Visualization Tool for Linac Control System

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Abstract

We consider the use of data visualization software in the SPring-8 linac control system. Some commercial products were evaluated with respect to the display functions, user interface and link to the operation process. It was found that the use of these products was possible and helpful for the control and study of the accelerator.

1. Introduction

Recently there is a remarkable progress in the visualization technology which is applied in various field. The scientific visualization is also increasing its importance as the phenomenon becomes more complex. Displays of multi-dimensional data in an easily understandable form are remarkably effective in providing rapid and detailed insight and understanding of complex three-dimensional structures, time-varying processes or correlation among many parameters. There are many kind of displays, for example, 2-D graphs, 2-D line and shaded contours, 2-D images, mesh and shaded surfaces, 2-D and 3-D vector fields, 3-D iso-surfaces, 3-D volumetric rendering, 2-D slices of 3-D scalar fields, 3-D particle tracing and so on.

Nowadays there are many commercial products of the software for the scientific visualization. If they can be used in the operation system, the graphical display process becomes powerful in the machine study.

In the accelerator field, many kinds and lots of data will be acquired as its control system is developed. As a result the visualization of stored data will be necessary. In this report, the data visualization in the SPring-8 linac control system[1] is considered and the results of the evaluation for some commercial products are described.

2. Data Visualization in the Linac Control System

The control system of the linac consists of the VME computers which control devices directly and a host workstation which acts a role of the man-machine interface and sends control commands to the VMEs. The details of the system are described in other sections in this annual report. Every operation and parameter, which includes machine parameters, status, beam parameters and so on, will be recorded in the database. The analysis of these data must be needed for the automatic tuning of the machine without experts of the traditional accelerator operation.

The kinds of the parameters and the quantity of data will be huge and there is a great importance in the software tool for displaying such data in many forms which enable the operator to understand the correlation among parameters. Such a tool is also expected to have functions of the statistical analysis, fitting, data handling and so on. Furthermore, it should be possible that the visualization process is called by the operation process and the parameters are shared in them.

3. Evaluation of Visualization Softwares

We evaluated two visualization software products. One is AVS[2] released by Advanced Visual Systems Inc. and the other is PV-WAVE by Visual Numerics Inc. These were installed on a workstation, DEC3000-model300 (OpenVMS AXP). The evaluation was done with respect to the user-friendly interface which is needed for operators and whether the visualization process can be called by the external process which is needed for the link to the operation process.

In the AVS, every function is moduled and displayed by icons on the screen and a user sets up these modules by using a mouse instead of typing a keyboard for programming. This feature enables machine operators to visualize the data easily and in a short time. A sample screen of the network editor which is shown in Fig. 1. In the network editor, many modules for a data input, filtering, mapping and a data output are provided. Since the modules created by AVS users in the world are collected by the International AVS Center and these can be obtained from the FTP servers, we can use these resources. In the displaying function, AVS have excelled in imaging and volumetric rendering rather than 2-D graphs. But recently AVS Inc. cooperates with UNIRAS and AVS includes UNIRAS's powerful graphic routines. Unfortunately AVS dose not support OpenVMS from version 5.2 though we will use OpenVMS for the operation system.

The other software, PV-WAVE (PV-WAVE

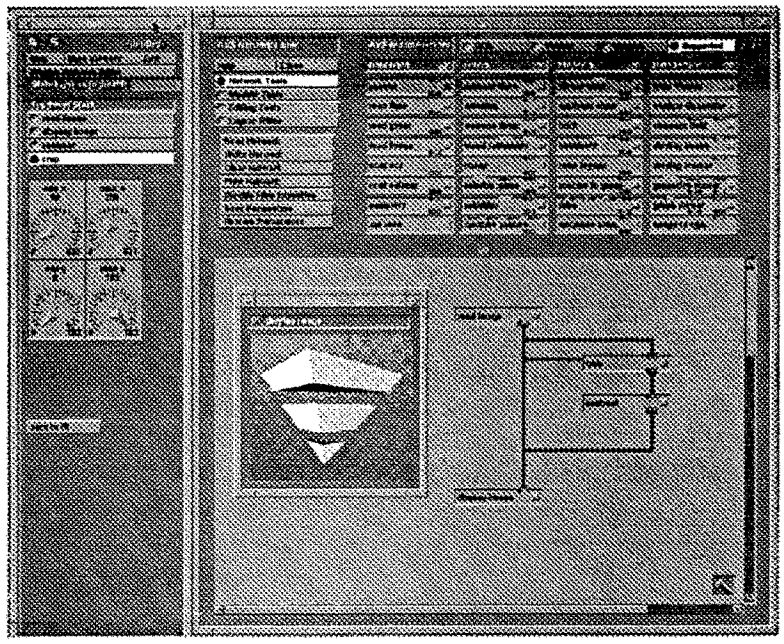

Fig. 1. Sample screen of network editor in AVS

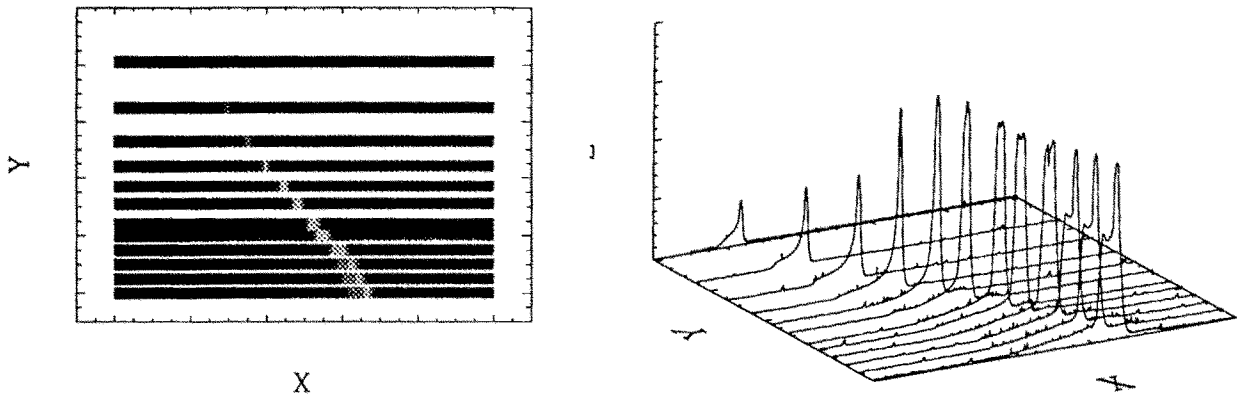

Fig. 2. Sample plots by using PV-WAVE

advantage) was also evaluated. Because PV-WAVE itself does not have graphical user interface (GUI) as AVS dose, users must write a program for displaying data. However there are WAVE functions for building GUI on the X window system, therefore it is possible to build GUI in the case of routine operations. WAVE functions can be called easily from the external process. With respect to this function PV-WAVE seems to be superior to AVS. Example plots by using PV-WAVE are shown in Fig. 2.

From this evaluation, it was found that AVS was suited for an off-line analysis of data and PV-WAVE for a linked use to the operation process.

4. Conclusion

The data visualization in the linac control system was considered and two commercial products of the visualization software were evaluated. These products can be used in the control system and save man powers. Furthermore, such kind of tool will be also useful for the expression of experimental data in the SPring-8.

References

[1] H. Yoshikawa et al., "Design of the control system for the injector linac of SPring-8", Proceedings of the 16th linear accelerator Meeting in Japan, September 1991.

[2] Upson Craig, Thomas Faulhaber Jr., David Kamins, David Laidlaw, David Schlegel, Jeffrey Vroom, Robert Gurwitz and Andries van Dam. "The Application Visualization System: A Computational Environment for Scientific Visualization." IEEE Computer Graphics and Applications (July 1989), Vol.9, No.4, pp 30-42.