

GTF Systems Upgrade Status Report

The GTF is upgrading its control and data acquisition systems. New computer-based instrumentation and software will soon replace the existing control system used to operate the GTF photoinjector, linac, and associated beamline components. We have also acquired new data and image acquisition instrumentation, including waveform digitizers, framegrabbers, IR and UV cameras, as well as the ancillary components needed to improve data quality and to manage data flow and image display. Overall, our goal is to achieve more efficient operation with extended capability. A status report follows.

A new personal computer (PC) and a compactPCI system has been configured to replace the control system that now runs on a 486 machine. The compactPCI system, hereafter just "PXI" for National Instruments' implementation of the compactPCI standard, consists of an eight-slot chassis equipped with various PCI-based instrumentation cards, and is linked to the PC by a high-speed copper cable. (The chassis and cards are "compact" compared with VME or CAMAC crates.) We currently have three PXI cards installed: an analog output card for DC-voltage control (modulators and quadrupoles, for example), an analog input card for monitoring system response and status (GTF has not done this in the past), and a GPIB card for controlling the solenoid and spectrometer power supplies. There has been one glitch with the hardware: when the GPIB card is installed, the processor will not boot. It's not clear whether this is a problem with the PXI chassis, the PXI card that links the chassis to the computer, or the GPIB card itself. I am working with NI on this, and have on loan a GPIB card that circumvents the problem and allows system development to proceed unimpeded.

An all new, LabVIEW-based interface has been written for operating the GTF. An improvement over the previous interface is that all controls can now be accessed from a single front panel. Several convenient features have been added, a potential accident eliminated, and some execution ambiguities resolved. Except for the GPIB control of the solenoid and spectrometer, the interface has been fully bench tested and validated. "Bench tested" means that all software-controlled voltage outputs and inputs have been verified up to external connector blocks. GPIB functions will be tested sometime in the next week, when the accelerator vault is closed and power supplies can be activated (SSRL startup of SPEAR is now in progress).

What remains to make the new system operational is placement of the

terminal blocks in the GTF control racks, and cabling from the terminal blocks to the various power supplies. Much of the old cabling can be used with modification at the terminal block end. Our on-loan quadrupole power supplies are to be replaced with recently acquired SSRL hand-me-downs, which will require wiring and calibrating voltage dividers for input and readback, and readback cabling to the terminal blocks. It turns out that the solenoid and spectrometer supplies can be read back via GPIB. Once the hookups from connector blocks to supplies are complete, GTF is ready to operate at a level of functionality slightly better than in the past. This is the minimal goal: when GTF turns on again in November, to have the new system at least as functional as the one it is replacing.

Up till now, automated data acquisition at GTF has consisted of a single, rather versatile VI (Virtual Instrument---a LabVIEW program) that can acquire, via GPIB, a sequence of triggered single-point data from multiple channels on two oscilloscopes, along with other user-entered text describing system parameters such as quadrupole currents or gun phase. The data is saved in a text-based spreadsheet format. This tool has been very useful, for example, when calibrating Joule meters, performing Schottky scans, scanning the QE of the cathode, or performing quad scans (with the addition of a framegrabber). The program has run on a computer separate from the one running the control system, with its own GPIB card. A modest improvement over the minimal goal described above, allowing us to eliminate the second computer and GPIB card, requires demonstrating that the program will run in the new version of LabVIEW, and that serial communications can be made between the new computer and the GTF Master Trigger Box.

Once we have an operational control system, we want to improve our data and image acquisition systems. The first goal is to integrate image acquisition into the LabVIEW environment. The framegrabber we now use operates from yet another computer (the third), runs under Windows 3.11, and has limited functionality---all of which adds up to a huge bottleneck when performing emittance measurements, for example. To break the bottleneck a new NI framegrabber has been installed and tested in GTFmain (the new PC controller), and we have added NI's "Vision" image processing software to our LabVIEW environment. The code is not yet written that will allow us to discard the old framegrabber.

Probably the next bottleneck to overcome is the discontinuity between system control and data acquisition. A software routine that coordinates data acquisition over a range of beam parameters should have direct control over setting those parameters. The present

arrangement, where we acquire data with one routine as we change system parameters with another, and then go back and log the changes in the first routine, is tedious and error prone. A quick fix for this may be to modify our old standby VI so that it can issue system commands.

It was stated above that a minimal goal for the November startup is to have a system that uses the new instrumentation and software and is at least as functional as the old system. The more ambitious goal is to also have the new image and data acquisition routines functioning.

There are other aspects to the GTF upgrade, some of which will be implemented after the startup. New IR and UV cameras, and a 10-bit camera and framegrabber are to be installed. A system for controlling image intensity by means of remotely controlled polarizers will be installed. A matrix switcher, not yet purchased, will be used to select which video signals are being routed to specific monitors or framegrabbers. Multiple framegrabbers (we have three) will enable "simultaneous" capture of drive laser and electron beam profiles. For data acquisition, waveform digitizers have been obtained from SSRL, and we have purchased a VME crate and a hardware link that connects the crate to the PXI chassis and the LabVIEW programming environment. GTF presently has no effective means for waveform capture.

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