

NAME

peel – exponential peel analysis

SYNOPSIS

peel [runfile]

DESCRIPTION

Peel performs exponential peel analysis on a trace from a run file, as created by *cap*(1), *cavg*(1), or *analysis*(1). It allows you to find the two time constants associated with the decay of the hyperpolarising or depolarising pulse of that trace, as well as the electrotonic length. The traces are read from the specified *runfile* and displayed. If no *runfile* is specified, you will have to select one later. For this analysis, it is best to use runs of averaged data.

At the bottom of the display, *peel* prints the following menu prompt line:

```
Bin-select Cal-pulse Exp-peel File-select Go Interpolate Plot Quit Smooth Titles X-bounds  
Y-bounds
```

An operation is initiated by typing a single letter, the first letter of an item in the menu line. You can also step through the menu using the space bar and the backspace (or erase) key, to highlight the item you want, then press RETURN to select that item.

Bin-select

This selection allows you to pick one of the bins (frames), from the current *runfile*, to be used in subsequent operations. If no file has yet been selected, you will be prompted for one, as for *File-select* below.

You are then prompted to enter a bin number, which must be in the range indicated in the prompt. If you enter a valid bin number, the selected trace from that bin (frame) will be displayed on the screen. If no input is entered, or an invalid bin number is specified, nothing will change, i.e. a new bin will not be selected.

Cal-pulse

This selection allows you to measure the height of the calibration pulse of a selected trace. This will allow the program to determine the voltage associated with data points on the trace. If no bin has yet been selected, you will be prompted for one, as described in the section for *Bin-select* above.

The selected trace is then displayed on the screen, and you are prompted to set markers at the base and peak of the calibration pulse. *Peel* takes an initial guess at these positions and displays markers there. To set the markers elsewhere, use the pointing device to move the cursor to the desired position on the trace, then press either button **A** to set the baseline marker to the X coordinate of the cursor, or button **B** to set the peak marker. Press button **C** or **D** when you are done.

You are then asked for the calibration pulse level, in microvolts. If a level had previously been entered, it will be shown as the default in the prompt. Note that the level must be given in microvolts, thus for a 2 millivolt calibration pulse, you would enter the value **2000**.

Exp-peel

This selection allows you to perform exponential peel analysis on a selected trace. If no bin has yet been selected, you will be prompted for one, as described in the section for *Bin-select* above. Also, the calibration information is required at this point. Thus, if the selected file contained no calibration information, and you have not set the calibration information explicitly, using the *Cal-pulse* operation, then you will be required to do so now, using the procedure outlined in the section above.

Next, a baseline (or reference point) must be selected. This is done by using the pointing device to move the cursor to the desired position on the displayed trace, then pressing button **A** to set a marker to that position. The baseline will be the level of the trace at the selected point. Once you are satisfied with the selected baseline, press button **D** to indicate that you are done.

Next, you are prompted to select the sample range to be analysed, which should be the decay portion of the hyperpolarising or depolarising pulse. Again, you use the pointing device to move the cursor to the desired position on the trace, and press button **A** to set the START marker, button **B** to set the END

marker, or button **D** when done.

If the **START** point is below the baseline point, a hyperpolarising pulse is assumed, and the data will be inverted. The selected sample range is now displayed on a semi-log graph. The X axis represents time in milliseconds, and the Y axis represents displacement from the baseline in millivolts, on a logarithmic scale. You are then prompted to set start and end markers on the graph. Use these to select a portion near the end of the graph that seems almost linear. Once both markers have been set, *peel* will fit a least-squares line through the selected range of points, and display the slope, intercept, correlation coefficient, and time constant. The markers can still be changed, and each time one is changed, the statistics are recomputed. Setting the markers is accomplished the usual way: using the pointing device to move the cursor, and pressing buttons **A** and **B** to set the start and end markers, respectively. Once you are happy with the generated least-squares line, press button **D** to go on.

The program then *peels* off the exponential, i.e. it subtracts the exponential curve, corresponding to the displayed least-squares line, from the original data, and draws the results on the graph. The above procedure is then repeated on these new data. A portion of the plot is selected, and a least-squares line fitted to it, in order to obtain the second time constant. After button **D** has been pressed, the program peels off the second exponential, and draws the results. It also displays, at the top of the graph, the electrotonic length and the two time constants, as well as the two intercepts and their ratio.

File-select

This selection allows you to choose a new *runfile* and trace number to be displayed. You are prompted to enter the name of the file. Type in this name, then hit RETURN. If the file is a valid *runfile*, and its bins (frames) each contain more than one trace, you will also be prompted for a trace number. If a valid trace number is specified, or if there is only one valid trace number, that trace will be displayed for each bin.

Go

This selection redisplay the last graph that was shown, provided that a file is selected, and a completed graph is ready to be redisplayed.

Interpolate

This selection allows you to set the *interpolation* option. If this option is enabled, the data points of the displayed traces will be connected by line segments. If disabled, only the data points are displayed. Initially, this option is disabled.

Plot

This selection brings you to the plotting sub-system, which presents you with a secondary menu. See *PLOTTING* below.

Quit

This selection causes the program to terminate.

Smooth

This selection allows you to smooth the data in the current trace, using a low-pass filter. This operation is optional, and must be invoked explicitly, i.e. it will not be performed automatically by any of the other operations. Also note that this operation is undone by the *Bin-select* operation, even if the same bin number is specified, since the original data, as they were in the file, are selected.

If no bin has yet been selected, you will be prompted for one, as described in the section for *Bin-select* above.

You are then prompted to enter a cutoff frequency, in Hertz. The default frequency will be one third of the sampling rate, which results in only slight smoothing. Entering lower cutoff frequencies will result in more drastic smoothing. Specifying too high a cutoff frequency will yield nonsense results, due to a phenomenon known as "ringing." You should thus avoid frequencies higher than the default. Once the filtering is complete, the new trace will be displayed.

The filtering algorithm used is a "Second-order, zero-lag Butterworth filter," which filters in two passes to eliminate phase-shift distortion.

Titles

This selection allows you to set the *top-title* option. If this option is enabled, the two title lines, at the top of graphs, will be displayed. If disabled, the lines are omitted, and the graph is slightly expanded to use up the extra space. Initially, this option is enabled.

X-bounds

This selection allows you to set limits on the length of the X axis for the exponential peel graph. Normally, the length of the X axis is automatically adjusted to fit the selected range of data. You are allowed to restrict the length to a certain range, or set a fixed length.

You are first prompted for the minimum X axis length, in milliseconds. The current minimum is shown as the default. The X axis will be at least as long as the length you specify. You are then prompted for the maximum X axis length, in milliseconds. The current maximum is shown as the default. The X axis will be no longer than the length you specify. By specifying the same value for the minimum and maximum, you will fix the length of the X axis at that length.

The X bounds may be set at any time. If they are set when the exponential peel graph is being displayed, then the graph can be redisplayed by selecting *Go* from the menu.

Y-bounds

This selection allows you to set the upper and lower bounds of the Y axis for the exponential peel graph. Initially, these bounds are 10 millivolts and 0.1 millivolts, respectively.

You are first prompted to enter the lower bound of the Y axis. The current value is shown as the default. Any positive value may be entered; it need not be a power of ten. You are then prompted to enter the upper bound of the Y axis. The current value is shown as the default. The value you enter should be greater than the lower bound, but probably not more than 1000 times greater. Again, it need not be a power of ten.

The Y bounds may be set at any time. If they are set when the exponential peel graph is being displayed, then the graph can be redisplayed by selecting *Go* from the menu.

!command

Whenever the menu line has just been printed, instead of typing a letter to select a menu item, you can type an exclamation point, followed by any UNIX command, then hit RETURN. A UNIX shell is invoked to interpret and execute this command. You can recall and edit the last command entered, by hitting the "up arrow" key, or Control-K, after typing the exclamation point.

\$ or %

Whenever the menu line has just been printed, you can also type either a dollar sign (\$), to invoke an interactive Bourne shell, or a percent sign (%), to invoke an interactive C shell. In either case, the shell will continue accepting commands until you type a **Control-D**, to exit from the shell, and return to *peel*.

? or /

Whenever the menu line has just been printed, you can also type either a question mark (?), or slash (/), to get a short description of all choices available in the current menu.

PLOTTING

The *Plot* selection is used to produce a plot similar to what would be displayed on the screen by the *Go* operation. A new menu is presented, allowing you to change certain plotting parameters. The choices are:

Axes Data File Interpolation Markers Plotter Quit Screen Text Video

Selections are made by typing the first letter of an item in this menu.

Axes, Data, and Markers

These selections allow you to change the pen numbers used to plot axes, data points, and markers, respectively. You will be prompted to enter a pen number, an integer from **0** to **8**. The three pen numbers are initially set to **1**. Selecting pen number 0 suppresses plotting of those items.

File

This selection allows you to store the HPGL commands used to plot the graph in a file. You will then be able to plot this graph, at a later time, by invoking *hardcopy*(1). You will be prompted to enter the file name. If you enter a file name, the graph will be stored in this file. If the file already existed, it will be overwritten.

Interpolation

This selection allows you to change the plot interpolation option. If this option is enabled, the data points of the plotted graph will be connected by line segments. If disabled, only the data points are plotted. This is similar to the "Interpolate" option for the screen display, but is maintained as a separate option because it is common to want interpolation enabled for plotting, but not for the screen display.

Plotting with interpolation enabled allows the plotter to work much faster, with less wear on the pen.

(Note that, in either case, interpolation will not be performed on the data points in the exponential peel graph.)

Plotter

This selection allows you to plot the graph directly to the plotter. The *hardcopy* program is invoked to plot the displayed graph. Before beginning this operation, make sure the plotter is powered up, on-line, and that a clean sheet of paper has been loaded. Also make sure the plotter's *autoload* option is enabled.

Quit

This selection returns you to the previously displayed menu.

Screen

This selection allows you to change the screen redraw option. If this option is enabled, the graph will be redrawn on the screen while it is being sent to the file or the spooler. If disabled, the current contents of the screen will remain, while the plot is generated.

Text

This selection allows you to change the plot text option. If this option is disabled, the generated plot will not contain any text; all titles and labels will be stripped from it, leaving only the axes, tick marks, data points, etc. This is useful when the plot is reduced in size to the point where the text would be illegible. If enabled, the generated graph will be complete with all titles and labels.

Video

This selection does not affect the pen plotter, but instead produces a printed copy of the video display's current contents – a screen dump – by invoking *sdump*(1). The same thing can be accomplished by pressing the *quit* key, normally **Control-B**. The *Plot/Video* operation has the advantage that it can be used even when the program is reading its commands from a file, rather than the terminal. Also, the *Plot/Video* operation clears the menu area before performing the screen dump.

X WINDOW SUPPORT

When the X Window version of this program is run on an X Window terminal, a new window will be shown for displaying program output. Unless the input was redirected from a file, it will be taken from the keyboard when this window is the "input focus", i.e. the active window. When running this way, it is essentially detached from the *xterm* window from which you run the command, and it can be run in the background.

As for most other X Window programs in this package, the following X command line options are accepted:

–cursor num

You can specify any cursor number (not cursor names) in the Standard Cursor Symbols described in the *X Window System User's Guide* using the **–cursor** or **–curs** option. The default value is 68, the left pointer symbol. This can also be specified using the **CURSORS** environment variable.

–display [host]:server[.screen]

By default, the host, server and screen, which identify your X terminal, are obtained from the environment variable **DISPLAY**. However, you can also specify them using the **–display** or **–disp**

option. The *host* is the name of the machine or terminal, on which the window is to be created, *server* is the server number, and *screen* is the screen number (default is 0).

-fn *font*

You can specify any fixed-width font to be used for text display using the **-fn** or **-font** option. The default value is **9x15** if the window is at least 900 pixels wide initially, and **fixed** otherwise. This can also be specified using the **SCRFONT** environment variable.

-geometry *geometry*

By default, the program will create a window that covers most of the display. However, you can specify custom window dimensions and location using the **-geometry** or **-geom** option. The format of the *geometry* string is described in the *X Window System User's Guide*. This can also be specified using the **GEOMETRY** environment variable.

-iconic

This option will cause the program to start up in an iconified state, which can be reactivated by double-clicking on the icon.

-rev This option will cause the program to use reverse video in its display window.

-title *name*

This option will change the name shown on the window's title bar, which is usually just the program name. It can also be given as **-name** *name*.

NOTES

Peel should be run from a graphics terminal, or X terminal, in order to view generated graphs. It can be run from other types of terminals, to plot out graphs, but no graphs will be generated on screen.

SEE ALSO

cap(1), cavg(1), analysis(1), hardcopy(1), sdump(1)