SLAC

EXPERIMENT MANAGER

CORRELATION PLOTS ON ACID

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CASE FOR SOME SIMPLE ITEMS OF SOFTWARE
INFRASTRUCTURE IN SUPPORT OF NLC CORRELATION PLOTS

SUMMARY

The "Experiment Manager" is a simple idea for an NLC controls user level application program, very similar to Correlation Plots. The difference would be that the Experiment Manager could perform sequences of user interface operations, and could acquire any item of user interface level data in addition to strictly control system data.

The intention is to make possible the automation of those kinds of simple experiments which are now performed on the SCP by users in which they make repetitive sequences of GUI button pushes to step some independent variable, record some arbitrary displayed data in their log book, and plot the resulting graph in something like Matlab. Currently this is made difficult in the SCP because Correlation Plots does not understand button macros for driving a step variable, and it's not possible for Correlation Plots to retrieve every kind of data item displayed anywhere on the SCP, it only knows about those specific data items which it has been programmed to retrieve.

This document proposes requirements for the NLC control system user interface that would make it easy for a user to specify a complex sequence of events for a step variable, and allow them to easily tell Correlation Plots which quantities they want sampled.

Additionally, it's shown that NLC could benefit greatly from a common API shared by archiver and real-time data access. This API would be used by Experiment Manager utility components, which could in turn be used for constructing software for system identification and hence non-linear and dynamical systems control.

PROBLEM EXAMPLE

Start with a simple example: say one wanted to investigate the association between the beam angle at the IP and the dispersion in the ring. At present Correlation Plots would not be able to help much because it can't drive the dispersion correction package (even through button macros), it can't read the RMS of the measured dispersion (even though it's displayed on a plot) and it can't directly measure the beam angle. So the idea is to allow the NLC version of Correlation Plots to drive the User Interface scripting scheme, and to make sure that any value displayed anywhere on an NLC plot is available to Correlation Plots.

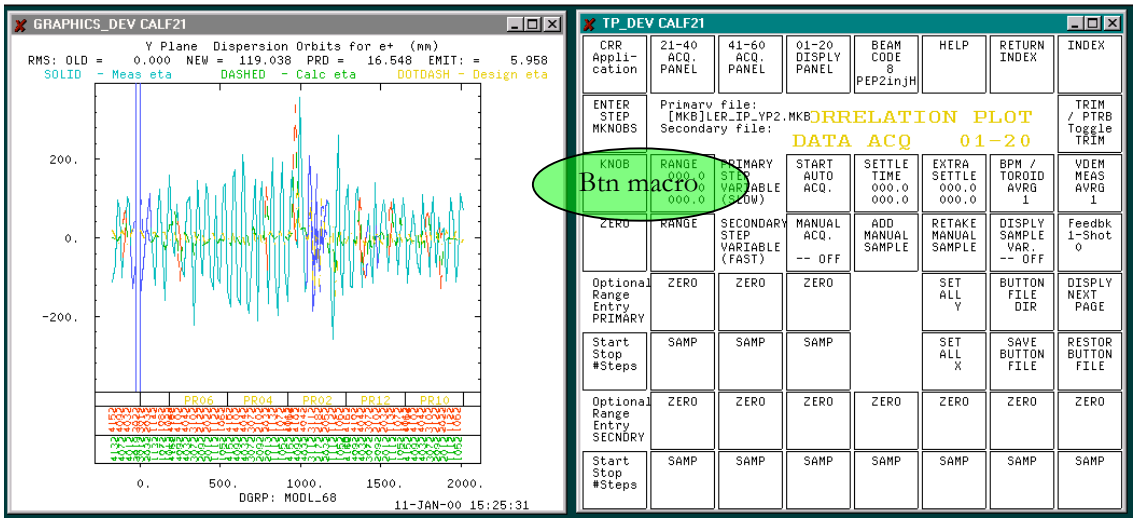

Figure 1: Problem 1; need to be able to put a script, like a Button Macro, into a step variable, and allow correlation plots to control the steps

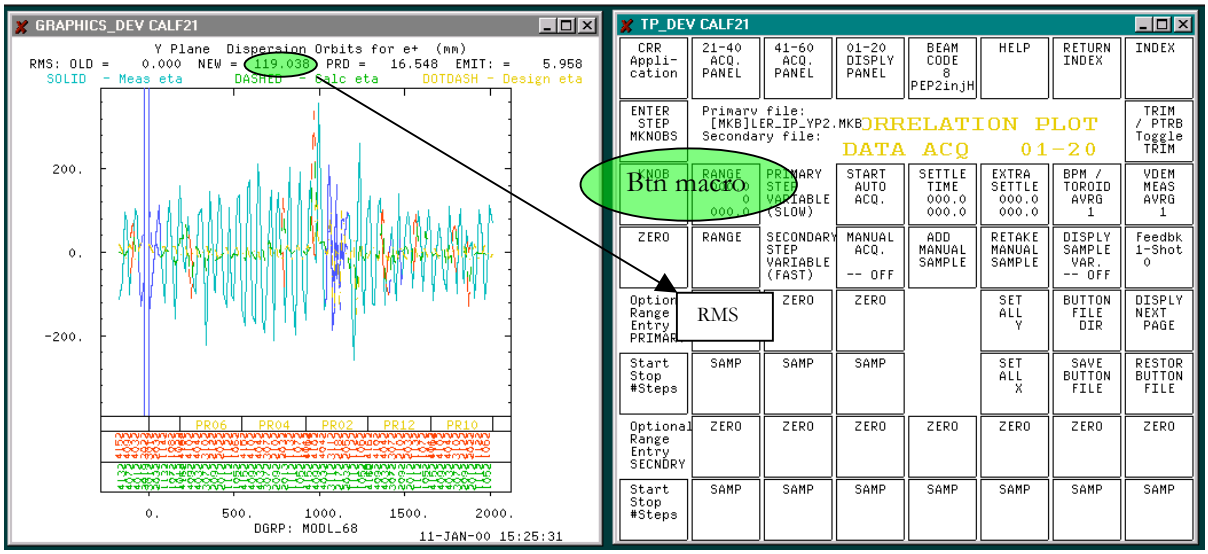

Figure 2: Problem 2: Correlation plots must be able to acquire any variable displayed on any application

SOLUTIONS

To allow for NLC's Correlation Plots fitting and minimization facilities to be brought to bear on problems like this, we would need the following facilities in the NLC's User Interface Manager:

1. A scripting facility similar to Button Macros which:

    a. Can drive any control system application (like Button Macros can)

    b. Can calculate and set variables in the scripts at execution time (so that it can, for instance, set the extent to which Steering should attempt to minimize dispersion as opposed to orbit). This is unlike the current Button Macros because Button Macros, being implemented in TPU, can handle only integer arithmetic.

    c. Can acquire data by direct access to the control system's databases, rather only by panel scraping, as Button Macros can.

2. Allow for any variable which is displayed on the screen to be acquirable. This is not possible in the SCP, but (I think) is a given for EPICS. However, using a process variable from EPICS for every kind of displayed variable which would be useful for the sorts of things the Experiment Manager would want to optimize would imply a single-user kind of EPICS. For instance, take the RMS of the predicted orbit resulting from a steering minimization calculation. That RMS is only interesting to the one user who is trying to steer the beam, so it would probably not be a PV on an EPICS DM screen. But the RMS resulting from a minimization calculation is exactly the sort of thing the

Experiment Manager would be interested in. In short, for EPICS to satisfy this requirement, it would have to be a single-user system.

COOL

For some time users have asked "why is there a difference between the Correlation Plots panels and the History Buffer Correlations Panels?". Ideally one function of NLC's Correlation Plots would be to plot one device against another, just as SLC's Correlation Plots does, except acquire the data from some period in the past not the immediate future, like History Buffer Correlations. Clearly one can't step a step variable in the past and watch the result, but a common use of Correlation Plots is to plot data from two devices against each other over time – exactly as is done using History Buffer Correlations (see **Error! Reference source not found.**).

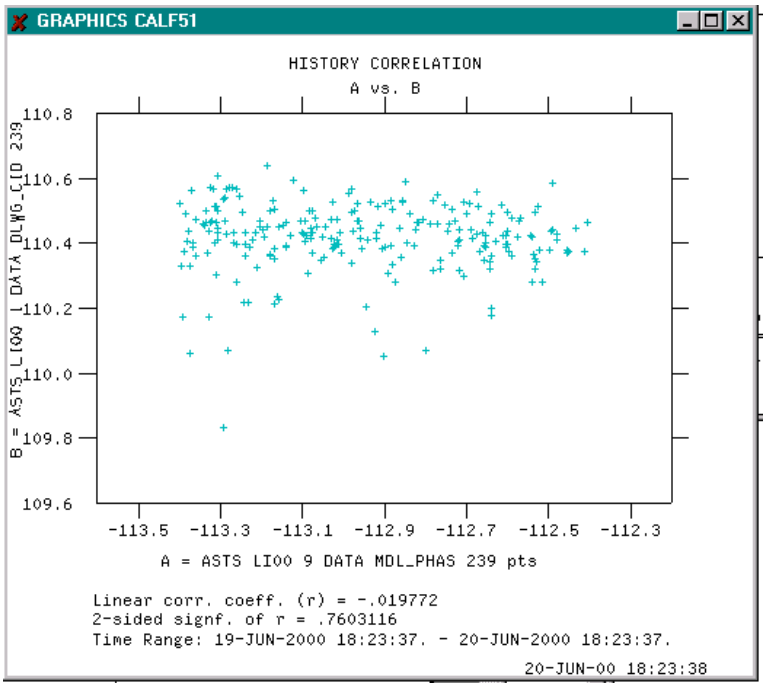

Figure 3History Buffer Correlations Scatter Plot

This ability would be supported trivially if we used a common API for archiver and on-line control data. The History Plotting facility and the Correlation Plotting facility would in fact be the same application. The error display facility should also be folded into this picture. Recently we needed to overlay the times that Steering trimmed corrector magnets over a plot of the history of the BDESs of all the correctors in the HER. This shows that the error log is really just a history of message codes and associated data. So the archiver and the archive/online data API should be flexible enough to encompass error logging using time-stamped message codes, data and text.

It also seems logical to take this unification further. The application level data acquisition and plotting facilities provided by the Experiment Manager would form the basis for other applications, as they are in SLC Correlation Plots Applications. But if the "streamed" RT data, history data, and classical Correlation Plots type data were are available through the single Experiment Manager API,

then more classes of application could be built using the Experiment Manager framework, e.g. BPM plots.

REALLY COOL

The fact that we will intend to record all real-time beam related data also suggests that the Experiment Manager low level component utilities should include facilities for the construction of applications that can to do system identification. That would in turn make the construction of sophisticated non-linear and dynamical feedback control much easier. It would still be very difficult, but not Herculean. The feasibility of such systems as SI would be greatly improved because the data acquisition problem would have already been solved. They would also be much cheaper because there would be a single data acquisition sub-system whose cost is realized early in the NLC budget. It would make that problem one of accelerator physics and control, rather than engineering.