DEEP-SEATED CANCER TREATMENT SPOT-SCANNING CONTROL SYSTEM

W. Zhang, S. An, G.H. Li, W.F. Liu, W.M. Qiao, Y.P. Wang, F. Yang,
IMP, LAN Zhou 730000, P.R. China

Abstract

System is mainly composed of hardware, the data for a given waveform scanning power supply controller, dose-controlled counting cards, and event generator system. Software consists of the following components: generating tumor shape and the corresponding waveform data system, waveform controller (ARM and DSP) program, counting cards FPGA procedures, event and data synchronization for transmission COM program.

INTRODUCTION

HIRFL cooling storage ring (HIRFL-CSR) is a national big science project. It consists of injector (SFC), beam transport line, the main loop (CSRm), experimental ring (CSRe) and connecting to the main ring and the ring of secondary radioactive beam experimental line (RIBLL2) and other components, the total length of about 500m [1]. Figure 1 show an Overall Layout of HIRFL-CSR. It is the heavy ion beam acceleration, accumulation, cooling, storage, and then proceeds to internal / external target experiments and high-resolution particle detection of large-scale experimental apparatus. It's built and put into operation for the physical and related research, experiments provide a good platform. Since 1995, Institute of Modern Physics, Lanzhou heavy ion accelerator using cooling storage ring (HIRFL-CSR) to provide heavy ion beams to carry out the biological effects of heavy ion beam irradiation and its mechanism, has laid a heavy ion beam cancer treatment technology base[4]. In 2009, we built on the HIRFL-CSR depth treatment of the terminal used for deep tumors. The control system is to realize the point of scanning mode in deep tumors.spot-scanning system of deep tumors is to solve the scan uniformity and conformal requirements automatically carried out.

SYSTEM STRUCTURE

The system mainly consists of hardware and software. Hardware to complete the scan waveforms output, measured data channel count and the establishment of the function. Software for data processing, transmission and analysis capabilities. System components as shown in Figure 2.

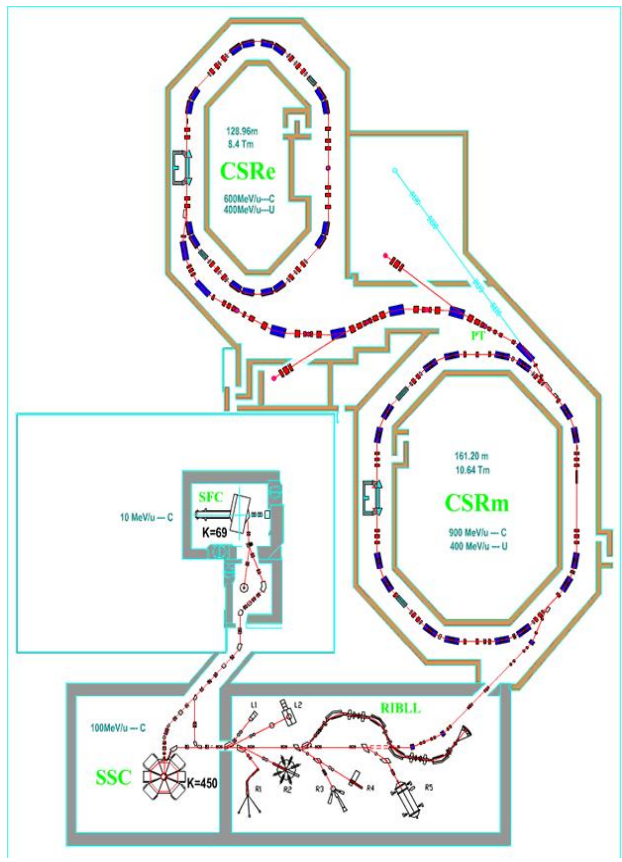

Figure 1: Overall Layout of HIRFL-CSR.

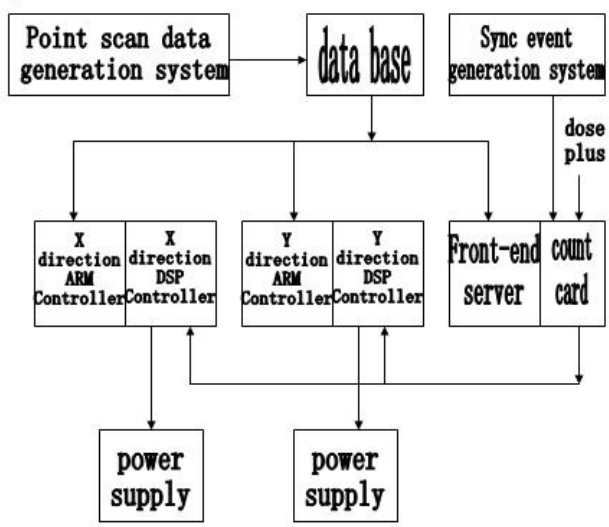

Figure 2: System components.

HARDWARE COMPOSITION

The hardware is composed of the data waveform controller hardware, counters and event generator system. The data waveform controller designed by our own is by the ARM controller and DSP controller composition. ARM controller is responsible for contact with the database. It requires the output of the waveform data from the database, then put it into a format defined by DSP controller memory. DSP controller is responsible for the corresponding input data processing, and the corresponding required output waveform. Counting cards is by our own design of the FPGA controller. It is the main achievement of the input dose pulse count and pulse required to issue hop and protection signals. Event generator system is also designed by our own FPGA controller. It is mainly to achieve our own definition of the output pulses formed by a series of examples, for the synchronous control system equipment.

SOFTWARE COMPONENT

There are three main parts. The first part is the bottom of the control equipment procedures, including ARM controller, DSP controllers, counters, and event generator system program. The second part is to generate waveform data corresponding to the tumor shape and the program. The program is the main interface operating procedures in deep spot-scan. The interface shown in Figure 3[2]. The third part is the transfer case and the COM data synchronization process [3]. It implements the DSP controller output waveform database and data synchronization, Provide the conditions for the active transformation of energy. The fourth part is the output signal monitoring procedures. It implements the DSP controller, real-time monitoring of the output waveform. The monitoring interface is shown in Figure 4 [2].

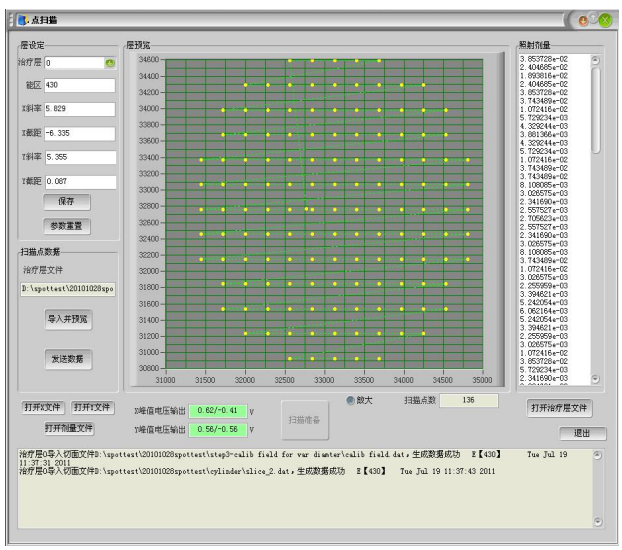

Figure 3: Interface operating in deep spot-scan.

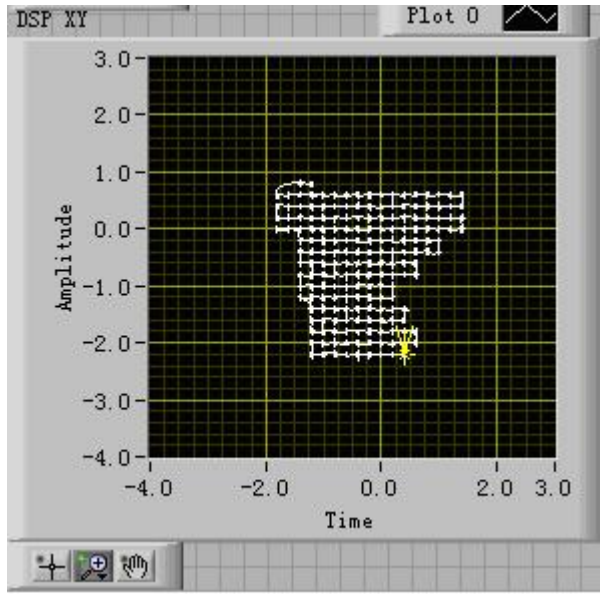

Figure 4: Output signal monitoring interface of DSP controller.

WORK PROCESS

The shape and the points according to the tumor dose requirements，Prepared using our own point of scan data generating system generates the appropriate power supply output data and counting card data。And the data pass the database, when the database receives the data, it will simultaneously transmit data to the corresponding ARM and the front-end servers。The ARM will then pass the data in DSP, waiting for the trigger pulse to the output after the。At the same time front-end server will count card data transmitted through the PXI bus, counting cards. When the count received by sync event generator card issuing an example of the start of scan, the count of cards received by the dose given detector pulse began to count, When the count to the count stored when the card count to send a pulse to the DSP, DSP receives a pulse from the current output value will be a smooth transition to the next treatment point of X, Y output value, Counting cards at a time to continue to receive from the dose given detector pulse counting, counting to then send a pulse to the DSP, this loop until the scan is complete, a layer of points. Repeat the above steps for different layers can be. Through the above process can be achieved on the different shapes of the spot scanning treatment of cancer.

CONCLUSION

In January and May 2010, we conducted a spot scanning system, the overall test, the test results meet the design requirements, and on-site test is shown in Figure 5 and Figure 6. In July 2011, point scanning control system through the acceptance of experts.

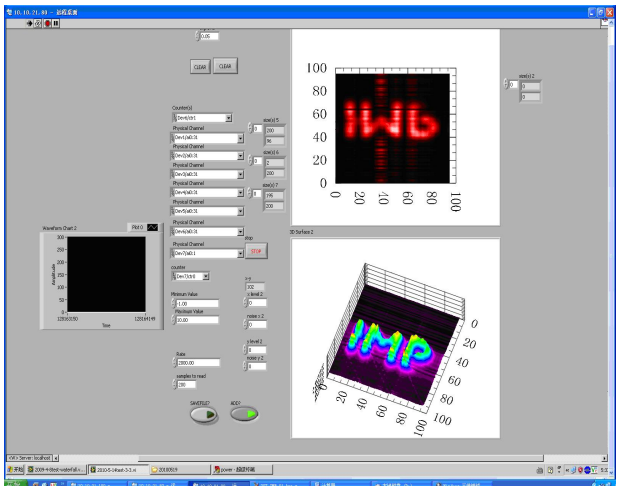

Figure 5: On-site test is shown 1.

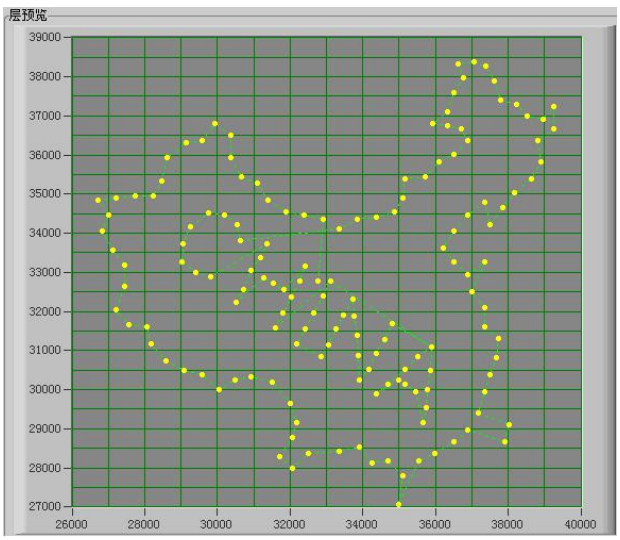

Figure 6: On-site test is shown 2.

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