The control and data acquisition program for the LSF PIRATE laser

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Introduction

The PIRATE pump probe time-resolved IR Laser Facility measures transient changes in molecular vibrations that absorb in the mid infrared. The technique is sensitive to the structure and charge re-distribution in photo-excited molecules in the condensed phase and is used to study fundamental chemical reactivity in Nature.

The previous control and data acquisition system for Pirate was written over the period 1999 to 2003 and ran on an 800 MHz Pentium 4 computer using the NT4 operating system. It used the serial port to control an opto-mechanical slide used to create the delay between the reference and the probe beams and a Datel ISA 250 ks/s, 8 simultaneous channel, ADC card with 12 bit grey levels to read the data from the 64 pixel detector.

A number of factors combined to make it necessary to rewrite the code, including –

- The need to remove the NT4 system from the laboratory network for security reasons.
- The fact that the ADC card and ISA slots in the computer are no longer manufactured or available.
- The need to add functionality such as automated beam shutters to reduce laser beam photo-exposure.
- The need to extend the code to use a GPIB interface to a Stanford pulser to provide the delay as a switchable alternative to the slide and the future need to extend the code to use a InGaAs detector with 128 elements as a switchable alternative to the existing 64 element detectors.

Implementation

It was decided to replace the computer with a Viglen P4 PC running Windows XP, to continue using the serial port to control the slide delay, purchase a new ADLINK ADC card with 4 simultaneous channels (measuring Probe, Reference and Pump on) at 16 bit grey scale accuracy and purchase an ADLINK GPIB card to control the Stanford pulser.

The program is written in Borland Delphi (version 7) which uses Pascal as the language as this expertise exists in the CLF.

It is based on two windows, the main window to handle all the operation of the facility and a secondary window to handle the underlying parameters that control the operation.

All parameters are remembered until changed and can be saved and restored as a named text file.

The functionality of the main window

The functionality provided on this screen (see Fig. 1) is -

- The ability to start / stop a data run over a number of conditions set through the setup screen (see below).
- The ability to start / stop a test run at the present set of conditions.
- The ability to enter the setup screen.
- The ability to view the data and results every second, cumulative over this cycle and cumulative over all cycles.
- The ability to scale and offset the data and results.
- The ability to overlay the data.
- The ability to reset the view of the cumulative results.
- The ability to manually control and zero the slide or Stanford pulser.

It also reports –

- The run number, the sample, the date and time and the directory used to store the data.
- The state of the run (Running or stopped, cycle number, delay number, time into this setting).
- The state of the data (Failed because of pump out of sequence, failed because of data statistics out of range, failed because data too low).

The menu items allow you to -

- Save and restore the settings as a text file for reference or future use.
- Execute certain test functions.

The functionality of the setup window

The parameters set on this screen (see Fig. 2) are –

- The Run Parameters (Sample name, run number, the number of cycles in the run, the number of delays per cycle, the number of seconds dwell time at each delay).
- The ability to change the data directory, enter a comment in the data files, acquire and save a background measurement and the ability to switch the delay between the slide and the Stanford box.
- The ability to enter the delays and to randomize them such that the random order is retained for the whole run. (To edit a delay, click on the position and enter the delay in the pop up box. To remove a delay, just enter blank in the pop up box).
- The ability to enter dead pixels (this has to be applied once entered).
- The ability to test the shutters.
- The ability to control the data format as a text and / or an excel file.
- The ability to set the various failure parameters, to set the level at which they will stop the run and to turn them on or off.

Future developments

It is proposed to add the ability to switch between the existing 64 mercury cadmium telluride detector array and the 128 indium gallium arsenside detector array[1)] by adding an ADLINK I/O interface card with software and providing a switch on the setup screen. All other changes to the code will follow the setting of this switch.

References

1. M.Towrie *et al.*,
   Towards a new ultrafast time resolved near-infrared facility using custom InGaAs Arrays.
   CLF Annual Report 2004-2005, p 234

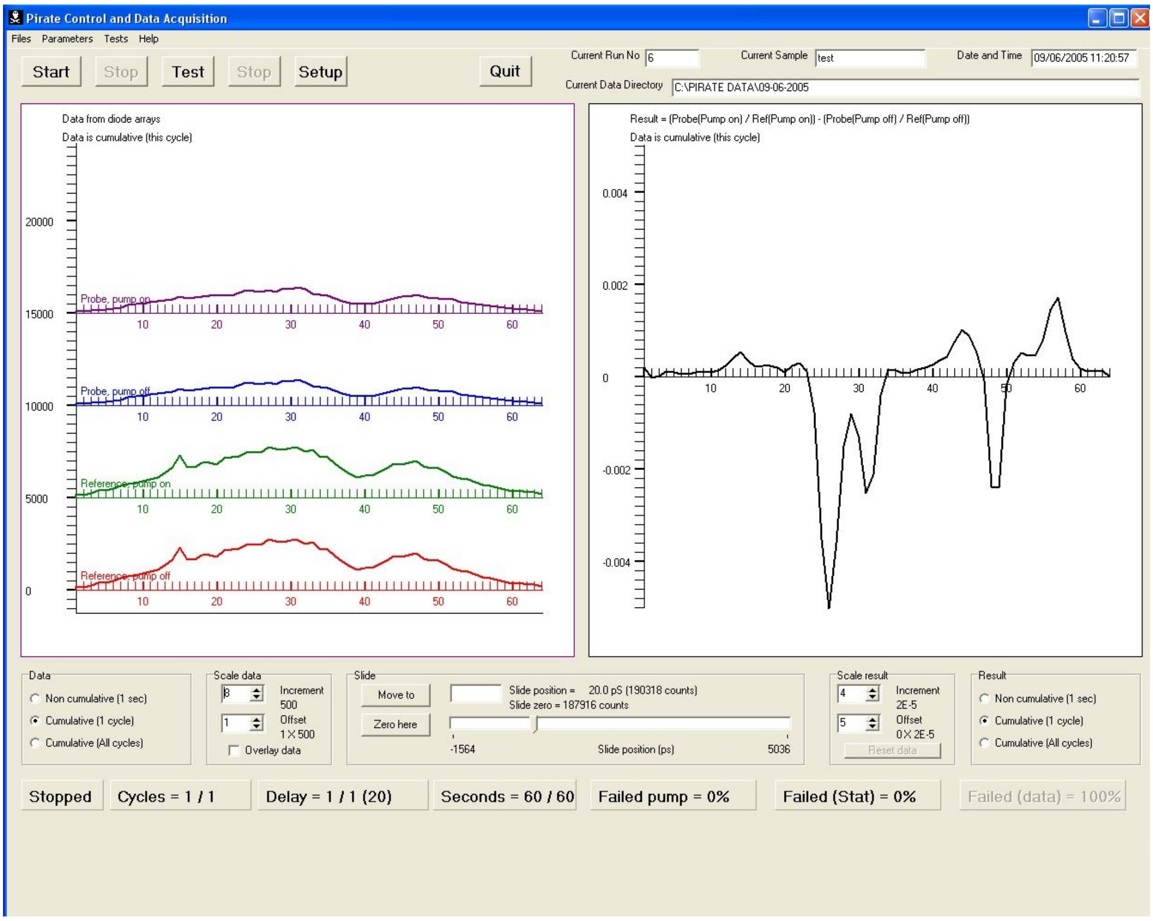

Figure 1. The Main Screen. Left hand display box showing reference and probe data in pump-on pump-off data sets. The right hand display box shows the signal for one 60 second accumulation of a metal carbonyl compound acquired at 20 ps pump probe delay. The vertical axis is change in transmission between pump off and pump on and is set to +/- 0.005 ΔT full scale.

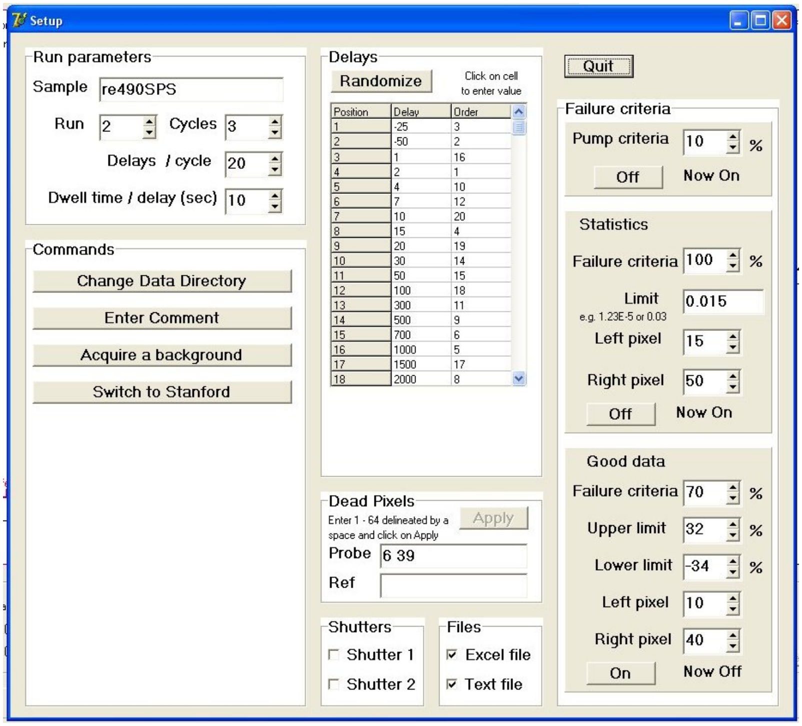

Figure 2. The Setup Screen. This shows the setup for a sequence of 20 pump probe delay positions each acquired for 10 s over 3 cycles. The statistical filter is used to detect intermittent "bad shots" that corrupt data. Text and Excel files contain the data for each time delay, each cycle containing the accumulation data for each cycle and the rolling average of all cycles for each delay.