JPsmartConcPanel Manual

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November 5, 2018

Contents

1 Installation

Note: file and folder names are in quotes to help minimize confusion with long names.

First, unzip the "td analysis.zip" file provided and make either aliases (macOS) or shortcuts (Windows) of both the "td analysis" folder and the "link to igor procs" folder contained within.

Igor makes a folder called "Wavemetrics" that can be found in either your "Documents" (macOS) or "My Documents" (Windows) folder. Inside this folder there are two additional folders named "Igor Procedures" and "User Procedures." Move the "link to igor procs" alias you created previously into the "Igor Procedures" folder. Similarly, move the "td analysis" alias you created into the "User Procedures" folder.

Next, go back to the "td analysis" folder and open the "link to igor procs" folder. Copy the files "IVtiming.txt" and "CLsettings.txt." Move the copies to the "Igor Procedures" folder inside the "Wavemetrics" folder (inside your "Documents" folder). Rename the copied files to remove the 'copy' and the space before 'copy' and ensure the names are exactly "IVtiming.txt" and "CLsettings.txt"—capitalization is important.

Note: the "Igor Pro" folder in the Applications folder contains folders with the same names as above but these should NOT be modified. Instead, make sure all modifications are done in the "Wavemetrics" folder in either the "Documents" or "My Documents" folder.

Finally, before using JPsmartConcPanel, you must first ensure that the routines have been compiled and loaded. To do this, open the Macros menu. If you see an option named "Compile," click it. Then, an option to "Load TD Analysis" should appear—click this. Note: this may take a few seconds to complete. Once this has finished, you should be able to select JPsmartConcPanel from the Macros menu, which will create the JPsmartConcPanel panel.

Once you have clicked "Load TD Analysis," an additional option "Unload TD Analysis" will appear in the Macros menu—you may use this at any time to remove all routines associated with TD Analysis from the Macros menu. If you do this, you can simply run "Load TD Analysis" again to bring it back if desired.

2 Overview

JPsmartConcPanel provides a more streamlined method of combining numerous peak time base waves (ptbs) and performing various analyses on the resulting wave. The JPsmartConcPanel interface has three primary tools: Smart Concatenate, Vary Burst Window, and Cluster, each of which will be described in their respective sections. Additionally, JPsmartConcPanel has a number of other minor features and tools which will be described in the "Miscellaneous Tools and Features" section.

3 Smart Concatenate

Smart Concatenate is the primary workhorse behind JPsmartConcPanel. It takes any number of selected ptbs and concatenates each chronologically to form a more condensed version of the original data which can then be used to run Cluster, Vary Burst Window, and all other analyses found within JPsmartConcPanel. At this time, JPsmartConcPanel requires both the ptb waves generated from event detection as well as the raw data waves to be present in the experiment. All controls directly relating to the use of Smart Concatenate are located under the tab labeled "Smart Concatenate."

3.1 Selecting Desired ptbs

Once you have opened an experiment containing both the aforementioned ptbs and raw data waves and opened the JPsmartConcPanel panel, you should see all present ptbs displayed in the box in the upper left corner of the panel. If not, or if at any point you have added, removed, etc. any ptbs, the button labeled

"Update" can be used to refresh this box's contents. You can select any number of ptbs from this list. Multiple ptbs can be selected for use by shift-clicking. Additionally, the button labeled "Select All" will select all ptbs listed within the box.

3.2 Smart Concatenate Options

There are a few options that allow you to modify Smart Concatenate's behavior. First, the boxes labeled "Before" and "After" can be used to adjust the time before and after each event to save, respectively. Similarly, the box labeled "Gap size" allows one to set the threshold below which gaps between ptbs will not be marked on the graph. The box labeled "Bin" allows the user to specify the bin duration to be used. When checked, this will generate an additional graph when Smart Concatenate is run which displays the number of events per bin. When unchecked, this value has no effect on the operation of Smart Concatenate and will not produce the bin graph. Note that one must run Smart Concatenate with binning enabled to use Cluster unless you wish to manually specify your own wave.

3.3 Running Smart Concatenate

Once the desired ptbs have been selected and options set appropriately, press the button labeled "Smart Conc" to run Smart Concatenate.

3.4 The Smart Concatenate Graph

Once Smart Concatenate has been run, the main graph window will be populated with the Smart Concatenate graph. An example is shown in Figure 1. The red trace is the wave created by concatenating the selected ptbs. Gaps between ptbs larger than the duration given by the value in the box labeled "Gap size" are marked in cyan. If binning was enabled, a histogram denoting the number of events per bin will be graphed below. Bins which overlap with the aforementioned gaps between ptbs are marked in red.

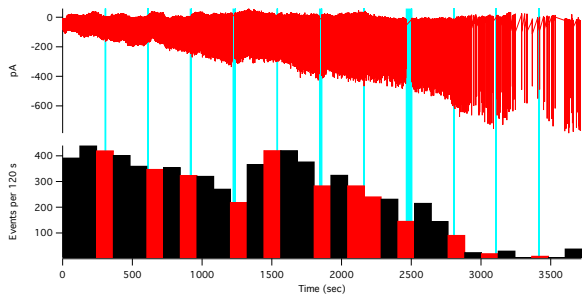


Figure 1: Smart Concatenate with binning enabled

4 Vary Burst Window

Vary Burst Window detects the number of bursts (and other related parameters) for each burst window within a given range, allowing one to see how the number of bursts, etc. changes as the burst window does. All controls directly related to running Vary Burst Window are located on the tab labeled "Vary Burst Window." Vary Burst Window requires only that Smart Concatenate has already been run.

4.1 Vary Burst Window Options

Vary Burst Window's operation is controlled by a handful of parameters that one can set. The boxes labeled "Burst window start" and "Burst window max" are used to set the upper and lower bounds, respectively, of the range of burst windows Vary Burst Window will use. Note that the range is inclusive at both ends. The box labeled "Increment" specifies the increment used to select burst windows. For example, to have Vary

Burst Window consider all burst windows in 10ms increments between 0 and 2 seconds, one would set the start, max, and increment to 0, 2, and .01, respectively. The "Num. intervals" box describes the number of burst windows Vary Burst Window will consider. Note that these parameters are largely tethered together. If start and max are changed, the number of intervals will automatically be changed to reflect the new range and increment pairing. Similarly, if either the increment or number of intervals are directly changed, the other will be adjusted accordingly.

4.2 Single and Multi-Region Vary Burst Window

Vary Burst Window allows one to either consider the wave created by Smart Concatenate as a whole or separate it into regions to be treated separately. To consider the wave as a whole, ensure the radio button labeled "Use one region" is selected. To use multiple regions, ensure the radio button labeled "Use region table info" is selected. Then, use the table just below these buttons to specify the ranges (in seconds) to be used for each region. An arbitrary number of regions of arbitrary durations can be used. Use "inf" as the end value to extend a region to the end of the recording. Additional regions can be added by typing in the grey boxes. An example of Vary Burst Window with and without regions can be seen in Figure 2.

4.3 Running Vary Burst Window

Once Vary Burst Window's various options have been satisfactorily set, press the button labeled "Make VBW Graph" to run Vary Burst Window.

4.4 Vary Burst Window Output

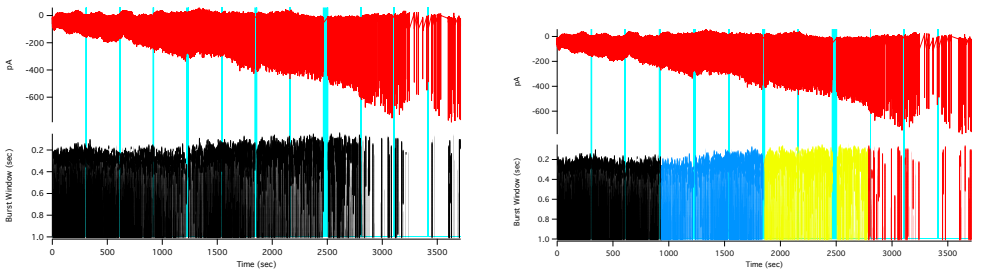
Running Vary Burst Window will generate a city plot on the primary graph. If regions were specified, they will be color-coded accordingly. Additionally, Vary Burst Window outputs the following parameters for each burst window:

- The number of bursts (bn)
- The mean burst duration in seconds (mbd)
- The number of spikes per burst (spb)
- The burst frequency in hertz (bf)
- The number of single spikes (ssn)
- The frequency of single spikes in hertz (ssf)
- The frequency of events in hertz (tf)
- The interevent interval in seconds (inter)
- The intraburst interval in seconds (inter)

The Vary Burst Window graph on the Output tab (graphing each of the above parameters as a function of the burst window) will be available for use—see the "Output Tab" section for details. Finally, table forms of these graphs can be obtained by pressing the button labeled "Make VBW Tables."

5 Cluster

Cluster operates on a wave containing binned data of the number of events over time and outputs a number of parameters related to the occurrence of peaks and nadirs within the data. All controls directly related to running Cluster are located under the tab labeled "Cluster."



(a) Vary Burst Window with no regions (b) Vary Burst Window with four regions

Figure 2: Vary Burst Window primary graph

5.1 Cluster Parameters and Settings

5.1.1 Selecting a Wave

By default (and whenever the radio button labeled "SC w/ binning wave" is selected), Cluster will use the wave generated by running Smart Concatenate with binning enabled. As such, in order to use Cluster in this mode one must first run Smart Concatenate with binning enabled as described above. After this is done, no additional work is needed to direct Cluster to the appropriate wave.

If you wish to manually specify the wave for Cluster to use, you may do so by selecting the radio button labeled "Insert Own Wave." Then, to select the wave, click the button with the downward facing arrow to the right of the box labeled "Select a wave." This will display a data browser from which you can choose your desired wave—you may have to expand the root folder to see any of your waves. Once a wave has been selected, it will be graphed on the primary display on the panel. Again note that, while the interface will accept any wave, Cluster expects binned data of the number of events over time.

5.1.2 Input Parameters

To change the number of points for a peak, T-Score increase, etc., that will be used when Cluster is run, simply enter the desired value in the box to the right of the parameter you wish to change.

5.1.3 Choosing an Error Type

To select the error type to be used, one must use the radio buttons near the bottom-left corner of the panel. For the square root and fixed value options, you can additionally specify the zero or fixed value you would like to use by entering the value in the box to the right of the appropriate radio button. To specify the error wave to be used, follow the same general steps as selecting the initial wave.

5.2 Running Cluster

Once a wave has been selected and input parameters have been set accordingly, press the button labeled "Calculate" to run the Cluster analysis.

5.3 Results

5.3.1 Graph

When Cluster is run, the primary graph will be updated similar to Figure 3. Yellow vertical bars indicate peaks detected by Cluster will appear on the primary graph. You can also choose to display graphs of the T-Score and ups/downs by checking the appropriate boxes in the top left corner of the panel before running Cluster. If you choose to display the graph of the T-Score, you can also choose the scaling of this graph through the "Autoscale T-Score" option. If selected, the graph will display the full range of the T-Score

data—otherwise, the maximum and minimum limits for the graph will be set at the values provided for "T-Score Increase" and "T-Score Decrease," respectively.

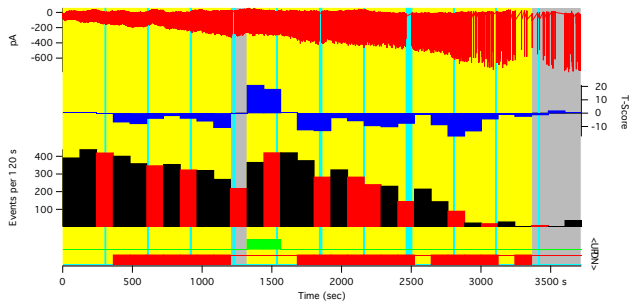


Figure 3: Cluster output graph with all optional graph elements shown

Additionally, the output parameters described below will be graphed on the Output tab—please see the "Output Tab" section for usage instructions. Unless you are also using the Monte Carlo functionality, these graphs will likely be of little or no use as they provide no more information than what can be found in the output table.

5.3.2 Settings and Results Tables

Each time Cluster is run, a new row corresponding to the run will be inserted in each of the two tables just below the primary display. The top table displays the various results and statistics from each Cluster run while the bottom table shows the settings used for the run. The number of peaks and number of nadirs detected by Cluster are also displayed just beneath the "Calculate" button.

Cluster's outputs the following parameters, each of which can be found in the results table:

- The name of the wave containing the information used to graph the peaks (pulsewn)
- The name of the wave Cluster used (datawn)
- The duration of the recording in seconds (dur)
- The frequency of peaks in peaks/hour (freq)
- The number of peaks (#Peaks)
- The number of nadirs (#Nadirs)
- The mean peak duration, given in terms of the number of bins (meanPeakDur)
- The duration of all peaks combined, given in terms of the number of bins (totalPeakDur)
- The mean nadir duration, given in terms of the number of bins (meanNadirDur)
- The duration of all nadirs combined, given in terms of the number of bins (totalNadirDur)
- The mean number of events for a bin among all bins found within a peak (meanPeakAmpPeak)
- The mean number of events for a bin among all bins found within a nadir (meanNadirAmpPeak)

Regarding the settings table, note that the error type is listed as a number 1-7. "Global SD" is denoted by 1, "Global SE" by 2, "Local SD" by 3, etc. Similarly, the column labeled "Options" will display either nothing, the zero value, the fixed value, or the name of the error wave used depending on which error type was selected.

5.4 Using the Settings and Results Tables

In addition to displaying the results and settings for each run, these tables are used to provide additional facilities for changing and saving the parameters used.

5.4.1 Using Parameters from the Settings Table

The settings table can be used to update the parameters on the left side of the panel that will be used when Cluster is next run. To do this, select any cell in the row of settings you wish to use. Then, press the button labeled "Use Table Settings."

5.4.2 Storing and Clearing Tables

If you would like to make copies of these tables or save them, you can do so by using the button labeled "Store Results."

If you wish to clear the tables within the panel, you can do so by using the button labeled "Clear Results." If there is any data in these tables when you either attempt to clear the table or close the JPsmartConcPanel panel, you will first be prompted if you would like to store these tables.

5.5 Storing and Loading Parameters

Parameters can also be stored to and loaded from a file to help streamline the process of using the same parameters across multiple different experiments, etc.

5.5.1 Storing Parameters

To save parameters, first select any cell in the row of settings you wish to save, as above. Then, use the "Store Params" button. You will be prompted to provide a name (used to help you quickly identify each group of settings) and asked whether you would like to save these parameters in the default location. If you choose to use the default location, these parameters will be stored in a file in the "Igor Procedures" folder (in the "Wavemetrics" folder) created by Igor. Otherwise, you will be prompted to either create a new file or select an existing file for use.

If you choose to use an existing file (presumably one you created previously to store other parameters), Igor will warn you that the file will be overwritten. In this case **ONLY**, you can assume that it will not do so and are free to click replace—you can safely store multiple sets of parameters in the same file.

5.5.2 Loading Parameters

To load parameters, use the button labeled "Load Params." You will be asked whether you would like to load parameters from the default location (the location mentioned above)—if you select no, you will be asked to locate the file where you would like to load parameters from. Once you have selected a location, you will be presented with a panel similar to that shown in Figure 4. To choose which group of settings you would like to use, select any cell in the row you wish to use and press the "Use Selected" button. The parameters on the left side of the panel will now reflect those you loaded.

6 Miscellaneous Tools and Features

6.1 Output Tab

The Output tab contains two additional graph windows used to graph various output parameters from Vary Burst Window and Cluster. The top graph and associated box display the output parameters from Vary Burst Window as a function of the burst window. Additionally, there is an option to display a log graph of the intervals. Examples of the Vary Burst Window Output tab graph can be seen in Figure 5. The bottom graph and box displays the output parameters for Cluster. Unless used in conjunction with the Monte Carlo

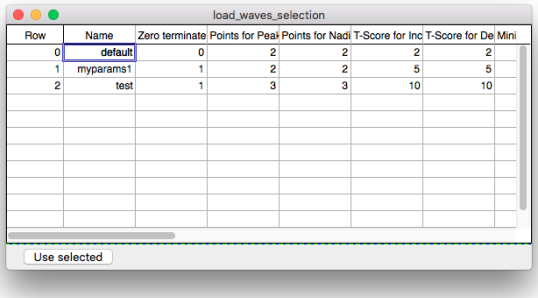
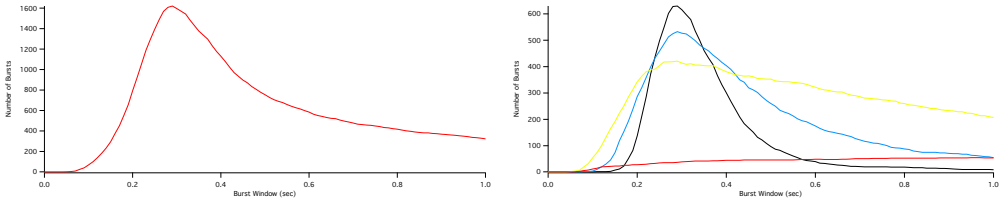


Figure 4: Window to select the group of parameters to load

routines, this graph for Cluster will likely be of little use. To display the graph for a given parameter, click the parameter of interest and the associated graph will be shown. For a discussion on what each parameter is, see the "Vary Burst Window" or "Cluster" section, as needed.



(a) Vary Burst Window ran with no regions (b) Vary Burst Window ran with four regions

Figure 5: Vary Burst Window output graph of number of bursts as a function of the burst window

6.1.1 Output Tab and Monte Carlo

The graphs on the output tab are especially helpful for visualizing the results of the built-in Monte Carlo routines. After running MC VBW or MC Cluster, the check boxes on the right side of the panel allow you to choose to display the results from the original data (the one created by first running Smart Concatenate) and/or the results from the Monte Carlo runs. The"Show MC runs" option determines whether MC results are graphed. The option "Show all MC runs" determines whether to display all MC runs or only the one listed in the box labeled "Show run."

Any given trace on the Vary Burst Window output graph is just the chosen parameter as a function of the burst window with the original being red and any MC VBW results being black. However, Cluster either shows the value of the selected parameter for the original data (again shown in red) and a value from a single selected MC run (in black) or the value of the selected parameter for the original data and the frequency distribution for the output parameter across all MC runs.

6.2 View Settings

The View Settings tab provides some rudimentary tools for reorganizing the primary graph's layout. Each graph element can be assigned a range which it will occupy from [0,1], with 0 being the bottom of the graph and 1 being the top. So, to make an element occupy the bottom quarter of the display area, one would assign begin and end values of 0 and .25, respectively. The button labeled "Apply" simply applies any changes you may have made. The check box labeled "Retain view settings," if checked, will prevent the graphs from being re-sized if Smart Concatenate is re-run, or any additional graphs are added. The "Restore Defaults" button simply returns these ranges to their default values.

6.3 Graph Tools

The "Reset Zoom" button can be used to reset the main graph's scaling back to the default.

To access the full list of options for exporting graphs created within the interface, you first will have to replicate the graph. The button "Rec. graph" will create an external copy of the graph that can then be saved in additional formats.

6.4 Monte Carlo

Note: The Monte Carlo (MC) routines were written as part of a project to investigate whether there seems

to be a "special" or otherwise non-random pattern to a cell's activity. The base MC routine takes the wave created by running Smart Concatenate and shuffles the interevent intervals to create random "runs" of data which we can then feed into Cluster and Vary Burst Window to develop a point of comparison for determining whether our original data appears to be random or not.

6.4.1 Running Monte Carlo

To run the Monte Carlo routines, first set the desired number of runs using the box labeled "Num. runs." Then, assuming Smart Concatenate has already been run, click the "Run" button—this generates the randomized runs. To run Vary Burst Window and/or Cluster on each of these randomized runs, first ensure that you have ran the analysis on the original data, then press the "Run MC VBW" or "Run MC Cluster" buttons, respectively. The MC versions of each of these will use those same input parameters used as when they were run on the original data.

6.4.2 Viewing Monte Carlo Results

Outside of the Output tab, individual runs and the results of the analyses ran on them can be seen by using the "Show shuffled analyses" box to hide or show the individual runs. The "Show run" box can be used to select which run, if any, to display. If displaying both the shuffled and original analyses, you can change the orientation of the graphs using the radio buttons labeled "Horizontal" and "Vertical."

Within the output tab, the MC specific functionality described within the "Output Tab and Monte Carlo" is now available for use.

6.4.3 Exporting Monte Carlo Data

As much of the analysis for this project happened outside of Igor, the two buttons "Exp. MC CL" and "Exp. MC VBW" can be used to export the data from MC Cluster and MC VBW, respectively, in .tsv format to be used elsewhere.