STATISTICAL ANALYSIS PACKAGE FOR THE OPEARION MONITORING AT THE TLS*

Yao-Kwang Lin†, Hsin-Hui Chen, Hung-Chiao Chen, Jar-An Li, Szu-Jung Huang, Changhor Kuo, An-ping Lee, NSRRC, Hsinchu, Taiwan

Abstract

Machine operation parameters and interruptions to user beam at Taiwan Light Source (TLS) and Taiwan Photon Source (TPS) are recorded in databases. The data retrieve to TLS uses the File Transfer Protocol (FTP) with two separated databases 10 Hz and 0.1 Hz for quick or detail data analysis options. TPS data storage uses the open source database PostgreSQL.

A statistical analysis package HISTORY has been written in Microsoft Visual C to perform operation monitoring and data mining. Operation and failure statistics functions are produced for performance evaluation and User Administration & Promotion Office user time statistics.

INTRODUCTION

The HISTORY layout is clear and easy to use. Quick function keys are on the top of window for database selection, parameters pickup and specific operation statistics [1]. More plot functions are also included in the top function keys (see Fig. 1).

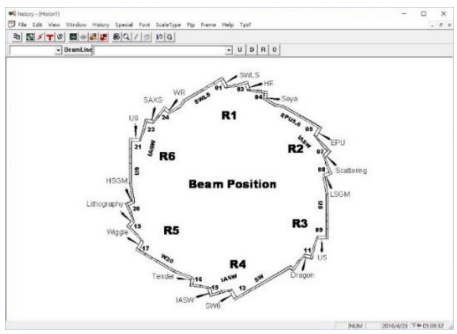

Figure 1: Layout of HISTORY.

The TLS operation plot for specific day is generated by HISTORY (see Fig. 2). The plot shows several critical operation parameters including beam current, beamline photon deviation, beam size and fault time mark [2].

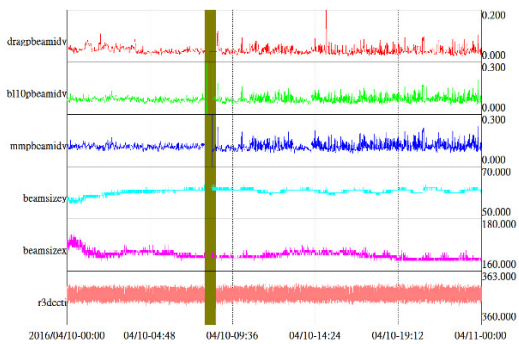

Figure 2: Graphic plot for operation period.

* Work supported by National Synchrotron Radiation Research Center
† glory@nsrrc.org.tw

OPERATION STATISTICS

Periodic operation report is important for performance review and user time statistics. HISTORY includes two different function to generate operation report [3].

MonthR3

MonthR3 function can generate a standard form of operation report including downtime period and percentage. The generation steps are:

- Use special function to select specific signals (see Fig. 3).
- Specify beam current threshold and user time period for each day (see Fig. 4).
- The monthly operation report is generated as text file for further process with Excel template (see Fig. 5).

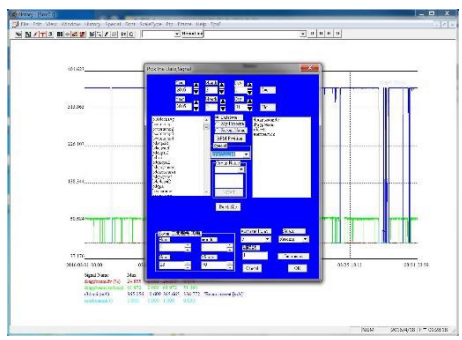

Figure 3: Special function selection.

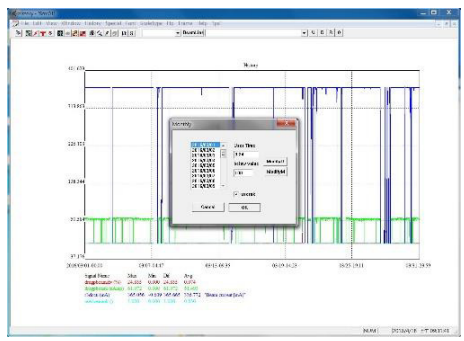

Figure 4: Specify setting values.

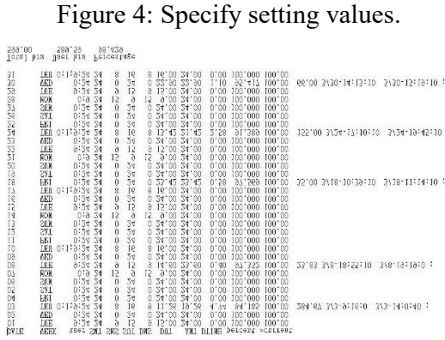

Figure 5: Generated operation report.

ISBN 978-3-95450-147-2

MonthIO

MonthIO is the simplified version of MonthR3 to generate quick operation report. The report displays the user time percentage for operator quick review (see Fig. 6).

```
DATE       usertime <stab percent
2016/03/01      9:24 0.100 99.889
2016/03/02      0:24 0.100 98.955
2016/03/03 0:1;9:24 0.100 98.656
2016/03/04      0:24 0.100 98.830
2016/03/05      0:24 0.100 99.073
2016/03/06      0:24 0.100 99.375
2016/03/07       0:9 0.100 98.054
2016/03/08      9:24 0.100 99.422
2016/03/09      0:24 0.100 98.796
2016/03/10 0:1;9:24 0.100 99.444
2016/03/11      0:24 0.100 97.986
2016/03/12      0:24 0.100 99.306
2016/03/13      0:24 0.100 99.722
2016/03/14       0:9 0.100 98.148
2016/03/15      9:24 0.100 98.814
2016/03/16      0:24 0.100 99.120
2016/03/17 0:1;9:24 0.100 99.667
2016/03/18      0:24 0.100 99.585
2016/03/19      0:24 0.100 98.865
2016/03/20      0:24 0.100 98.643
2016/03/21       0:9 0.100 97.994
2016/03/22      9:24 0.100 99.574
2016/03/23      0:24 0.100 99.931
2016/03/24 0:1;9:24 0.100 98.076
2016/03/25      0:24 0.100 97.140
2016/03/26      0:24 0.100 98.194
2016/03/27      0:24 0.100 98.958
2016/03/28       0:9 0.100 98.889
2016/03/29      9:24 0.100 98.574
2016/03/30      0:24 0.100 99.523
2016/03/31 0:1;9:24 0.100 99.611

Total Average Percent 98.929
```

Figure 6: Quick operation report.

ORBIT TRACKING

The beam trip event should be tracked for serious interruption of user time. Orbit change is important to clarify the event characteristics. The special function 'Difference' in HISTORY can track the beam orbit based on beam position monitor (BPM) signals (see Fig. 7).

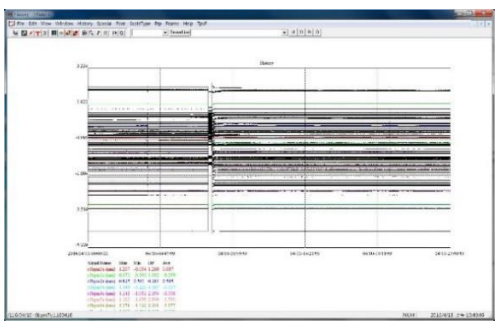

Figure 7: TLS bpm signals.

It shows the graphical orbit difference through predefined golden orbit. The golden orbit should be solid reference in stable beam condition. Target means the orbit for event monitor (see Fig. 8). The special function 'Difference' shows the difference of golden and target orbit with graphical plot. 'Difference' provides an easy way to monitor the continuous orbit difference plots.

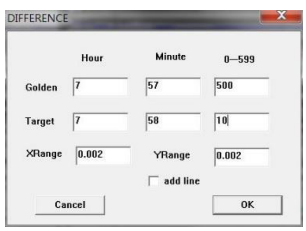

Figure 8: Specify setting values.

The orbit change on specific time can be monitored with graphic mode. Figure 9 shows the orbit change of final moment before beam trip event. The 1st and 2nd figures shows the 2/10 and 1/10 second orbit difference before beam trip. The 3rd figure shows the orbit difference on beam trip time for tremendous BPM values.

'Difference' function can also be used to check beam stability or suspicious pattern. Storage ring parameters can be optimized with this orbit tracking tool.

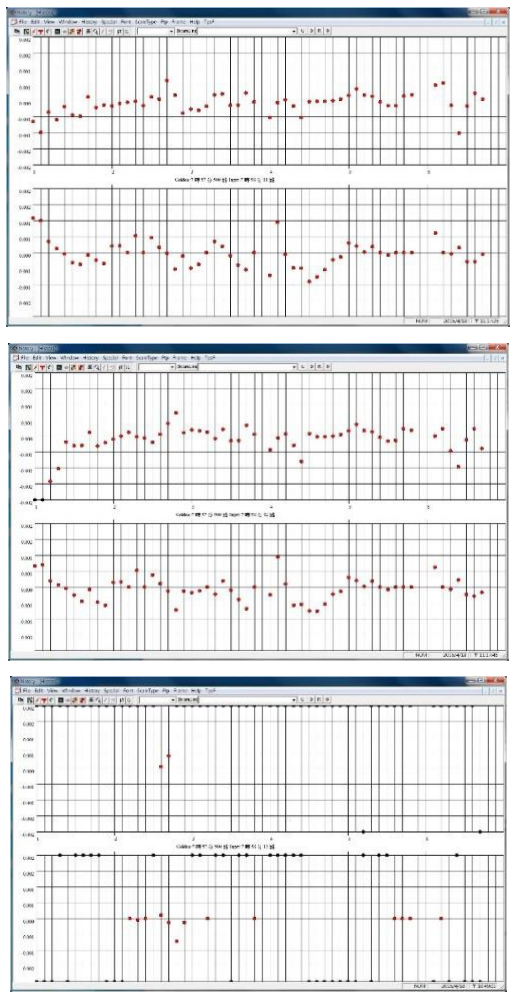

Figure 9: Orbit tracking on beam trip.

BEAM TRIP AUTO LOGGER

Retrieving history data is important for beam trip debug. Because database capacity is limited by hard disk size, the operation data will be replaced by new data after period time. The task how to keep the beam trip data is critical for trip event debug.

HISTORY provides the auto logger function to save all 510 signals value on trip event. When HISTORY runs on Windows PC, the operation parameters are monitored. The logger function will start up if once beam trip event happens (see Fig. 10).

HISTORY includes the function to retrieve the logger saved data with graphical plot. Part of saved files are selected with function window and HISTORY generates the graphical plot (see Fig. 11).

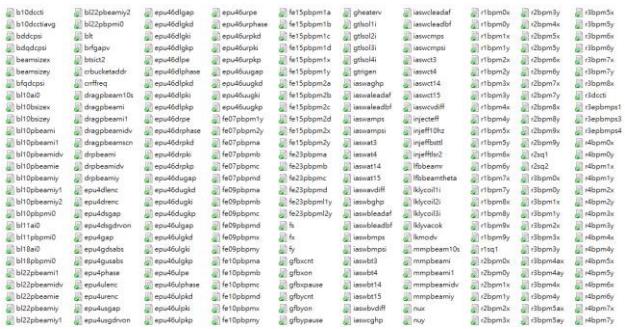

Figure 10: Auto logger saved data.

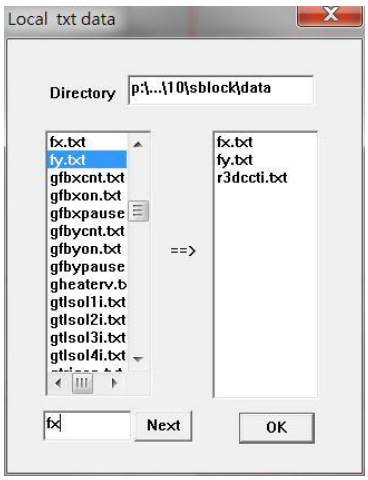

Figure 11: Retrieve auto logger data.

CONCLUSION

The application program HISTORY provides the instant examination of relevant parameters. It gets the benefit to acquire archive data from various servers, like VAX, UNIX, and Windows. Parameters correlation to specific event is the most important function for detail accelerator status check, including photon beam stability, life time, chamber vacuum and cavity temperature.

The HISTORY provides variety of functions for daily, weekly, monthly monitor on operation, beam stability, beam trip debug. Parameter fluctuation for long term can be analyzed by this tool. The new special function is under development for operation monitor. The main functions are linked to TLS database. However part of the main functions also implemented to TPS database for commission reference.

REFERENCES

[1] Y.K. Lin, G.H. Luo, C.C. Kuo, K.K. Lin, Development of a Machine Status Program “HISTORY” and its Application to Beam Stability Analysis, Proceedings of EPAC2000, Vienna, Austria.

[2] G.H. Luo, Glory Lin, K.T. Hsu, C.C. Kuo and I. Hsu, The Correlation Plot and Phenomena Analysis from Archives Data, Proceedings of EPAC96, Barcelona, Spain.

[3] Yung-Sen Cheng, Archive System Introduction, Training Course for TPS Commissioning, NSRRC, Hsinchu, Taiwan, June 19, 2014.

ISBN 978-3-95450-147-2