

IMPROVEMENT OF THE CONTROL SYSTEM FOR LINAC AND PULSE BEAM STRECHER
AT TOHOKU UNIVERSITY

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ABSTRACT

A computer of the control system for Linac and Pulse Beam Strecher was replaced by Micro VAX II. On this occasion, a control loop as a private network using optical fiber cable and an intelligent controllers based on VME bus were added. Consequently, an ability of the control system has been very improved.

INTRODUCTION

For the improvement of the control ability, the reconstruction of the control system for Linac and Pulse Beam Strecher has been started since December of 1987¹⁾²⁾. The contents are as follows:

- 1) To exchange MELCOM-70 mini computer for Micro VAX II,
- 2) to exchange CAMAC modules for intelligent controllers based on VME bus in the Linac control system,
- 3) to adopt a control loop using optical fiber cable and
- 4) to adopt graphic displays and mice for control device on the operator's console.

Consequently, the operation parameters which are necessary for their control have been determined very reproductively and it is very useful for the Accelerator operation.

With this control system their parameters can be monitored via a TAINS (Tohoku University Academic/All-round/Advanced Information Network System) computer network.

HARDWARE

The control computer and interface system are shown in Fig.1. Two CAMAC crates in the control room are driven by Kinetic systems 2922 Q-bus adapter and Kinetic systems 3922 crate controllers. The control loop to control the linac, touch panels, push buttons and graphic displays on the operator's console are connected with the crates.

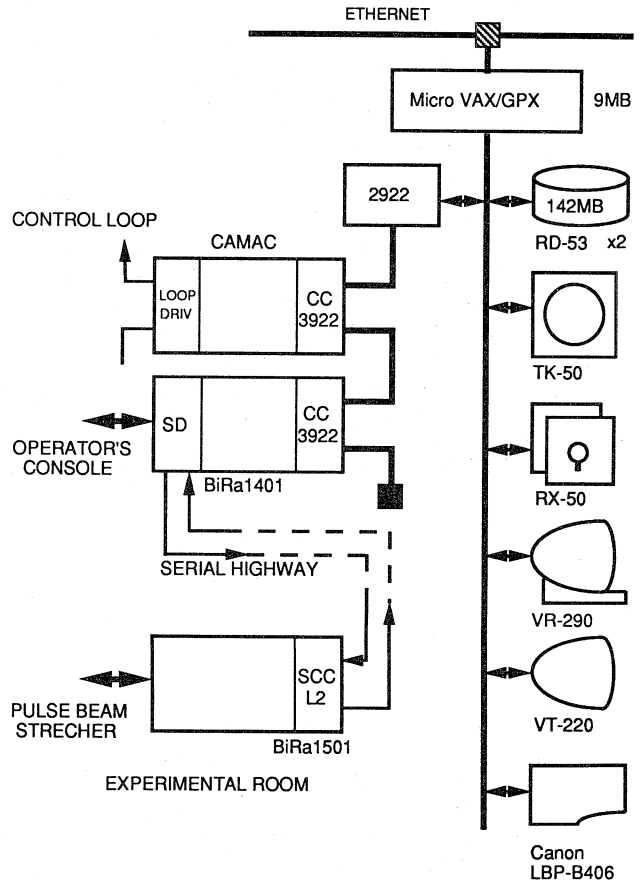


Fig.1 Block diagram of the computer control system.

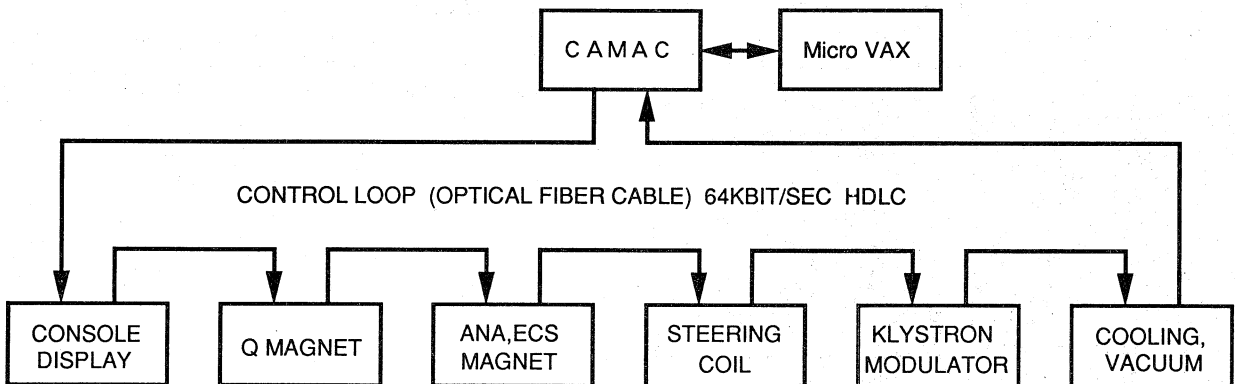


Fig.2 Block diagram of the control loop in the Linac.

A CAMAC crate in the second experimental room that is used for the operation of the Pulse Beam Strecher is driven by a Bira 1401 serial driver and a Bira 1501 type L2 crate controller. Both the 1401 and 1501 are jointed by a bit serial line and its transmission speed is 1 Mbps. The power supplies of various magnets and various beam monitors for Pulse Beam Strecher are connected with its crate and all the equipments are controlled by the computer.

CONTROL LOOP

Fig.2 shows the layout of the loop to control the Linac. Most of devices constructing linac are connected with the computer via the loop. The loop driver is a standard single-width CAMAC module with a microprocessor and it is originally designed. The node control devices provide the ability of receiving and transmitting messages through the loop, and they are originally designed, too. The node control devices are connected with VME which controls a power supply or connected with a personal computer for graphic display by the use of an RS-232C communication line. Table 1 shows typical specifications of the loop.

Table 1 Typical specifications of the control loop.

Protocol	: HDLC
Transmission speed	: 64Kbit/sec NRZI
Transmission line	: Optical cable
Cable length	: 200m
Transmitter/Receiver	: DLR-BN1500/BR1500
Number of nodes	: 8

A loop driver which works as a master communicates with node controllers which work as slaves through the loop by a polling method. Typical communication sequences are shown in Fig.3. In the case of Fig.3(a), when the master demands initialization of the slave, the slave clears its internal registers. In the case of Fig.3(b), the master transmits polling message to each receiver. When the slave received the message, it must

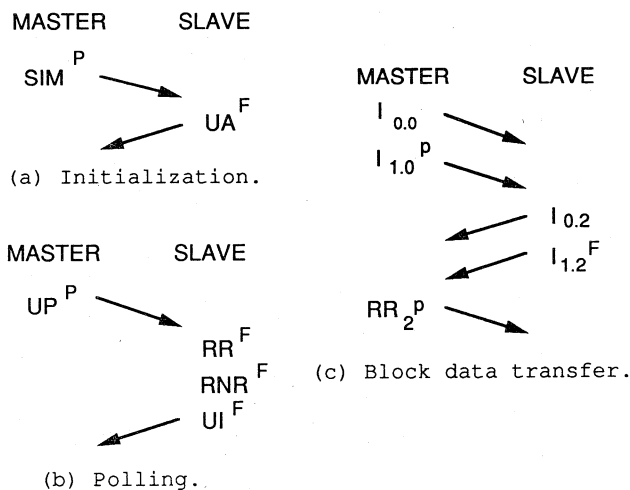


Fig.3 The communication sequences between the master and slave.

respond to the master with a receive ready (RR) message or a receive not ready (RNR) message if it has no information, and it must respond to the master with unnumbered information (UI) message if it has information, and the master generates LAM (Look-At-Me) signal on a CAMAC dataway. In the case of Fig.3(c), many data are communicated between the master and slave.

VME CONTROLLER

VME bus is adopted, because it is more inexpensive than CAMAC and moreover because of the intelligent microprocessor of the VME the load of the host computer can be reduced. For instance, as shown in fig.4 it works as a klystron modulator controller³⁾, it can simultaneously set DC-voltage and de-Q'ing level for five klystron modulators, it can control thirty four phase shifters and it can process fifty five shutdown statuses. OS-9 and OS-9/68K-C are used for operating system and for language, respectively, in their VME controllers.

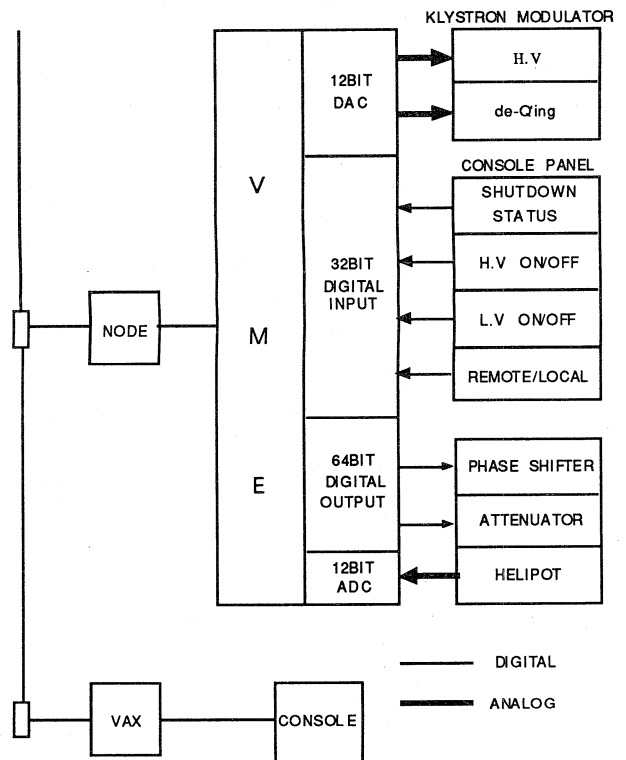


Fig.4 Block diagram of the VME controller for the klystron modulator.

OPERATOR'S CONSOLE

A DEC terminal VR290 and a personal computer (FM-16β) with a touch panel are used for a graphic display on the operator's console of the Linac. A personal computer for a graphic display, an exclusive touch panel and a character display for a status indication are used on the operator's console of the Pulse Beam Strecher⁴⁾.

SOFTWARE

The block diagram of the software is shown in Fig.5. Data base is a core in the system. The contents are informations of the control devices constructing Accelerator, those are, device conditions(normal or breakdown), input procedures of voltage, current and status(CAMAC N.A.F and multiplexer channel number of ADC module etc.), device characters and old and new actual operation values. Basic programs are dispersed around the data base independently.

When an accelerator operator handles the mice, touch panels and push buttons on the console, the information is transferred to data base. Then, the data base program accesses CAMAC handling program to meet an operator's requirement according to a control procedure list. The CAMAC handling program outputs the command to the Accelerator and inputs actual operational conditions of the Accelerator and sends informations from the Accelerator to the data base. The program for display on the operator's console can always get new operating informations from the data base.

Other control programs provide many useful informations during the Accelerator operation.

All the control programs are written using the C programming language.

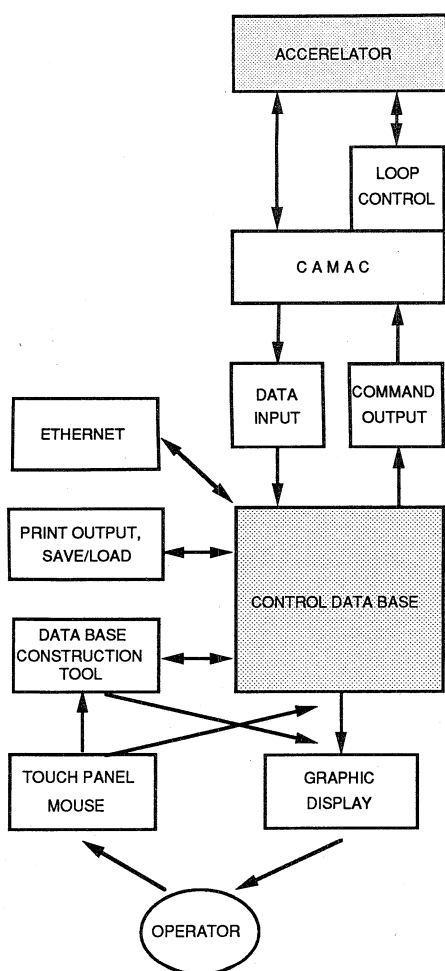


Fig.5 Block diagram of the control software.

INFORMATION SERVICE USING NETWORK

Since the control computer is connected with TAINS through communication server(CS), it has been able to be accessed from any personal computers in the campus. Operational informations of the Accelerator are obtained as a following procedure: after the login to VAX, Fig.6(a) is displayed on a screen, then if '1' is selected, Fig.6(b) is displayed.

To give the more available informations graphically at real time, programing is now under going.

ACKNOWLEDGEMENTS

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REFERENCES

- 1) M.Mutoh et al., Reserch Report of Laboratory of Nuclear Science, Tohoku University 20 (1987)393.
- 2) M.Mutoh et al., Proc. Linac. Meeting Japan (1988)22
- 3) T.Oonuma et al., Proc. Linac. Meeting Japan (1989)316
- 4) M.Mutoh et al., Reserch Report of Laboratory of Nuclear Science, Tohoku University 15 (1982)164.

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VT28X Terminal
LINAC,SSIR INFORMATION SERVICE
<<<< Main Menu >>>>

1 - LINAC operation data
2 - SSIR operation data
3 -
4 -
5 -
6 - Exit

Enter a number :
    
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(a)

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VT28X Terminal
LINAC,SSIR INFORMATION SERVICE
<<<< LINAC operation data >>>>      10-NOV-1989 13:56:
gamma-PAI      204.0(MeV)      2-Straight
FocusG11  0.000 A      AccQ01  6.670 A      AccStc08  -0.22 A
FocusG12  0.000 A      AccQ02  4.470 A      AccStc09  -0.88 A
FocusG13  0.000 A      AccQ03  15.21 A      AccStc10  0.15 A
FocusA11  67.91 A      AccQ04  20.01 A      AccStc11  -0.42 A
FocusA12  85.71 A      AccQ05  17.34 A      AccStc12  0.56 A
FocusA13  95.21 A      AccQ06  19.30 A      AccStc13  -0.16 A
                                      AccQ07  6.010 A      AccStc14  0.92 A
                                      AccQ08  6.990 A      AccStc15  -0.02 A
                                      AccQ09  3.750 A      AccStc16  0.05 A
                                      AccQ10  11.20 A      AccStc17  -0.59 A
                                      AccStc18  0.44 A
                                      AccStc19  -0.46 A
                                      AccStc20  0.40 A
                                      AccStc21  1.00 A
                                      AccStc22  -0.01 A
                                      AccStc03  -1.35 A
                                      AccStc04  -0.02 A
                                      AccStc05  0.00 A
                                      AccStc06  0.00 A
                                      AccStc07  -0.14 A

Enter(l:next page, 2:Exit) :
    
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(b)

Fig.6 Operational information of the Accelerator.