SEQUENTIAL CONTROL SYSTEM AND DATA ACQUISITION FOR BEAM EMITTANCE MEASUREMENT

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1. Introduction

A 20 MeV Proton Linear Accelerator at KAERI is currently operating. The accelerator consists of an ION source, LEBT (Low Energy Beam Transfort), RFQ (Radio Frequency Quadrupole), DTL (Drift tube linac) and Beam dump. To increase beam current, the ION source was modified and re-aligned for better transmission rate through LEBT. We installed the Allison type emittance scanner in the middle of LEBT for beam emittance measurement [1]. In this report, the performance of a variable DC output control for bias voltage of Allison type emittance scanner and a data acquisition system for LEBT beam emittance measurement based on NI PXI devices and GUI (graphic user interface) based on Labview are presented and the future works is discussed.

2. Component

The scanner is the Allison type emittance scanner of -200V to 200V bias voltage. The scanner installed in a vacuum chamber in the middle of LEBT is moved by linear motion feedthrough (MDC: k200/RPLM-6) which is 20 mm by 1 loop and total length 250 mm. The schematic of Allison type emittance scanner is shown in Figure.1. The slit size and length of the scanner are 0.1 mm and 80 mm.

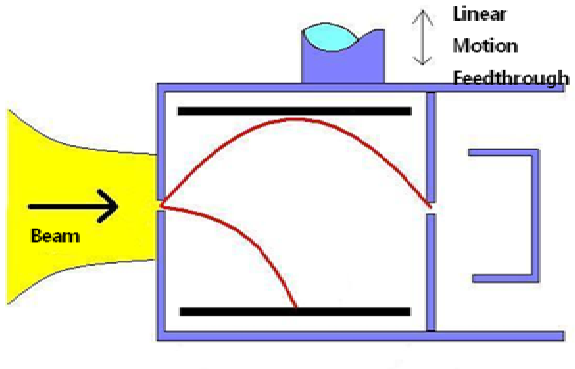

Figure.1. schematic of Allison type emittance scanner

For variable DC voltage (-10V~+10V), we installed PXI-6040E in the extension slot of PXI-1011 and linked the sub-accessory TB-2705 to use BNC connection. The signal of BNC port is transmitted to the BOP (Bipolar Operational Power Supply/Amplifier) that is amplified DC voltage. The adjustment of DC voltage is automatically step by step controlled by Labview 8.5.

The monitoring system consists of an oscilloscope (Tektronix TDS5054B) and PXI-1011. The beam signal measured by the scanner is monitored by an oscilloscope. The sampling number of oscilloscope is 5000 because of limitation for processing time (1s). We used GPIB & Ethernet for communication with PXI-1011 and oscilloscope.

We have two control devices. One of them is the adjustment of DC voltage and the other is the saving of the beam signal. The DC voltage is increased uniformly. Also, the beam signal is uniformly saved. All of them are programmed using Labview 8.5.

The schematic of measurement device control and data acquisition system for beam emittance measurement is shown in Figure .2. There are three divisions. The Allison type emittance scanner, linear motion feedthrough and Bipolar Operational Power Supply/Amplifier are in the LEBT of the linac site. The oscilloscope is in the first control room. The PXI-1011 and auxiliary NI devices are in the second control room.

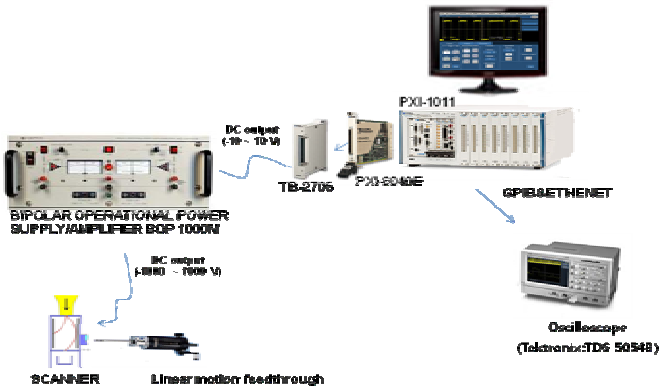

Figure.2. Beam emittance measurement control system

3. Data acquisition

3.1. GUI (Graphic user interface) base on Labview

In Labview process, we used visa resource and NI-DAQ for oscilloscope monitoring and DC output control, respectively. The oscilloscope and PXI-1011 are linked through a TCP/IP connection. The BOP and PXI-1011 are linked by BNC connection.

We modified Vi of Tektronix which is composed of a single channel, parameter selection about mean value for the data acquisition. Also, we make a variable DC voltage which is composed of a minimum value, a maximum value, an interval voltage and an interval time. The graphic user interface is shown in Figure.3. The monitored beam signal which is the beam width 2ms per 1 Hz is saved for trigger time (1s ~ 2s) when changed DC voltage step by step as 0.1V~0.2V. The acquisition data is labeled as linear motion feedthrough position and a variable DC voltage value.

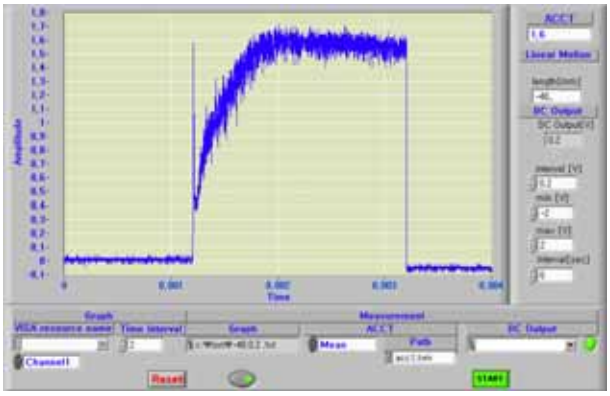

Figure.3. Labview application for DC output control and data acquisition

3.2. GUI handling

- Execute the GUI.
- Check the visa resource and NI-DAQmx device.
- Setting up the minimum voltage, maximum voltage, interval voltage and interval time in the variable DC voltage part and the linear motion feedthrough position for labeling of saving file.
- Press the save button then activate the green light for data acquisition.
- Press the start button.
- Press the reset button then activate the LED of DC output voltage and changing voltage.

4. Future work

Now, the GUI based on Labview was troublesome. First, the linear motion feedthrough is about automatic movement. If it is possible that the movable linear motion feedthrough by a step motor can be controlled of NI motion devices, we will make the auto-multitask which is a variable DC output voltage, the monitoring system and the movable linear motion feedthrough. Second, the save time of acquisition data file is different from measurement time. It is not certain when it took place. But this problem will be gradually resolved through the modified logic of Labview.

ACKNOWLEDGMENT

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[2] www.NI.com/