Emittance GUI

Scope

This graphical user interface (Fig. 1) for Matlab enables the measurement of the projected and slice emittance of the LCLS electron beam at various OTR/YAG beam profile monitors and wire scanners using a multiple screen scan or a scan with varying quadrupole strength. The software displays the measurement results and can save and load the measurement data. Program settings can be saved and retrieved in a configuration file.
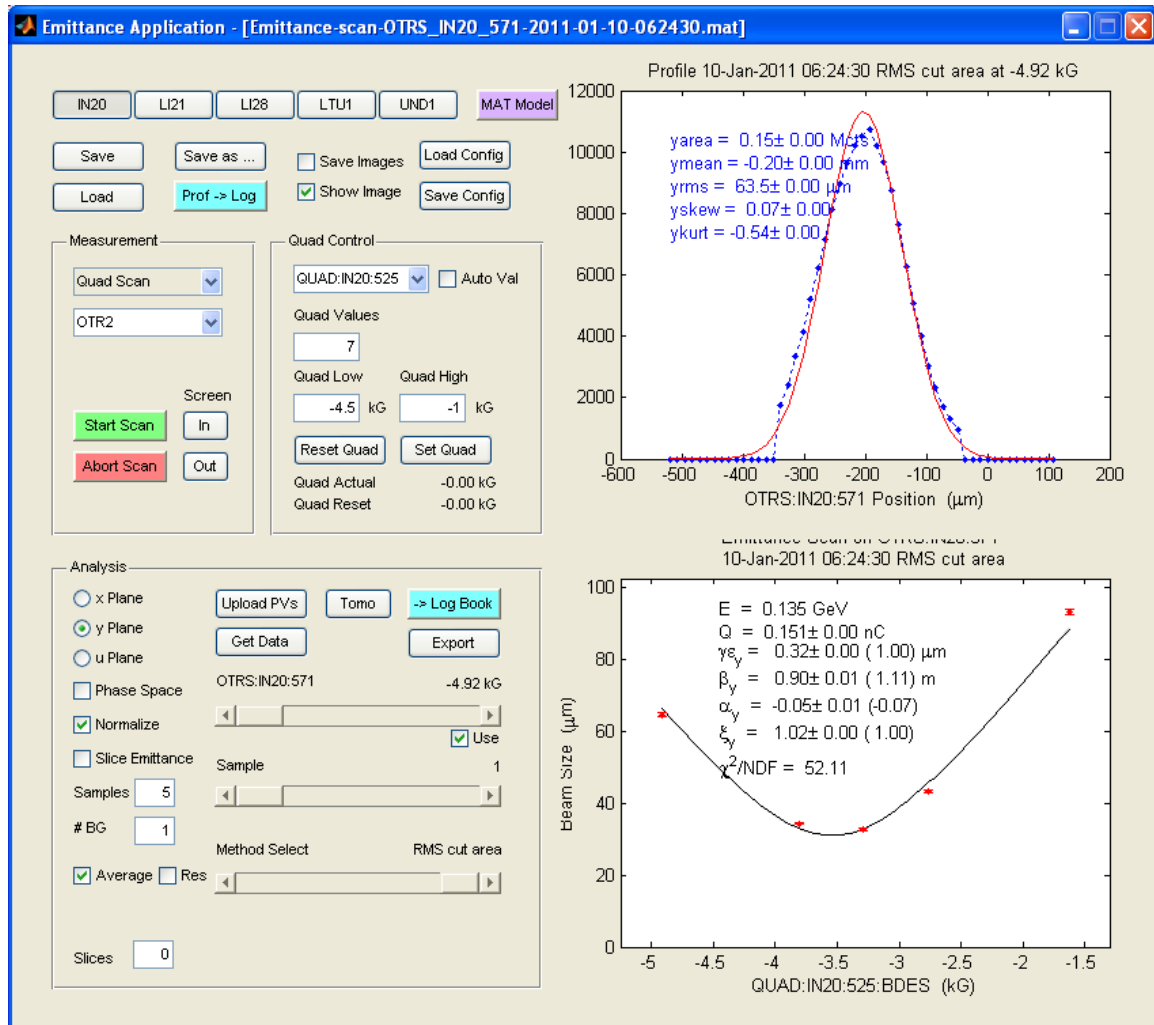

Figure 1: Graphical user interface for emittance measurement

Usage Procedure

1. Start program. For LCLS, on the LCLS Home Screen, open User Dev Displays and then select Emittance GUI. For NLCTA, select Emittance GUI from the NLCTA_guiLaunch screen. Alternatively (for either accelerator), type emittance_gui from the command line in a Matlab session.
2. Select measurement method Multi Screen or Quad Scan.
3. Select the desired accelerator region.
4. Select measurement location, YAG/OTR screen or wire scanner.
5. For a quadrupole scan, select the quadrupole to scan and the scan range for that quadrupole. The config for the program stores the quad name and its range for each screen, so the selection at program start should be useful.
6. If the quadrupole selection or range was changed and deemed permanent, save the present configuration with Save Config.
7. Check if the Quad Reset value corresponds to the actual value in the control system.
8. If a wirescan is requested, select the plane, x Plane or y Plane.
9. For a slice emittance measurement, select the number of Slices and the slice window size SliceWin. 2.5 (in multiples of the beam size) is usually a good value. Select the desired emittance plane x/y Plane. The slicing is done in the perpendicular direction. All the slicing related parameters can be changed after the measurement as well.
10. For YAG/OTR screen measurement, select the number of images (Samples) per quad setting or screen location. Depending on beam stability, 5 to10 shots are reasonable. Select number of background shots (#BG); 1 shot is usually sufficient.
11. Autoval can be used to calculate the correct range for the quad settings using the machine model. If selected, two other options become visible. Twiss Act. will use the Twiss values of the extant machine parameters to calculate the quad values. XY will choose the quad values such that both the X and Y plane will have curves as symmetric as possible with a measured value near the minimum.
12. Start the acquisition with Start Scan.
13. If the measurement was successful, the program will display a new emittance measurement.
14. After a quad scan, check if the Quad Actual value equals the Quad Reset value.
15. If the measurement has to be aborted use Abort Scan. If this doesn't work, abort the program using CTRL-C.
16. 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.
16. If a quad scan was aborted, press the Quad Reset button to put the quad to its original value.
17. Play with the Average, Phase Space, and Normalize check boxes and the Method Select slider until happy with results.
18. The Res check box will account for the resolution due to the wirescanner wire size.
19. The Get Data button will allow for collection of a new data point at the given quad setting or screen selection.

20. After a slice measurement, use the Slice Emittance checkbox to display a slice summary plot. Play with Slices number and window size SliceWin until happy. Each change however can take a long time to process.
21. If the emittance is below 1um, press the ->Logbook and Save buttons. The Upload PVs button will store the results in PVs.
22. If the emittance is above 1um, increase effort.
23. Subsequent scans. If the program doesn't respond to Start Scan, press the Abort Scan button and try again.
24. If at start of quad scan the actual quad value in the control system differs from the Quad Reset value stored in the program, a dialog box will appear and inform the user of the situation. Depending on the cause of the discrepancy two different actions are recommended. If the actual value is wrong because the quad was left at an undesired value due to a program crash or abort, choose to keep the Quad Reset value and the quad will be set to the nominal value after the scan. If the actual value was deliberately changed to obtain a different matching since the last quad scan, choose to discard the Reset Value and take the present value as the new Reset Value.
25. The Tomo button enables a tomographic reconstruction of the beam. Choose the desired algorithm (SART, CBRT, SART_SP, SART_SPN, or MENT) from the pulldown menu and press Run.