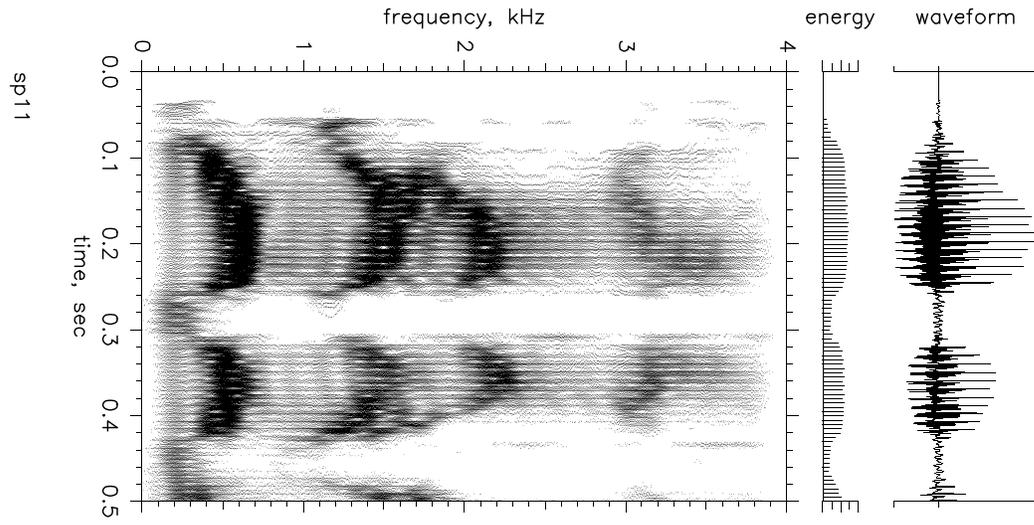


```
; 2pan.spc - example of two panels on one page
;
annsiz=0.1
bandwidth=200
newpage=0
grid=0
xlen=3.0
tmin=0.0
tmax=0.5
mhal=1
mval=5

xllc=1.0
1.0 0.1 "sp11"
sdfile sp11.ils

xllc=5.0
5.0 0.1 "sp22"
sdfile sp22.ils

newpage=1
```



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