Index Panel

SLC Control Program

SLAC's Software Engineering Newsletter

September 29, 1992 | All that Fits is News to Print | Vol. 6, No. 10

Old Fast Feedback is Dead, Long Live New Fast Feedback

September 12, 1992

Author: *Fast Feedback Group* **Subsystem:** *Linac* **User Impact:** *Medium*
Panel Changes: *Few* **Documents:** *Yes* **Help File:** *No*

After a long and useful life FB31, the last of the family of old fast feedback loops (which consisted of FB29, FB30, FB31, and FB69) is dead. A memorial service (a.k.a. code burning party) will be held at a time and place to be announced soon. FB31 is survived by a large family (22 and growing) of new fast feedback loops which inherited many ideas, but no lines of software from FB31 and its brethren.

In most regards, the new FB31 behaves like the other new fast feedback loops. It is accessible from the FFBK SELECT PANEL and the loop is labeled FB31 ENERGY. You can save gold orbits, change setpoints, look at ring buffers, display vectors, and so on.

There are some differences though, mainly due to the fact that it uses phase shifters to control the energy and these are related by a non-linear transformation.

- If you look at DISPLAY VECTOR, you will see eight actuators: four energy gains and four phases. Standard feedback software calculates the energy gains (total desired energy that sectors 27 and 28 should contribute to the beam). Special purpose software calculates the necessary subbooster phases from the energy gains. The resulting phases are designed to maintain the BNS contribution to the energy spread as specified in the LCON secondary of the SBST primary (presently set to -17 degrees). The normal subbooster phases are taken into account.
- The total energy contribution that LI27 and LI28 can contribute depends on how many of their klystrons are active and on their powers. These may change with time. Each time FB31 is turned on the energy gain is calculated and saved in the actuator LIMITs that one normally sets from the feedback actuator panel. In this way, both the normal summary display and the actuator panel can be used to see how much energy headroom is left.
- When the loop runs out of headroom, it immediately (most other loops wait 1 minute) outputs an error message (in reverse video) telling operators to add or drop a klystron. This message also generates the same noise as the crashing micro messages do. The scavenger energy loop will also do this now. Soon, FB31 will rate-limit the beam to 10 Hz when it is out of headroom. This may help prevent holes from being drilled in the BSY beam pipe.

- The phase shifters are controlled by PAUs in FB31. The use of PAUs allows different control on the two time slots. The FB31 loop does not measure this timeslot difference but can implement a user requested difference in the energy gain for the two time slots. You can enter this desired time slot energy difference with a new button on the FB31 PHASE AND AMPL panel which can be reached from the feedback magnet panel. Later, a new slow feedback loop will measure the timeslot energy difference and automatically send it to the FB31 loop.
- Because of the time slot control, the PAUs are run in pipe-line mode. This mode has the annoying feature that if there are no triggers, the PAU output is "disabled". This results in the beam energy changing greatly when FB31 is IPL'ed (during an IPL, the PDU triggers go away for awhile). Hence one should treat FB31 like the linac micros LI01–LI30 and rate–limit the beam when it is IPL'ed.
- Note that FB31 still uses its own BPM processors to read out the BPM data. It does not share the BPM processors of CA11, CA01, and LI30. This allows it to read both electrons and positrons at 120 Hz. It also means that the FB31 public BPM calibration should be updated periodically by the operators.
- It should also be noted that the new FB31 corrects a step change in the beam energy in 1/2 the time of the old one. It runs with a gain of 1.0.
- Because the BSY energy is such a critical parameter of the SLC, The real–time (MATROX) display of the energies and currents vs. time has been maintained. The use of the MATROX display can be disabled with a new button on the FB31 PHASE AND AMPL panel.
- In the past, FB31 had the annoying problem that while it thought it was maintaining the energy properly, it was actually slowly drifting by 100–200 MeV as measured by the arcs and final focus. We believe this is caused by slight (1 bit) pedestal drifts of the BPM processors which cause a bias in the FB31 energy measurement. To eliminate this problem, FB31 reads (via a SAM) the beam energies as measured by the NA12 and SA12 loops (which write them to a DAC). It uses these energies along with the FB31 BPM readings to estimate the bias on the FB31 energy measurement. It then uses this estimated bias in its energy correction so that it maintains the energy constant as measured in the arcs. The calculation of this bias estimate is heavily time averaged so it will change very slowly (20 seconds) compared to the time it takes FB31 to correct an energy error (6/120 seconds). In other words, rapid energy changes are corrected using the FB31 BPM readings. The long term time average of the energy is corrected using information from the arc loops which have smaller systematic errors in their energy measurements. Note that the loop operates properly when the beam is stopped in the single-beam-dumper.
- Due to the above method of obtaining the energy from the NA12 loop, the average beam energy is determined by NA12's gold orbit, not FB31's. FB31's gold orbit only becomes important when the beam does not go through the arc for an extended period of time (hours). Hence to change the beam energy, one needs to change the FB31 setpoint. If you want to then save a gold orbit so the setpoint will be zero, first save the NA12 gold orbit, then change the FB31 setpoint back to zero, and finally, after looking at ring buffers to make sure that the NA12 loop is happy with the energy (this should take about 20 seconds at 120 Hz,) save the FB31 gold orbit.
- The loop can control either the electron or positron energy or a weighted average of the two energies. This is controlled via a new button on the FB31 PHASE AND AMPL panel.

- All of the VAX software which uses FB31 loop to control the energy has been updated to use the new version. This includes the FF eta package, the slow feedback BSY EDIFF loop, and the arc oscillation and dispersion packages.

Fast Feedback Gold Orbit Modification

August 12, 1992

Author: *Phyllis Grossberg* **Subsystem:** *Fast Feedback* **User Impact:** *Small*
Panel Changes: *One* **Documents:** *No* **Help File:** *Yes*

Up until now, fast feedback gold configuration files contained orbit measurements as well as actuator data. The gold orbit function has now been modified to save only orbit measurement data

To simplify operator interface when updating actuators, a new button 'UPDATE ACT REFS' has been added to the gold orbit panel. This button causes the current actuator values to be used as reference values by the micros during their attempts to stabilize the beam. This button does not affect gold orbit configuration files in any way.

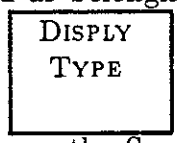
Old configuration files containing both types of data are still useable. The software has been modified to load only measurement values and to ignore actuator data when these configurations are loaded.

The button 'ACQUIR ACTS ONLY' has been removed from the gold orbit panel.

Fast Feedback Summary and Setpoint Displays

September 16, 1992

Author: *Phyllis Grossberg* **Subsystem:** *Fast Feedback* **User Impact:** *Small*
Panel Changes: *Yes* **Documents:** *No* **Help File:** *Yes*

In order relieve the current crowded conditions on the fast feedback Summary and Setpoint displays, each fast feedback loop has been designated as belonging to one of four groups: extraction, injection, diagnostic or development. The new 

button on the Fast Feedback Main Panel will determine which group of loops appear on the Summary and Setpoint displays. This button toggles through the available group types, and when a Summary or Setpoint Display is subsequently requested, only loops of the selected type will appear on the display.

If there are no diagnostic or development loops currently available, those types will not appear on the toggle button.

To accommodate this new button on the Feedback Main Panel, the button for Single Unit Display of the selected loop has been moved to the Fast Feedback Diagnostic Panel.

Fast Feedback Element Selection by Name

September 16, 1992

Author: *Phyllis Grossberg* **Subsystem:** *Fast Feedback* **User Impact:** *Small*
Panel Changes: *Yes* **Documents:** *No* **Help File:** *Yes*

A new button has been added to the Fast Feedback Diagnostics panel to allow users to select a feedback element by entering its name. This is analogous to the existing function of selecting a fast feedback loop by name. It is recommended that you use these functions instead of the usual panel selection methods when creating button macros. This will ensure the integrity of the button macros over time should database composition change.

The Diagnostics panel is accessible from the fast feedback main panel through the fast feedback State panel. Press the SELECT ELEMNT button and respond to the prompt for up to an eight-character name, such as "XPOSE-". If the name you type is invalid, you will be given a list of valid names and a chance to re-enter. If the name you type is valid, the new element will be selected just as if you had pushed one of the buttons on one of the vector panels. Should you subsequently go to the appropriate vector panel, the button for your newly selected element will be highlighted.

Beam Phase Slow Feedback Loops

September 23, 1992

Author: *Ed Miller* **Subsystem:** *Accelerator* **User Impact:** *Small*
Panel Changes: *Few* **Documents:** *No* **Help File:** *Yes*

Four new slow feedback loops have been added for purpose of monitoring (but not controlling) the phases of the electron and positron beams with respect to the RF accelerating voltage. These loops are accessed from the FEEDBACK panel with the BEAM PHASE LOOPS button. The BPHA_ELE and BPHA_POS loops measure the electron and positron phases (respectively) using FB31 BPMs. The BPHAELE2 and BPHAPOS2 loops do the same, utilizing BPMs in the final focus region.

Ordinarily all four loops will be in SAMPLE mode; however, any combination of the loops may be turned on or off. In all cases, data for all of the loops are collected in a single buffered acquisition (omitting those devices which are needed only for loops which are currently HSTA'ed OFF or have less than 60 Hz of beam rate). As a consequence, beam energy estimates (and, hence, beam phase estimates) may be highly correlated as measured by FB31 and final focus BPMs, as they are both measured using the same beam pulses.

The general method for measuring beam phase is to collect a series of beam pulses with the damping ring extraction phases set to two different values near the current operating position. Data is collected from BPMs (beyond the linac) which are sensitive to beam energy changes. This yields a set of independent measurements of Ediff, the fractional change in beam energy corresponding to the change from one phase setting to the other. The beam phase is then estimated from the average observed change in beam energy with respect to extraction phase.

A number of output parameters are calculated (and saved in history buffers) for each loop. Some of these have meanings which are peculiar to these loops. They are all listed below.

SGNL	Phase: The beam phase as estimated by the latest successful execution of the loop. Value is in degrees, and negative values, *e.g.* -5, are typical.
CMND	Phase (filtered): The filtered value of SGNL; it is an exponentially-weighted average of all signal measurements.
LMSE	Ediff_avg: The average fractional energy difference between the two dither position values used.
CHSQ	Ediff_rms: The observed rms of all the individual Ediff measurements contributing to a single loop execution.
SERR	Ediff_err: An estimate of the error in Ediff (based on observed Ediff_rms and the number of separate Ediff measurements contributing to a single loop execution).

There are a number of parameters which may be set on the loop touch panel to control the details of how the data is collected and analyzed for the measurements. The HELP file for these loops gives information on how these parameters are used. Note that one of these parameters is the standard loop GAIN. For these loops, the GAIN parameter is used not for its normal function of scaling the control output, but instead to calculate the filtered signal (CMND) from the measured signals.

During the few seconds it takes to collect data for these loops, the fast feedbacks in EP01 for scavenger energy and in FB31 for the linac energy will be automatically disabled. In addition, the phase ramp controls will be flagged as 'under feedback control' to reserve them for exclusive use by the feedback process. Note that if you try to knob the positron phase ramp you will be informed of this, but not if you knob the electron phase ramp. This anomaly is due to the fact that the multiknob software (needed for electron, but not positron phase ramps) does not yet inform the user of this prohibition, even though it does obey it.

Damping Ring RF Watchdog

August 21, 1992

Author: *Ron Chestnut* **Subsystem:** *Damping Ring* **User Impact:** *Small*
Panel Changes: *None* **Documents:** *No* **Help File:** *None*

Two new slow feedback watchdogs have been implemented to monitor the state of the damping ring RF, one in each damping ring. These loops can be selected from the slow feedback panel. Akin to the polarization watchdog in PL01, these loops update status (FFBK,DR02,42,PSTA and FFBK,DR12,43,PSTA) which are used by the summary display as input to the PHAS/AMPL/etc. box for the damping rings. This status supercedes the previous AMPL checking in the damping rings.

The status possibilities are as follows:

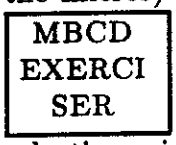
- Damping Ring RF forward power low
- Damping Ring RF forward power high
- Damping Ring RF gap voltage out of tolerance
- Damping Ring RF reverse power high
- Damping Ring RF gap voltage unbalanced

MBCD Diagnostics

September 3, 1992

Author: *T. Gromme* **Subsystem:** *micro software* **User Impact:** *Minor*
Panel Changes: *New panel* **Documents:** *No* **Help File:** *None*

A diagnostic routine, known as MBCD exerciser, has been added to the SCP (with support code in the micros) for helping to measure Camac error rates. This diagnostic panel is accessed with the



button located on the network index panel. Buttons on this panel may be used for selecting micro, crate, test duration (in hours,) and test type. All of the options, with the exception of micro and crate, can be defaulted. The START button may then be used to initiate the test for the selected crate. At most one test can be running in any one crate. Tests can be running concurrently in any number of crates and in any number of micros. The display button on this panel shows all currently running tests. Test results are recorded in the ERRLOG, and can be retrieved with the ERRLOG /ERRC=CREX qualifier. Unless the camac hardware is badly malfunctioning, all tests available from the MBCD exerciser panel are non–invasive.

Development SCPs Revealed!

August 21, 1992

Author: *R. Chestnut, T. Himel* **Subsystem:** *SCP* **User Impact:** *Small*
Panel Changes: *Few* **Documents:** *No* **Help File:** *Yes*

In order to more easily identify development or experimental SCPs in the control room an indicator has been added to the INDEX button on every panel. If normal production software (NEWSOFT) is being run, nothing is shown on this button. In all other cases there will be a reverse video message on the INDEX button to warn about non-standard software. The message may be OLDSOFT, DEVSOFT or a word (such as FFSCP) defined by the person who was testing the software (the special word may be defined with the DCL statement `define devscp_name FFSCP`).

If you find a SCP running development software and want to go back to standard production software, exit the SCP and then type the following:

1. `NEWSOFT`
2. `TESTSHRX/DEASS ALL`
3. `SCP`