PQLX Client-Side Programs

Introduction

Once a server instance has been started, the PQLX system client application **pqlx** may be executed. This document is a quick usage guide and overview of the functionality provided by the following programs:

1. pqlx – GUI program to visualize database data
2. pqlxPNG – program to produce PNG plots of System and User PDFs

pqlx

The client program **pqlx** is the GUI interface used to read and visualize time- and frequency-domain data stored in the PQLX database. Time-domain data (i.e., trace files) may be either files that have been analyzed by the server, or trace files on disk that have not been analyzed (via Trace Viewer).

Startup

To execute pqlx:

bash> $PQLXBIN/pqlx

will start and render the GUI interface to the screen.

Available Data Display Systems

Via the pulldown menu in the upper left-hand corner of the screen or the keys F1, F2, or F3, three data display systems are available:

- **Trace Viewer** - view trace data in detail (this does not utilize a connection to a PQLX database)
- **PSD Viewer** - view PDF and Spectrogram plots of PSD data stored in a PQLX database
- **STN Viewer** - view trace data and its availability by station and channel that has been analyzed by the PQLX server.

Trace Viewer

A broad overview of the functionality provided by the Trace Viewer:

- **Trace Tab** - view trace data, originating from:
  - individual trace files,
  - data passed from the PDF viewer, or
  - data passed from the STN viewer
- **Magnify Tab** - Zoom In and Out on sub-selected data segments
- **Spectra Tab** - display and transform the fourier way on sub-selected data segments
- **Split Tab** - display multiple data views simultaneously
- **Header Tab** - display all trace file header information

More specific and detailed help and usage information can be found via the Help button on the sidebar.

PSD Viewer

Upon initial execution, **pqlx** is not connected to any specific database. In order to view PDF and Spectrogram plots, a connection to a database must exist. This is achieved via

the Servers button available on the sidebar of the Main tab. The first time a server (not the localhost) is connected to, the IP address or fully qualified hostname must be provided. Once a successful connection to the machine is made, double-clicking on the hostname in the left-hand display pane will list all available PQLX databases in the right-hand display pane.

(N.B. Connection requirements for **pqlx** and the server database: MYSQL communicates over port 3306. If you can ping the server machine while an attempt to connect to a database fails, confirm that the PQLX database server and client machines are both properly permissioned to allow open communications across port 3306.)

To connect to a specific PQLX database, double-click on the database name in the right-hand display pane. Once successfully connected, all required data will be downloaded and the GUI will build up its various components for user interaction (all pull-down menus as well as internal data structures).

In the Controls Panel, it is possible to specify that a server and database should automatically be connected to at program startup. This is useful if a single database is connected to more than others.

The PSD Viewer is broken up into two notebooks, PDF and SPECTRO, where PDF displays various PDF types, and SPECTRO displays optional PDF's as well as spectrograms of PSD data.

PDF Notebook

The PDF notebook is further broken down into various sub-notebooks, these being:

Main Tab

Display system PDFs computed by the pqlxSrvr program.

Display By options:

- **Group -**   Display a selected system PDF for the selected stations and channel group
- **Station** -   Display three user-selected system PDFs for a particular station and channel group
- **PDF** - Display a selected system PDF for three individual stations and channel group
- **Both** - Display three system PDFs for each of three individual channels of specific stations

Available System PDFs:

- **ALL** -   PDF of all PSDs
- **Month** - PDF of last month of <u>available</u> PSDs (previous 30 days)
- **Week** - PDF of last week of <u>available</u> PSDs
- **L Month** -   PDF of previous month of <u>available</u> PSDs (previous 60 - 30 days)
- **L Week** -   PDF of previous month of <u>available</u> PSDs (previous 14 - 8 days)
- **Year** -   PDF of current year's PSDs
- **L Year** - PDF of last year's PSDs

Mouse Functions:

- **HOVER** - Lower Right Hand Corner of PDF plot:
  - display Probability Colour Bar

- **CLICK** - on PDF Plot:
  - take PDF to Detail Tab

Detail Tab & Panes

- **NW Pane** - Main PDF of Detail Tab

- **SW Pane** - PDF of sub-select of Main PDF. This PDF is made up of all PSDs intersecting the point or region defined by the NW Detail Pane sub-select

- **NE Pane** - displays the first 15 traces representing the PSDs of the NW pane sub-select

- **SE Pane** - displays the start time and duration of all PSDs returned by the NW pane sub-select

SideBar Options:

- Back and Forward Buttons:
  When making sub-selects of a PDF, a list of PDF's is maintained allowing the user to cycle backwards or forward through the list.

- Trace Plot:
  User options defining how trace data is displayed in the NE pane:
  - Do Not Plot –No trace data will be retrieved or displayed
  - Entire Trace – Display the entire trace containing the computed PSD
  - PSD Portion – Display only that part of the trace corresponding exactly to the computed PSD

- Hour Sub-Select:
  User options defining how PSD's are sub-selected in the SE pane:
  - Inclusive – Select all PSD's falling inside the bounding box
  - Exclusive – Select all PSD's falling outside the bounding box

- Save Data:
  Allows the user to save the various types of data on display in the Detail Panes:
  - PDF – PDF data (frequency, dB, number of hits, probability) of the NW pane (or SW pane when sub-select PDF exists) is saved to file specified by user.
  - PSD – PSD start times are saved to file specified by user.
  - Stats – Statistics (frequency, dB) for the selected statistic saved to file specified by user.

Mouse Functions:

- **NW Pane** - Click:
  - define sub-select point

- **NW Pane** - Click+Drag
  - define sub-select region

- **SW Pane** - Click:
  - make sub-select PDF the new Detail Main PDF, i.e., move to NW Pane

- **NE Pane** - Click:
  - Take all traces of sub-select to PQL

- **SE Pane** - Click+Drag:
  - Select PSD's by hour and date to display a new PDF in the NW Pane

Request Tab & Panes

Each display pane allows for display of a user-specified PDF based on date and time range parameters. For each of the display panes, selecting the corresponding button in the sidebar allows for the following types of PDF data requests to be rendered:

- **Range** - a simple request allowing the user to specify start and stop values corresponding to the PSD values for Year, Day and Hour. Any field left blank will default to the boundary as defined in the database. Wrapping around boundaries is properly understood. For example, specifying a start day of 1-December and end day of 31-January will render a PDF of all PSDs for the months of December and January.

- **Frequency** - a more complicated type of request allowing the user to specify the number of days for which PSDs should be extracted, followed by a number of days to be skipped. So, for example, it is possible to create a PDF of all weekdays, skipping weekends, or vice-versa. Rather more complicated requests are also possible, for example, a PDF of only the week before and week after a full moon, but only during the hours in which the moon is within 90 degrees above the station's position on earth.

- **Ago** - a request specifying a relative time range in terms of days ago. For example, a PDF of all PSDs occuring between 45 and 15 days ago.

Mouse Functions:

- **CLICK** - on PDF Plot:
  - take PDF to Detail Tab

Movie Tab & Panes

The Movie Tab allows the user to make animations of PDF's over a series of time. Display of 1 or 4 simulaneous panes is possible. Using the Make Movie side-bar buttons, select the channel and time range desired as well as the number of days which should be contained in each movie frame. As well, define if a movie should be made up of cumulative PDF's or individual PDF's per movie frame.

SPECTRO Notebook

The SPECTRO notebook is further broken down into various sub-notebooks, these being:

Main Tab

Display system PDFs (optional) and corresponding spectrogram computed by the pqlxSrvr program. Like the Main Tab of the PDF notebook, via the side-bar, a specific System PDF may be selected, the specific set of stations selectable via the 'STATIONS' button, and/or a Channel Filter may be selected to restrict the list of channels to display.

Next and **Previous** buttons advance the display list accordingly.

Period Bounds allows the user to specify the exact period boundaries that should be used when display specific channel groups.

PDF Display indicates whether the corresponding PDF should be displayed or not.

Mouse functions include: (see 'mouse tips' at side-bar bottom for more options)

- click on PDF - take PDF to PDF::Detail screen
- click on Spectrogram - take Spectrogram to SPECTRO::Detail screen

Detail Tab

Taking a spectrogram to the Detail tab allows for further analysis and investigation of the spectrogram, allowing, for example, zooming in and out on the spectrogram. Zooming can be done in multiple ways:

- mouse-click-down at zoom start + drag + mouse-up
- mouse-wheel scroll up - zoom in
- mouse-wheel scroll down - zoom out

STN Viewer

As with the PSD Viewer, once a database has been connected to, either via the PSD viewer or the STN viewer itself, all GUI menus and internal data structures are appropriately populated.

Main Tab

The STN (station) viewer allows for display of data coverage or data itself organized by channel; each channel of data is displayed horizontally with the X-axis corresponding to individual days. Various settings via the Controls panel and sidebar provide for a display configuration corresponding to a user's precise requirements, for example, colours, maximum number of channels to display, number of days, etc.

Via the Display options available on the sidebar, two ways of displaying data are possible:

- **Coverage** - Reading from the database, the coverage mode simply displays the existence of data as well as location and duration of gaps and overlaps. Small vertical ticks indicate the physical boundary of the actual data files themselves. This is good for when the client does not have direct access to the trace files for display. Used in combination with the PDF display (described in Mouse Functions below), the user can still get a good indication of the quality of the data itself.

- **Data** - In Data mode, actual data files are read from disk and displayed, much like as in PQL. Unlike in PQL, however, all displayed data is internally held as a single trace. Important when, for example, applying a filter; no effects of data discontinuity (e.g., physical data file boundaries) will be suffered.

Mouse Functions:

- Stats Label:
  - **HOVER:**
    - Display Statistics for channel for date range on display
    - Request PDF from database for channel

- PDF Label:
  - **HOVER**:
    - Display PDF for channel of date range on display
  - **CLICK**:
    - Take PDF plot to PDF Viewer, Detail Tab

- In Plot Region:
  - **SHIFT+CLICK+DRAG**
    - Take selection(s) to PQL, removing any previous selections in PQL
  - **CTRL+CLICK+DRAG**
    - Take selection(s) to PQL, adding to any previous selections already present in PQL

- **a-key+CLICK+DRAG**
    - Take selection(s) to Analysis Tab, removing any previous selections
- **s-key+CLICK+DRAG**
    - Take selection(s) to Analysis Tab, adding to any previous selections already present

  N.B. The action of taking the selection(s) to PQL and the Analysis Tab happens on Key-UP of the selection keys. In this manner, multiple selections are possible.

- On STN Label:
    - As for **SHIFT**, **CTRL**, **a-**, and **s-** keys above:
        - Select entire **station** on display

- On Channel Label:
    - As for **SHIFT**, **CTRL**, **a-**, and **s-** keys above:
        - Select entire **channel** on display

- Between Day Labels (X-Axis region):
    - As for **SHIFT**, **CTRL**, **a-**, and **s-** keys above:
        - Select entire **day** of data on display

Analysis Tab

Bringing data to the Analysis Tab from the Main Tab of the STN viewer allows the user to perform various analytical transformations on the data:

- Demean
- Differentiate
- Integrate
- Reverse Polarity
- De-Trend
- Spectra - Compute spectra of data on display, provided in a separate pop-up. See Controls for more options.
- PSD - Compute total power spectral density of data on display, provided in a separate pop-up. Access to the response files as defined in the database is required. See Controls for more options.
- UVW - Convert XYZ data coordinates back to UVW coordinates. Valid for STS-2 and Trillium instruments only. (Configuration setting for this can be found in Controls panel of the Trace Viewer Display.)
- Deconvolution - Remove the instrument response from the trace data (time domain)
- Particle Motion - Display two-component (horizontals) particle motion plot

All other side-bar controls are the same as found elsewhere in pqlx and pql.

pqlxPNG

The program **pqlxPNG** provides the ability to create PNG graphical format plots of both System PDFs and user-defined PDFs.

Using this program, it is very easy to create PNG format output files of all System PDF plots, writing these to a directory that may be accessed via a web browser (LAN or WAN). This allows access to **pqlxSrvr** results to a broader category of end-user than simply those using the GUI client **pqlx**:

1. those users who do not have the GUI client pqlx installed on their machine

2. those users not having access to the database itself, for example, external users that are not permissioned to access the LAN on which the server resides.

As well, in providing PNG format output, it is very trivial to create graphical images which can be used for publication.

Usage

```
pqlxPNG [OPTION...] - Make PNG Plot(s) of PDF Data
```

Application Options:

```
  --width            Width of Plot (in pixels, default = 550) - optional
  --height           Height of Plot (in pixels, default = 425) - optional
  --noBorder         Draw No Border Around PDF Plot — optional
  --icon             Additionally create icon versions — optional
  --systemPDF        Make PNG plots of System PDF's...
  --dbName=[SERVER:]pqlxDB    For Database pqlxDB on SERVER - required
  --pngDir=/path/to  Directory Where to Place PNG Files - optional
  --inputPDF         Make PNG plot of PDF provided via stdin...
  --pngName=90TH     Name of PDF to provide in PNG Filename - required
  --pngDir=/path/to  Directory Where to Place PNG Files — required
```

Options –width, --height, and –noBorder control the format aspects of the PDF plot and are self-explanatory.

Two types of PDF plots are possible to make with pqlxPNG:

1. All System PDF plots for a given database
2. PDF plot of data supplied as input via stdin by the user

System PDF Plot Generation

Specifying the option --systemPDF, all System PDFs defined for a given database will be generated. In this case, the option --dbName is required to specify for which database on which server the .png plots of System PDFs are to be generated.

If the optional argument --pngDir is omitted, the output will be put to the directory specified by the field **DBWWWDir** in **$PQLXDBDEF/*dbName*.pqlx**. If this field is defined to NONE, execution of pqlxPNG will fail. Either define the field **DBWWWDir** and update this information to the database server using **updatePQLXdb.sh** and execute again. Alternatively, you may specify the option **--pngDir** to specify this output directory.

User-Supplied PDF Plot Generation

Specifying the option --inputPDF, a PDF plot will be created using the PDF information provided to pqlxPNG via stdin. This option is intended to be used in conjunction with the

PDF data extract routines **exPDFfreq** and **exPDFhour** (see document **PQLX-Extract-API.pdf** for details).

For this usage, two additional options are required: --pngName and –pngDir. Option --pngName defines the name to be used when generating the .png output file name. Option --pngDir defines the directory where the .png files are to be output.

Example usages of this option include:

```
bash> exPDFfreq PQLXdb IU ANMO -- BHE 2007-01-01 2007-03-31 1.0 180.00 \
    -200 -50 -PNG | pqlxPNG --inputPDF --pngName=2007Q1 --pngDir=/tmp

bash> exPDFhour PQLXdb IU ANMO -- BHE 1 3 00:00 24:00 -PNG | pqlxPNG --inputPDF \
    --pngName=ALLQ1 --pngDir=/tmp
```

If producing your own PDF data for plotting, the required input format of PDF data for this option is the following:

> **NTW.STN.LOC.CHN SYYY SJ EYYY EJ numPSD**
> **freq<TAB>power<TAB>number of hits**
> **...**

where the first line of the file is:

- **NTW.STN.LOC.CHN** is the fully qualified channel name
- **SYYY** – is the start year of the PDF
- **SJ** – is the start julian day of the PDF
- **EYYY** – is the ending year of the PDF
- **EJ** – is the ending julian day of the PDF
- **numPSD** – is the total number of PSDs represented by this PDF

and each succeeding line of the file is:

- **freq** – the frequency, specified as seconds (not Hz)
- **power** – the power
- **number of hits** – the number of occurances of PSD data for this frequency and power combination.

An example of this format may be easily generated via execution of a data extract API script and specifying the -PNG option.

Output

For both output options, the directory structure and filenaming conventions are the same. All .png files are output to a subdirectory of **pngDir.** This subdirectory is named ***NTW.STN***, where:

- ***NTW*** and ***STN*** are the network and station of the channel being plotted

All .png files are named ***NTW.STN.LOC.CHN.name*.png**, where:

- ***NTW.STN.LOC.CHN*** is as one would expect

- ***name*** is the name of the PDF plot. For –systemPDF execution, this is the name of the System PDF. For --inputPDF execution, this is the name supplied by the argument –pngName.