

# Correlation Plot GUI

## Scope

This graphical user interface (Fig. 1) for Matlab enables the measurement of any number of EPICS process variables (Read PV) as a function of one or two control variables (Control PV). The results can be plotted against each other in any combination and various fitting functions can be applied to the results. The measurement data can be saved and loaded and the program settings can be saved and retrieved in user specified configuration files. The program can also launch other programs for profile monitors, wire scans, and emittance measurement to get the respective data. Beam synchronous acquisition is also available if the process variable supports this feature.

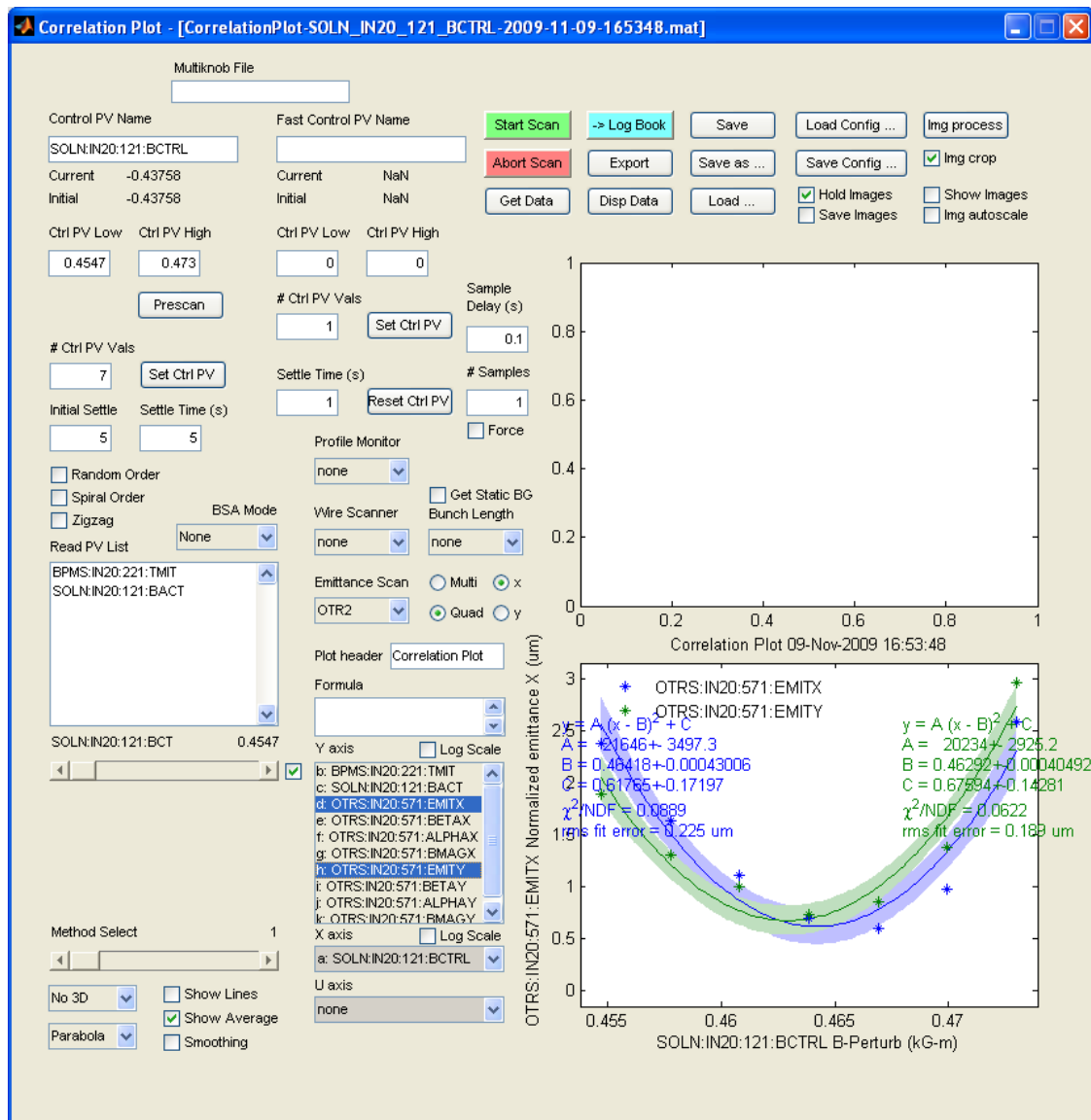


Figure 1: Graphical user interface for correlation plots.

## Usage Procedure

- 1) Start program. For LCLS, on the LCLS Home Screen, open User Dev Displays and then select Correlation Plots GUI. For NLCTA, select Correlation Plot from the NLCTA\_guiLaunch screen. Alternatively (for either accelerator), type `corrPlot_gui` from the command line in a Matlab session.
- 2) Pre-defined measurement. If the measurement setup has already been saved as a configuration file, use Load Config.
- 3) Time plot. If the evolution of measurements over time is to be taken, leave both the Control PV and Fast Control PV fields empty. All other settings for the control PVs will have no effect.
- 4) Standard plot. This is the measurement of the read PVs as a function of one control PV. Enter the name of the process variable into the Control PV Name field. If the name is a valid PV, its present value will be displayed as Current and Initial. The values will be NaN if the PV is invalid.
- 5) Multiknob support. If a multiknob file (\*.mkb) has been defined, enter its name in the Multiknob File field. A multiknob PV will automatically be assigned. Its value can be scanned using the control PV fields (discussed below).
- 6) 2D plot. This is the measurement of the read PVs as a function of two control PVs. Enter the name of the slow process variable into the Control PV field and the fast variable into Fast Control PV Name.
- 7) Enter the range for the control PV into the respective Ctrl PV Low and Ctrl PV High fields.
- 8) Enter the number of set points for the control PV into # Ctrl PV Vals. If two control variables are entered, the total number of setpoints will be the product of both # Ctrl PV Vals fields.
- 9) The order of PV Vals during the acquisition can be changed using the Random, Spiral, and Zigzag checkboxes. If no checkbox is selected, the control PV will be scanned from the lowest value to the highest. The checkboxes have the following effects:
  - a) Random – control PV values will be randomly selected.
  - b) Spiral – control PV values will be selected so that the values progressively spiral outward from the middle value. For example, for 9 control values between a low value of 1 and a high value of 9, the sequence will be 5,6,4,7,3,8,2,9,1. Note that the primary use case for the spiral mode is in the 2D scan mode which results in a square spiral pattern from the two control PVs.
  - c) Zigzag – control PV values will be chosen to minimize the change between the initial PV value and subsequent values. The control PV value nearest to the initial value will be chosen. Subsequent values will decrease as if alternating rungs of a ladder until the minimum value is reached. Values will then increase along the rungs of the ladder that were skipped on the way down until the maximum is reached. Finally, any missing values will be filled in as the PV value decreases towards its starting point. For example, if the initial value of the control PV is 5.3 and 9 control values between a low value of 1 and a high value of 9 are desired, the sequence will be 5,3,1,2,4,6,8,9,7.

- 10) Select settle times. The Initial Settle is the number of seconds to wait between setting the control variable(s) to the first set point and taking the data. The Settle Time of the (slow) control PV is the wait time after subsequent set points before taking data. The Settle Time of the fast control PV is the respective wait time after advancing the set point for the fast PV.
- 11) Select number of samples and sample delay. The # Samples is the number of shots to be taken at each control variable set point. For a time plot, this is also the total number of shots. Enter the (approximate) wait time between samples in the Sample Delay field. This field has no effect if synchronous acquisition is selected.
- 12) Read PVs. Enter any number of process variables to be measured into the Read PV List field. If any of the names is invalid, no data will be acquired.
- 13) Additional Matlab measurements. One Profile Monitor, Wire Scanner, and Emittance Scan measurement can also be specified to be done along the acquisition of the other read PVs.
- 14) Select beam synchronous acquisition (BSA). If all read PVs have synchronous acquisition PVs associated with them, i.e., there exist PVs with HSTn appended to the name entered in the Read PV List field, the beam rate ONE HERTZ, TEN HERTZ, THIRTY HERTZ, TS4, or 120 HERTZ can be chosen. The Sample Delay value has no effect then. If None is selected, the acquisition is non-synchronous.
- 15) Select display settings. Use the Y axis, X axis, and (for 2D plots) U axis controls to select in which way the measured data should be displayed. This can also be changed at any time after the acquisition.
- 16) Label the measurement. Enter a title for the plot into the Plot Header field. This name will be appended by the control PV name and the date and time for the actual plot title as well as for the auto-generated file name.
- 17) Start the acquisition. If the parameters for the scan are well-established and known to give good results click the Start Acquisition. If the correct range for the PVs is not known, click the Prescan button.
- 18) After each set point, new data are added to the plot.
- 19) If the prescan option was chosen, when the current scan completes, a pop-up window will appear allowing for the option of adding additional points to the data already collected. If no additional points are required, click Cancel.
- 20) When the scan is completed, check if the Current value equals the Initial value for the control PVs.
- 21) If the measurement has to be aborted, use Abort Acquisition. If this doesn't work, use CTRL-C to end the program.
- 22) If the measurement was unsuccessful, i.e. the program crashed, or was aborted by CTRL-C, press the abort scan button to enable new scans. If control PVs were changed, press the Reset Ctrl PV button to put the control PVs back to their initial value.
- 23) Play with the Show Average, Fit, Window, and 3D controls and the Method Select slider (if any additional Matlab measurements were done) until happy with results.
- 24) Formulae. If desired, one or more formulae can be entered in the Formula field to be available for display or fitting. The control and read PVs are referenced in the formulae with lower case characters starting at "a" with the control PVs and then the read PVs. The labeling corresponds to the order of the X axis list without the TIME

entry. The operations in the formulae have to be vectorized, i.e. use .\* instead of \* etc.

- 25) Save and log data. If deemed worthy for posterity, use Save (with auto-generated file name and folder location) or Save as (with user specified file name and location). Use the ->Logbook button to put the plot into the electronic logbook.
- 26) Subsequent scans. If the program doesn't respond to Start Acquisition, press the Abort Acquisition button and try again.
- 27) Change of acquisition values. If any of the values affecting the structure of the measurement data (like # Samples or Control PV Name) are changed, a dialog box will appear questioning the user to either save or discard the present measurement, as it will be removed from memory.