

THE CORRELATION PLOT AND PHENOMENA ANALYSIS FROM ARCHIVES DATA

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Abstract

In order to analysis the operation status during the users' beam time, a historical data analysis program can help the accelerator engineers and physicists to identify potential problems, find the solutions to abnormal operation status, or trace the inappropriate operation procedure of the storage ring. A workstation and PC based programs have been established to plot out the key signals. Simple algebra operation can also be performed during the analysis process. Some typical situation will be given to illustrate the performance of the ring and the functioning of the analysis program.

1 INTRODUCTION

The control system of SRRC is a two levels system which consist of a low level VME based controller and an upper level process computer [1]. Thess two levels system are linked by Ethernet and four layers' software structure. The software structure can be roughly cataloged as device, network, database, and general application levels.

The control database which includes the static and dynamic database is created on the console level. It is treated as data buffer between the low level tasks at VME crate system and console level applications. The application programs get devices' parameters from database. Many applications are coded and run at console computer, such as data achives, alarm checking, real-time.

The signal archives program which logs data for long term analysis has been activated about four years. It was designed to take data at one minute interval. It creates around 500 signal files a day. Control group has tested the time required on file accessing by the data archives program in order to test the possibility of increasing the resolution of the archives data. The testing results indicated that the program occupies too much computer resource on the I/O, if still remains in current archives algorithm. Some new technique needs to be developed to increase the archives speed.

In order to support NFS server to make the file accessible from NFS clients, the data format was changed to ASCII coding.

The major reason to develop a history plot program was to provide the accelerator engineers and

physicist to have a quick tool to analysis the archives data in graphics, and identify the potential problems. This program adapts the saving format of archives data format. Appropriate interpretation of the archives data also has been checked in the program. The accessing channel to the console computer is using the Ethernet to accessing the archives data.

2 THE BASIC FUNCTION

2.1 Printing, filing, and Editing Service

A PC based analysis program was written in C++ and developed under the MS Window environment. It supports all of the printing and filing service functions which are available to MS Windows applications. Basic graphical editing tool is also available in the program in order to integrate with users' application program.

As the program was executed, it will check the available communication software, hardware and network connection automatically. Once the program connected to the archives file server, it will generate a listing of available signal name.

The archives data format has been altered from binary to ASCII. It is possible that accessing archives data is mixing binary format with ASCII format. The program was programmed to distinguish the file format automatically. The retrieved data can also be saved as readable ASCII format as an input file for commercial program.

2.2 Weekly Report

A weekly operation meeting requests a general report of machine available ratio and machine status. The program will generate a weekly report with beam current and beam lifetime in daily frame. The statistic data of users' beamtime, schedule, and the available ratio was summarized.

The calculation of the beamtime available ratio is based on the following default assumptions,

- 1) the stored beam current must be over 50 mA,
- 2) the time leap of stored beam must be over 10 minutes,
- 3) the current is in decaying situation.

The storage ring will take about 10 minutes to complete the reinjection process which includes reloading the transport line lattice, opening the insertion

devices, turn on the pulse magnets, etc. The estimated reinjection interval is about 5.2 hours. The average injection time is 150 minutes each week. Hence, the beam time available rate will not be better than 98%.

2.3 History Plot

From the archives data, it is possible to find out the causes of the beam lifetime change and potential components failure. In default mode, horizontal axis is the time stamp for all selected signals. The vertical axis is absolute coordinate for all signals. In overlap mode, the vertical numbering is using each signal's maximum and minimum as the topmost and lowest value in the graph. The maximum and minimum range is listed as legend for each signal. Some basic algebra operation function also offered to analysis the signals' correlation. If specify the mathematics operation among signals, the program will perform point to point operation and generate a new function curve.

2.4 X-Y Plot

The x-y plot has an option to select a signal as reference variable in x-axis. The rest of signals will be plotted in the graph as function of the selected reference variable. The coordinates of the data points shown on the window can be traced at the right hand side window. Mouse can also be used to select the desired zooming range.

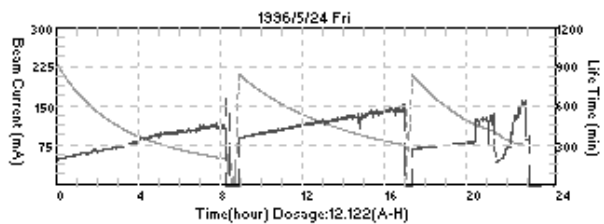
3 ILLUSTRATION

3.1 Weekly Report

The users' beam time is scheduled 80 hours per week. One of typical example of the weekly report was shown in Fig. 1. Only one quarter of the whole graph was shown in Fig. 1. Each day has a single frame with beam current and lifetime plotted. Seven frames of beam current and lifetime plus a summary section constitute one page of weekly report. Figure 1 shows that the available ratio for users' shift of the fourth week of May 1996 reached 96.5%.

3.2 X-Y Plot

Figure 2 gives a plot of the beam current vs. the beam life time. The average beam life time is around 5 hours. It could be used as comparison between different operation model. The installation of small gap vacuum chamber at straight section is one of examples that will affect the operation model. Generally speaking, the beam life time will reduce due to the shrinking of vertical chamber size. The skew quadrupole is one of the useable instruments to increase the coupling in order to compensate the lost beam lifetime.



USER TIME
Weekly Dosage:13.083(A-H)
Available(Working day) use ratio:96.54%
Mon 11:16 Tue 0:16
Wed 0:16 Thr 0:16
Fri 0:16 Sat 0:11
Sun 0

Figure 1. One quarter diagram of the weekly report. The users' beam time schedule each day is listed. The available ratio for users' shift of the fourth week of May reached 96.5%.

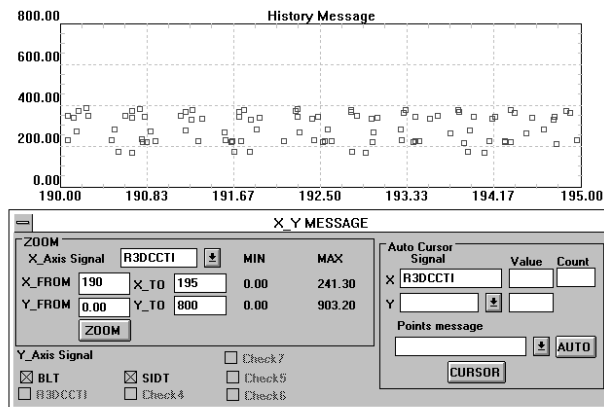


Figure 2. The image screen of the x-y plot, the beam current was chosen as reference x-axis, the vertical axis is beam lifetime and accumulated dosage.

3.3 History Viewer

Figure 3 shows a case of the life time decaying much faster than expected during normal operation. A failure of a vacuum related component was suspected. The front end, a welded bellows, of W20 was found as leaking source. The leakage caused local pressure increase. The stored beam scatter with sneaky air which reduced the beam life time dramatically. At time stamp around 11:20 the wiggler was opened in order to identify the leakage from the beamline or the vacuum chamber around the ring.

3.4 Algebra Operation

The beam lifetime is proportional to the product of beam size and inverse proportional to the number of stored charge [2]. Figure 4 shows that the beam size [3] in x direction is decaying with the beam current and

beam size in y direction is increasing as the beam current decaying. If we multiply the beam size in x and y direction divided by beam current, the generated curve reflects a similar curve to the beam life time. The beam size also has a sudden change around 6:00 with unknown reasons.

3.5 Abnormal Manipulation

Automatic tune correction program for W20 was under testing during machine study shift on January 30, 1996. The tune correction program did not shut off after experiment. Figure 5 shows that at users' beam time around 2:40 the beam became unstable. The operator increased the sextupole strength in order to increase the damping mechanism and adjusted the focusing quadrupole a little bit. System was ready for injection around time stamp 8:00. The tune correction program adjusted the quadrupole setting according to gap value of W20. During the new users' shift, beam still remained unstable. The operator reloaded the working lattice. Beam remained unstable and lost occasionally during the users' shift. It was found that the betatron oscillation in x direction near the third resonance during the users' beam time.

4 CONCLUSION

The analysis tool is offering a quick diagnostic instrument for accelerator physicists. However, the one minute updating rate will limit the analysis capability of fast events. It is a good tool to analysis the signal which has long term fluctuation. A mathematics correlation function with rank between two signals will be built as intrinsic function to enhancing the program in the near future.

Using this program, we also proved that the dipole power supply could not sustain constant current drive at full current excitation test. Part of the reason is due to the connection joints of the dipole magnet degrading which could increase the overall ohmic resistance. Some part of the reason is due to the power calculation is too close to the margin of the power supply. The drifting of the output dipole current will cause sever tune drifting and possible beam lost during the energy ramping. The problem was corrected by enhancing the transformer of the power supply and rechecking the all connection joints of all magnets.

Beam lifetime drop induced by the change of the orbit, which is due to the malfunction of the control card of the correction magnets, also has been identified. Dust trapping or ion trapping effect also has been observed occasionally. These trapping effects could cause the change of beam life time. The cavity-like effect, which could induce RF heating locally, has been observed around the storage ring.

5 REFERENCES

- [1] J.S. Chen, etc. "A graphical User-Interface Control System at SRRC" , PAC, 1993, 1878-1880.
- [2]M.S. Zisman, etc. " Zap User's Manual", LBL-21270, 1986, 173.
- [3] C.H. Kuo, etc. "Transverse Profile Measurement System at SRRC", EPAC, 1994, 1646-1648.

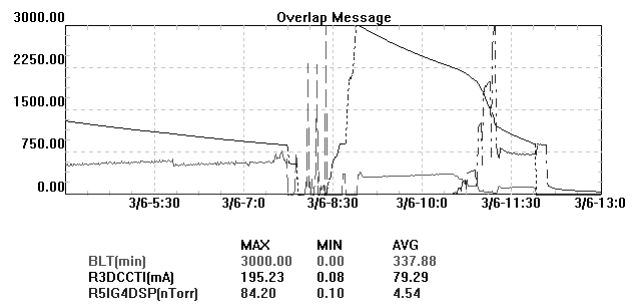


Figure 3. The front end, a welded bellows, of W20 was found as leaking source which induced the local pressure increase and beam lost.

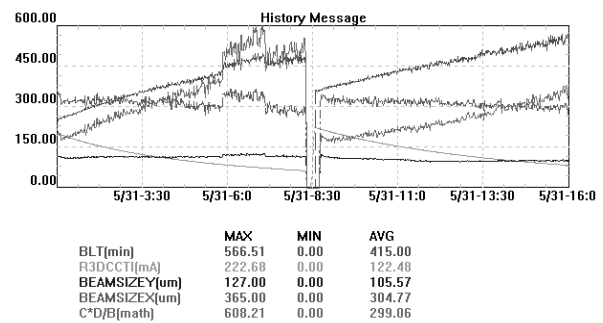


Figure 4. The illustration of the mathematics function of the program. The new function, which is proportional to beam life time, is equal to the product of beam size divided by the beam current.

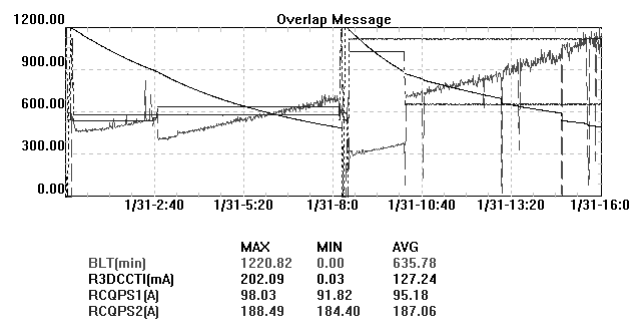


Figure 5. The typical example of historical graph. Abnormal operation procedure was found.