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Dithering Beam-Beam Scan

September 18, 1992

Author: *Lee Ann Yasukawa* **Subsystem:** *Final Focus* **User Impact:** *Medium*
Panel Changes: *Few* **Documents:** *No* **Help File:** *No*

In order to improve tuning procedures at the interaction point, a new option for beam-beam scans has been developed. The new "dither" beam scan option enables optimization to be less invasive than the standard scan by keeping the beams in collision during a larger portion of the scan. In addition, the dither scan measurements are expected to be more precise than standard scans.

This new dithering beam-beam scan will start at the specified position x_0, move n steps of the size Δx, and start over again at x_0. For instance, if the number of steps is 3, the beam positions will be $x_0,\ x_0+\Delta x,\ x_0+2\Delta x,\ x_0,\ x_0+\Delta x\ldots$ The number of data points for all dithering beam-beam scans will be 100 so the 1,2,3 pattern will repeat until 100 samples are taken. The range for the number of steps is limited from 2 to 5.

To support this dithering beam-beam scan, two new buttons were added to the SCAN OPTIONS PANEL. The [TOGGLE BSCN DITHER] button toggles the regular beam-beam scan to the dithering beam-beam scan and is located next to the DITHER OPTION label. The fourth line will have either scan OFF or ON depending on the type of scan selected. The second button displays the Start Position (STRT), Number of Steps (#STP), Number of readings to average internally in BPM software (#Avg), and step size (SSIZ) for a dithering beam scan and looks like [STRT -2 #STP 3 #AVG 3] with SSiz 2 appearing on the fourth line. The default values for these parameters are: Starting Position = -2 microns, Number of Steps to Use = 3, Number of BPM readings to average = 3, and Step Size = 2 microns. All of these values can be changed through the above button. With the Dithering Scan option selected, the information on this button overrides similar information on any other button such as the regular beam-beam scan buttons which also specify Range, Number of Steps, and Step Size.

On the FF BEAM-BEAM SCAN CORRELATION PLOTS panel, a label is displayed which informs the user which type of scan is selected. In the regular beam-beam scan mode, the label will display MODE: BEAMSCAN while in the dithering mode, the MODE: DITHER label will appear.

These new buttons will determine the type of scan used for Single Scans and for the optimization scans but not for Auto Beam Collides. Auto Beam Collides will never use the dithering beam-beam scans even if the TOGGLE BSCN DITHER button is ON.

The output of these dithering scans will be the average slope of the lines which best fit the points for each pass. For the optimization scans, the inverse slope will be used to find the location of the optimal beam-beam locations instead of using (width)^2 which is currently used for regular beam-beam optimization scans.

Beam scans and FB69 Fast Feedback

October 9, 1992

Author: *Gromme,Grossberg* **Subsystem:** *Final Focus* **User Impact:** *Small*
Panel Changes: *None* **Documents:** *No* **Help File:** *None*

In order to speed up IP optimization procedures, beam scan software has been modified to add an option for FB69 fast feedback to keep the beams in collision during waist scans and other tuning procedures. In between steps of a waist scan or other correlation plot scan, the feedback will keep the beams in collision in both planes, except for the actual pulses of an individual beam scan. This alleviates the need for an extra beam scan in the other plane. Furthermore, this change is needed to support the new dithering beam scan option, which has a greater need than traditional beam scans to have the beams in collision.

This feature is selected from the beam scan option panel. Toggle the BSCN Auto ReCenter button to FEEDBACK from the usual “1 PLANE” to “FEEDBACK”.

Fast Feedback Gold Orbit Actuator Updates

February 18, 1993

Author: *Phyllis Grossberg* **Subsystem:** *Fast Feedback* **User Impact:** *None*
Panel Changes: *None* **Documents:** *No* **Help File:** *Yes*

In response to a recent request, the Gold Orbit functionality has been modified so that when a gold orbit is saved, the actuator reference values for that loop are updated as well. This means that the current actuator values will be saved along with the gold orbit measurement values.

The button ‘UPDATE ACT REFS’ still exists on the Gold Orbit panel and operators should continue to use it (or associated macro buttons) at regular intervals to update the actuator reference values at times other than when gold orbits are saved. This is, of course, particularly true for loops where gold orbits themselves are not regularly updated.

History Plot Auto Scaling

November 18, 1992

Author: *Ralph Johnson* **Subsystem:** *History Plots* **User Impact:** *Small*
Panel Changes: *Some* **Documents:** *No* **Help File:** *Yes*

A new auto scaling algorithm has been implemented for the history buffer displays to provide plot scales that are not affected by *flyer* points, *i.e.* a few data points whose magnitudes are much different from that of most of the points. These *flyers* can cause the current auto scaled plots to have a *compressed* scale for most of the data. The new option is intended to avoid this scale compression.

Panels with auto scaled history plots have been changed to provide the option of the "standard" or the new auto scaling. This is implemented by providing a scaling type button which may be toggled between "Standard" and "IgnrFlyr" (ignore flyer). The current auto scale buttons have been modified to use the scaling type specified with the above button.

The algorithm for the current "Standard" auto scaling type is:

- Take 10% of the difference between the maximum and minimum points.
- Add/subtract it to/from the maximum/minimum.
- Use these values as the maximum and minimum for the y axis.

The algorithm for the new "IgnrFlyr" scaling is:

- Calculate the "standard" auto scaling maximum and minimum.
- Sort the data.
- Discard the highest and lowest 10% of the sorted data points. This is only for the purpose of calculating the maximum and minimum. The actual data to be plotted is unaffected.
- The highest and lowest data points in the remaining set of points are used as the maximum and minimum.
- 40% of the difference between these maximum and minimum points is added (subtracted) to (from) these maximum (minimum) values.
- The smaller of the maximum value and that of the "standard" maximum is used as the maximum scale value. Likewise the larger of the minimum value and that of the "standard" minimum is used as the minimum scale value.

Lattice Diagnostics Improvement

January 26, 1993

Author: *Tom Himel* **Subsystem:** *Linac* **User Impact:** *Small*
Panel Changes: *None* **Documents:** *No* **Help File:** *Yes*

Lattice diagnostics has been updated to handle the new fast feedback loops. When you run lattice diagnostics in the linac it will now automatically turn off all the linac fast feedback loops. The only exception is that it leaves LI27 on if you are not taking data downstream of LI27 (this may allow nondisruptive data taking). When it is done, it returns all the loops to their original states.

If you are doing a lot of lattice diagnostics, it is probably still a good idea to turn the loops off by hand. This will eliminate the repeated several second delays caused by lattice diagnostics turning the loops off and on.

New Measurement-Only Feedback Loops

October 05,1992

Author: *Phyllis Grossberg* **Subsystem:** *Fast Feedback* **User Impact:** *Small*
Panel Changes: *None* **Documents:** *No* **Help File:** *No*

In order to study beam conditions immediately prior to MPS trips, eleven diagnostic fast feedback loops have been created. These are in micros LI05, LI08, LI09, LI16, LI17, LI21, LI22, LI25, LI26, LI29, and LI30. Some of these loops measure electron BPMs and others measure positrons. These loops will generally take data at 120 Hz and are set up to be measurement-only and their HSTAs can only be set to SAMPLE or OFF. These are accessible from the fast feedback MAIN panel, and it is usually necessary to select the "Next Feedback" button to access them.

The ringbuffers for these loops will be frozen whenever an MPS trip occurs, *i.e.* whenever the beam rate drops to less than 5 Hz. The ringbuffers will remain frozen until either two minutes have passed or until they have been reacquired. This allows the BPM measurements in these micros to be saved for beam pulses immediately before an MPS trip. It is expected that a button macro will be created to acquire the ring buffer data and save it to MATLAB for later analysis.

SCP CUD Control Panel

February 25, 1993

Author: *Ralph Johnson* **Subsystem:** *SLC* **User Impact:** *Small*
Panel Changes: *None* **Documents:** *No* **Help File:** *No*

Three of the CUD displays update their information asynchronously whenever they receive a message from some other processes. These include the Device Summary display, the MPS Summary display, and the Faults List display. Each receives a message from the SIP process whenever a change of status occurs. Therefor manually changing the update rate for these displays will not improve their response to changes. As a result, these three displays are now designated as "async" and their rates cannot be changed from touch panel buttons. These buttons now show "ASYNC" as the rate.

Additionally, if you turn the HSTA off for a given CUD display, a message will now appear on the screen to tell you that the display is off. Previously the screen simply went blank. Now if the screen is blank, the monitor (not the display) has been either turned off (HSTA off) or it is broken.

Deflection Scans with Non-round Beams

February 20, 1993

Author: *Nan Phinney* **Subsystem:** *Final Focus* **User Impact:** *Small*
Panel Changes: *None* **Documents:** *No* **Help File:** *No*

To support running "Flat" beams to the IP, the beam-beam deflection fitting software has been enhanced to correct the estimated beam sizes when the horizontal to vertical aspect ratio is not equal to 1.0. The correction is necessary because the deflection scan fitting software assumes that the beams are round in order to simplify and stabilize the fit. This assumption was not strictly correct even for 1992 running conditions since emittance growth in the Arcs causes the horizontal beam size to be larger than the vertical. It is also not correct during a waist or other optimization scan where, at the extremes of the scan, the beam size is increased in the plane being optimized. For most types of optimization, this is not a problem because the minimum beam size is found correctly regardless of whether the size measured at the extremes of the scan range is exactly right. For waist scans, however, the steepness of the parabola also gives an estimate of the angular divergence so it is important to measure the beam size correctly at all points in the scan. For this reason, "Round" waist scans, where both horizontal and vertical waists are moved together to keep the aspect ratio close to 1.0, have been routinely used to accurately measure angular divergence.

A simple method for correcting the "round" fit beam sizes was proposed by Volker Ziemann.

Let R (Aspect Ratio) $= \frac{\Sigma_x}{\Sigma_y}$ (measured)

For $1.0 < R < 1.9$

$$\Sigma_x(\text{corrected}) = (0.78 + 0.22 \times R) \times \Sigma_x \text{ (measured)}$$

$$\Sigma_y(\text{corrected}) = (1.36 - 0.36 \times R) \times \Sigma_y \text{ (measured)}$$

For $1.0 < 1/R < 1.9$ ($\Sigma_y > \Sigma_x$)

$$\Sigma_x(\text{corrected}) = (1.36 - 0.36 \times 1/R) \times \Sigma_x \text{ (measured)}$$

$$\Sigma_y(\text{corrected}) = (0.78 + 0.22 \times 1/R) \times \Sigma_y \text{ (measured)}$$

This correction has been added to both the auto collide and to the optimization scan software. On the auto collide display, a new line above the luminosity summary gives the corrected beam sizes, the measured aspect ratio, and the luminosity correction factor. The corrected beam sizes are now stored in the database and in the usual history buffer locations. For tracking purposes, the uncorrected sizes are stored in the IPBM secondary WIDU, the individual width correction factors in WCOR and the aspect ratio and luminosity correction in LCOR. All of these items are available in the history buffers.

The correlation plot software for deflection scans has been upgraded to apply the same correction to the fitted beam size as long as the out-of-plane recentering option is being used. The out-of-plane scan is necessary to provide a measurement of the other plane beam size for the aspect ratio calculation. In a future release of the optimization software to support round waist scans, this recentering option will be automatically selected for waist scans. For now, it is recommended that the operator manually select 1-Plane centering when measuring the angular divergence. Note that with the correction applied, the divergence measured with round waist scans should be the same as that measured with single x or y waist scans.