SpectrumScanner User Manual

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This is the user manual of the homemade spectrometer system.

1 Hardware System

The spectrometer system is based on a stepper-motor driven monochromator. Controlled by the software, the stepper-motor drives the monochromator to scan through the desired wavelength range, and at the same time, the amplitude of the optical signal collected at the exit port of the monochromator is sampled and saved by the software as the motor advances. In the end, the software shows the spectrum on the screen, and the data can be saved to a text file. Below is the block diagram of the system:

Monochromator

Motor

Detector

Motor Driver

Lock-in Amplifier

NI-USB6008

PC
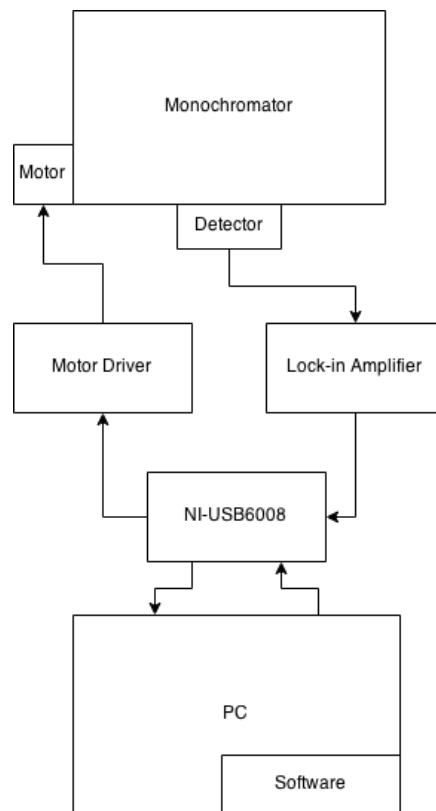
Software

The hardware interfaces with the software via NI-USB-6008, which is a light-weighted data acquisition device by NI. The optical signal is picked up by the detector and amplified by the lock-in amplifier before feeding into the NI-USB-6008. The controlling signal issued by the NI-USB-6008 controls the advance/reverse of the stepper-motor which is connected to the monochromator.

2 Electrical Connections

Below is the wiring on the NI-USB-6008:

AI0+: Lock-in amplifier output +
AI0-:   Lock-in amplifier output -
AI0-:   GND
GND: White wire of the motor driver
P0.0: Brown wire of the motor driver   (Pulled up to 5V with 1K resistor)
P0.1: Orange wire of the motor driver   (Pulled up to 5V with 1K resistor)
P0.2: Blue wire of the motor driver   (Pulled up to 5V with 1K resistor)
P0.3 Green wire of the motor driver   (Pulled up to 5V with 1K resistor)
PFI0: P1.0

The NI-USB-6008 connects to the PC via a USB cable. The detector should connect to the lock-in by a coaxial cable. And the signal from is chopper also connects to the lock-in via coaxial cable.

3 Control Software

The control software was created with the NI-DAQmx windows driver and Qt 5.3 C++ GUI framework. Source code can be found in the repository:
https://github.com/lionel88cn/SpectrumScanner
Step to install the software:
1. Download and install the latest version of NI-DAQmx (more than 1 GB):
   http://www.ni.com/nisearch/app/main/p/bot/no/ap/tech/lang/en/pg/1/sn/catnav:du,n8:3478.41.181.5495,ssnav:ndr/
2. Download and install Visual C++ Redistributable Packages for Visual Studio 2013 (make sure to install the x86 32bit version):
   https://www.microsoft.com/en-us/download/details.aspx?id=40784
3. Download and run setup.exe located at /installer of the repository:
   https://github.com/lionel88cn/SpectrumScanner/tree/master/Installer

The installer will create a shortcut on the desktop named SpectrumScanner, and its binaries can be found at Program Files/SpectrumScanner. The control software was fully tested on Windows 7, but should work with future versions of Windows which runs on x86 architecture.

To run a spectrum scan:
1. Make sure all the electrical connections are good, chopper is on and lock-in set to the desired sensitivity to see enough signal on the gauge
2. Adjust the monochromator to the desired wavelength before turning on the power of the stepper-motor
3. Switch on the stepper-motor driver and make sure the motor is now locked
4. Run SpectrumScanner.exe
5. If the starting position has slightly shifted, use the "ADVANCE" and the "REVERSE" buttons to adjust it back

6. Select the correct Grating Number and Resolution
7. Type in the Begin Wavelength and End Wavelength, which are the wavelength readout shown on the monochromator
8. Make the "Repeat" box if spectrum needs to be take repeatedly
9. Hit the "START" button, and type in the current wavelength of the monochromator
10. After the scan is done, the spectrum is shown in the right, the wavelength shown on the right is the product of the mechanical wavelength and the grating number
11. Save the data by clicking Functions->Save and save it to a text file for future use