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History Buffer Correlations Release 2.0

Jan 16, 1991

Author: *Gregory R. White* **Subsystem:** *Accelerator* **User Impact:** *Small*
Panel Changes: *Few* **Documents:** *Yes* **Help File:** *Yes*

Introduction

Two new charts have been added to the History Buffer Correlations (HCRL) facility to help interpret and compare data from two devices.

1. EXPRN chart - plots an arithmetic expression in the data vectors of devices assigned to A and B, vs time.
2. A VS B chart - displays the scatter-plot of the data vectors of the devices assigned to A and B, and displays their linear correlation coefficient.

These two charts are explained in the following sections, "Expressions - Chart Type EXPRN" and "Correlations - Chart Type A vs B". In each section, instructions are first given in "How to Obtain a Plot", followed by "Algorithm Notes". The final section deals with an extension of the device-name entry dialog which was included in the previous release of this package.

The behavior of existing buttons dealing with scaling has been extended to deal with these chart types, though their function when used for the existing charts, STPCHT and OVRLAY is unchanged. In addition, some new buttons have been added to specify the required EXPRN chart.

Expressions - Chart Type EXPRN

As for any chart, first select a time range for the plot from any History Plots panel and be sure that variables A and B are assigned device-names - see Assigning a Device-name below.

To plot an arithmetic expression involving history data assigned to variables A and B, select "EXPRN" from button [CHART TYPE] and then select an expression type from the [EXPRN] button.

Two expressions are currently available:

1. $A + (r \times B)$
2. $A/(r + B)$

where "r" is a real value entered from the [R IN EXPRN] button. Finally push the [PLOT CORREL] button to display vs time the resultant locus of applying the selected expression to the variables A and B. If variable C is defined it is ignored.

The plot of the resultant locus can be manually scaled in the usual way, using the manual-scaling buttons [AUTO / MANUAL SCALE] [MIN] [MAX] on the touch panel row specifying the expression.

In addition, the data value vectors for A and B can be "bound" before being used in the expression, by manually scaling the device one wishes to limit. In this case, original data vector elements outside the range will be replaced by linear interpolation between the previous and next elements whose values are inside the manual-scaling range. Note that this is an extension of the manual-scaling function buttons for A and B; it leaves their behavior for STPCHT and OVRLAY plots unchanged.

Algorithm Notes

Linear interpolation is always performed assuming A is the "independent variable".

Since the exact time that different devices are sampled may differ, linear interpolation is always performed on B in order to "align" the input vectors before evaluating the expression. Hence, expression 1. above would be specified more completely as:

$$L[i] = A[i] + (r * B'[i])$$

Where L is the resultant vector and i ranges from 1 to the number of original data points taken for A (before, if applicable, A was bound).

Note that, if device A is sampled twice before the first data point of B then the first element of the data vector of B, following linear interpolation, will have a characteristic spike to 0. This only occurs if A is sampled significantly more often than B.

This may well obfuscate some of the dynamics in the locus, as the auto-scaling function tries to put the whole locus on the plot. Therefore, always check that the number of data points taken for both A and B is approximately equal (within at most 2, as they will be if sampled at the same rate). If this in not the case, make sure that the device with FEWER data points is assigned to A, or that the chart is manually scaled to show only the interesting data points. The latter method has the advantage that less information is lost in the interpolation process itself. The number of data points taken for both devices appears below the chart.

Correlations - Chart Type A VS B

A VS B charts a scatter-plot of the data taken for A vs that for B, in the given time range.

To obtain this plot select "A VS B" from the [CHART TYPE] button. As in the preparation for an EXPRN chart, the data value vectors for A and/or B can be bound by manual-scaling. Elements outside the bounds will be replaced by linear interpolation between the previous and next elements whose values are inside the range.

The scatter-plot will be displayed when [PLOT CORREL] is selected.

The linear correlation coefficient (by Pearson's r) between A and B is also displayed, along with the Corrected Complimentary Error Function.

Algorithm Notes

Briefly, "r" is a measure of association between ordinal or continuous variables, say x and y, ranging between -1 and +1. When both x and y ascend in correspondence, r will be valued +1 and the association is designated as "perfect positive correlation". If y descends at the same rate x ascends, r = -1 and the association termed "perfect negative correlation". An r value of 0 indicates that no association between x and y has been found by this quantification method, they are "uncorrelated".

r measures only the extent of correspondence between variables known to have a significant association. It should not be used to *decide* whether two variables have an association in the first place.

If we assume that many calculations of r, over a very long time frame, for the same variables, would yield a symmetric distribution curve, then we can for any one calculation of r decide roughly how 'reliable' it is. This is quantified by a corrected Complimentary Error Function. That figure is given below r on the chart. Low values indicate r is more reliable. In this case, the error function is computed by an approximation based on a Chebyshev fit to the Gamma function, which has fractional error (everywhere less than 1.2E-7). However, this is irrelevant compared to the error in the interpolation.

Linear interpolation is used to bound the input data vectors on manual-scaling and "align" the vectors in preparation for a plot (this changes the data values most when significantly more data points are taken for one device than the other). All these will make the correlation coefficient figure artificially high.

Assigning a Device-name

The dialog entry for assigning a device name to a label (A, B, or C) was updated in release 1.1. When the button [ENTER DEVICE NAME] is selected, the five parameters of a device name (primary, micro, unit, secondary, and channel) are asked for, one after the other. These should be entered individually or together space delimited.

A default value for each parameter is presented. This is the previous value of that parameter, or if none, the value of the corresponding parameter of the most recently entered device. The channel parameter is never assigned a default as most devices have no channel. However, the channel will always be requested; if it is not applicable one should simply hit RETURN - it will then be set to null. Hitting return before entering a value for any other parameter than channel, is interpreted as accepting the default.

Two other responses are valid in answer to a parameter:

1. CLEAR or NONE (upper or lower-case) will set the current value of the dependent to null, ie blank
2. CTRL-C will, after confirmation, abort the current input leaving the dependent set to its existing device name.

Single Plane Emittance Measurements

January 23, 1991

Author: *Michael Glaviano* **Subsystem:** *SCP* **User Impact:** *Small*
Panel Changes: *Few* **Documents:** *No* **Help File:** *None*

It is now possible to do single plane emittance measurements from the Auto Emittance Measurement panel. The main reason for implementing this feature is to allow using a single wire (either x or y) for emittance measurement without incurring the overhead of also moving the off-plane wire. A new button, MEAS PLANE, has been added to the panel for this purpose. This button is a three way toggle and the choices include x, y, and both planes. The default selection for a profile monitor is to perform measurements in both planes, and for the wires the default is to perform emittance measurements in the x plane only.

In addition, some of the unnecessary or duplicate information has been removed from the panel.

Button Macro Changes

January 23, 1991

Author: *Bob Hall* **Subsystem:** *SLC* **User Impact:** *Small*
Panel Changes: *One* **Documents:** *No* **Help File:** *None*

Several small changes have been made to the button macro facility. A [MOVE TO PROD] button has been added to the Button Macro Management panel to enable one to change the status of a macro from "development" to "production". In addition, the error log will now contain an informational message indicating when a button macro was executed.

Among the changes that have minimal user impact is the requirement to enter the author's name when creating a button macro. A file will be created in the SLCBM_OUT directory now only when Button Trace is ON or an error occurs. The existing Delete Macro button will now also move the deleted button macro from the SLCBM directory to the new SLCBM_OBS directory. This capability also exists now in the BM_MODIFY_DB utility (located in USER_DISK_SLC:[SEM.TOOLS]). This utility can be used to restore a deleted macro to active status, which now also involves moving the button macro from the SLCBM_OBS directory to the SLCBM directory. Finally, a new option has been added to the BM_MODIFY_DB utility to enable one to erase all traces of a macro.