Software developments in Gemini

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Introduction

The Gemini laser system software consists of a network of applications which are used to control elements of the laser, manage user access and control, and monitor a large number of parameters both on-shot and continuously. The overall orchestration and synchronization of these components (as well as synchronization with the laser hardware itself) is handled by the main Control System. A number of semi-independent applications collect the diagnostic data associated with specific instruments, monitor general performance parameters, and allow operators and users to operate the facility. Here we outline some of the changes to the software and associated hardware that have taken place this year.

Upgrades to the Gemini Control System

As part of the continuing programme of upgrade work in Gemini, the main Control System was finally moved off its obsolete platform and onto a more up-to-date operating system. This move forced the replacement of the two old waveplate motion stages used to control the level of laser energy delivered to Target Area 2 (TA2) and Laser Area 3 (LA3): the 6K8 stages were replaced with Newport URS150s and SMC100 control units. By carefully orientating the wave plate, we were able to move away from an arbitrary position of 0 to 230 "units" to real physical units of 0 to 45 degrees for minimum/maximum transmission of the beam. This is more intuitive.

The software architecture within Gemini is slowly evolving to become more distributed, so a Python *cgi-bin* was written to, in effect, network-enable both stages. This had the advantage of allowing multi-access to the devices in the form of a dedicated control application (Figure 1), as well as continuing integration with the main Control System and those in the two Target Areas.

Figure 1: LA3 wave plate motion stage application

The move to a more up-to-date operating system also provided an opportunity to enhance the main Control System software. Operator controls which had been scattered amongst several windows have now been assembled onto one Home window (Figure 2), and there are separate windows to monitor communications between the various components of the Control System, and the trigger orchestration patterns (Figures 3 and 4). The latter has proved particularly useful on several occasions to enable us to debug fast shutter behaviour, and to demonstrate to users how that part of the system works.

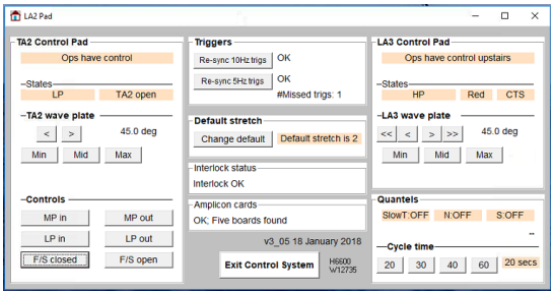

Figure 2: Operator's Home window

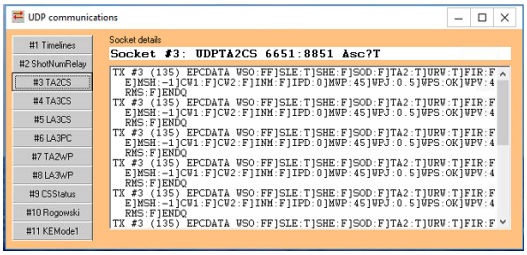

Figure 3: Component communications

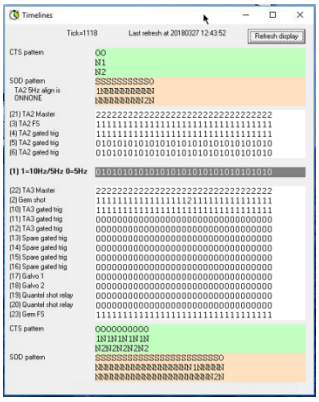

Figure 4: Trigger orchestration window

New TA2 5Hz capabilities

The maximum shot rate of Gemini is limited by the Quantels to one shot every 20 seconds; the maximum shot rate of TA2 has historically been limited to one shot per second although the pulse train is actually operating at 5Hz. An experiment earlier in the year required bursts of 50 pulses at 5Hz, and this raised concerns over the speed of response of the TA2 fast shutter which was not designed for, nor capable of, such sustained operation. The solution chosen was to modify the way in which TA2 operates so as to allow the fast shutter to remain open for the duration of a burst of shots. There are still some issues to be resolved with the operating protocol, but the ability to hold the

fast shutter open for a burst of pulses, together with associated modifications to the rules governing users' trigger patterns, has given TA2 a useful new capability.

New Gemini spectrometer

During the summer, a new multi-channel Avaspec-ULS2048 spectrometer by Avantes BV was commissioned. The spectrometer has five channels to analyse laser light delivered by optical fibre from different parts of the Gemini system.

A recurring issue within Gemini is the difficulty of integrating new instruments into our particular shot number system. The spectrometer was a case in point. The Avantes software provides an option to save data to a known file when an electrical trigger is received by the spectrometer. We implemented a LabView application to propagate to the instrument the triggers associated with actual shots and to rename the raw data files accordingly (Figure 5). A .NET application then polled for these files, performed a simple plot of the data, and massaged the files into the form required for submission to the data archival system (Figure 6).

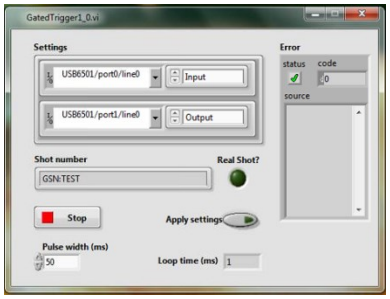

Figure 5: Trigger relay application

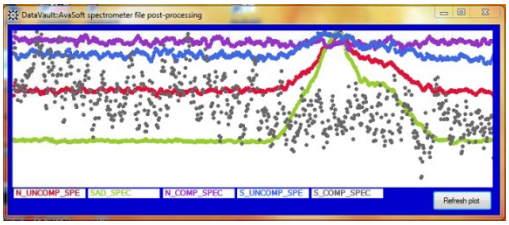

Figure 6: Spectrum plots

This suite of Avantes' Avasoft software together with two new purpose-designed applications has enabled us to integrate a new instrument relatively smoothly, and in a manner which would not have been possible using the manufacturer's software alone.

Dazzler settings

Another instrument which we needed to integrate into our particular shot number broadcast system is the Dazzler – an acousto-optical programmable dispersion filter manufactured by Fastlite.

A simple .NET application was written to perform on-shot screen grabs and save the resulting images. Although the screen-grabs are not diagnostic data *per se*, the application has proved a useful tool as it enables the Operators to keep track of Dazzler parameter changes (Figure 7). A number of other applications are planned.

Figure 7: Dazzler screen grab application

Acknowledgements

We would like to acknowledge the assistance given by all of the Gemini Operators while developing these applications, and support from the CLF Electrical Engineering Section during the changeover of Control System hardware.