Using the Spectral Workbench

In the last Bulletin we showed you how to make a simple spectrometer attachment that will fit onto your mobile phone. This allows you to take pictures of spectra.

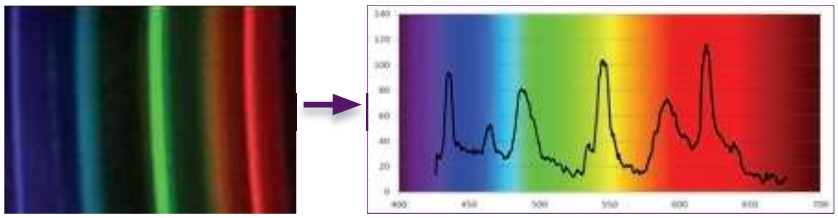

Figure 1

That is all very well but just having a picture of a rainbow-like image is not all that useful. In order to do proper science with it, you need some way of analysing the image to get a graph showing how intensity varies with wavelength.

Some of you physicists might have had some experience using Tracker.jar for this. (A favourite of the SSERC Physics team, it can analyse spectra as well as, more commonly, analyse motion). It is, however, a little fiddly to use.

Recently, however, a website called Spectral Workbench (http://spectralworkbench.org/, part of the Public Lab project) has appeared that makes the whole process much easier. (This was the source of the spectrometer design). You need to register (free) with Public Lab but that is all!

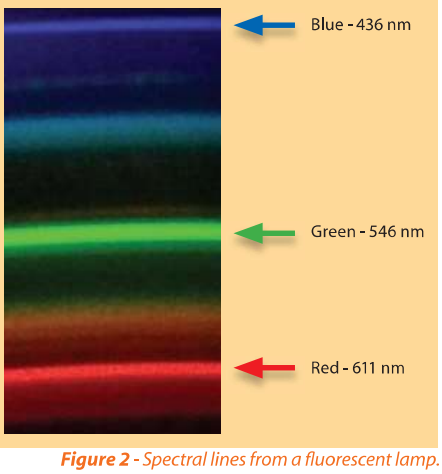

Figure 2 - Spectral lines from a fluorescent lamp.

Analysing the spectrum

In order to analyse the spectrum and actually get a graph of it, you need to have some reference points. Fortunately, we have these in the form of the spectrum of a fluorescent tube (ideally a compact fluorescent lamp). Usefully, fluorescent lamps have some notable spectral lines that can be used for calibration (Figure 2).

So the first thing to do is to take a photograph of your fluorescent source.

If it's too bright, and that is quite likely if you are pointing it at the source, point it at a piece of white paper or wall which is brightly illuminated by the bulb.

In order for your reference to be valid, make sure you use the same spectroscope/phone assembly each time and do not zoom in on any of the photographs. Each time you re-attach the spectroscope, you will have to take another reference photo of a fluorescent source.

Once you have logged in to the Spectral Workbench site you will need to upload your image. Click on 'Capture Spectra' (the blue button at the top right, of the screen and the drop down menu gives you the option to upload from file. Selecting this gives you this screen (Figure 3).

***Figure 3** - Spectral Workbench - Upload Screen.*

There is a tick box saying 'vertical' but as far as we can tell this makes no difference to how the software analyses your picture.

Enter a name and any other data you need and click the 'upload button. (Don't worry about the calibration at this point).

After a few seconds, your spectrum will appear - as shown in Figure 4.

If you see a series of horizontal coloured lines rather than a spectrum, click on the 'more tools' button (circled in red on Figure 4).

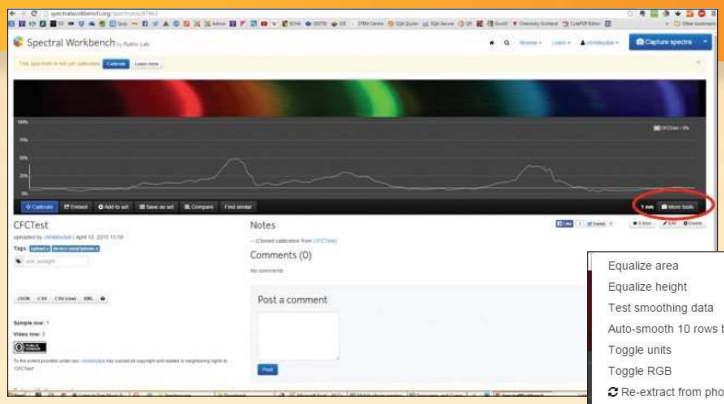

Figure 4 *- Spectral Workbench - Spectrum.*

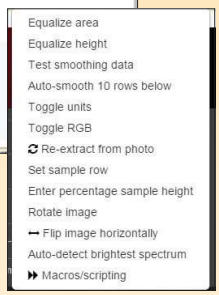

Figure 5 *- Spectral Workbench - More Tools Menu.*

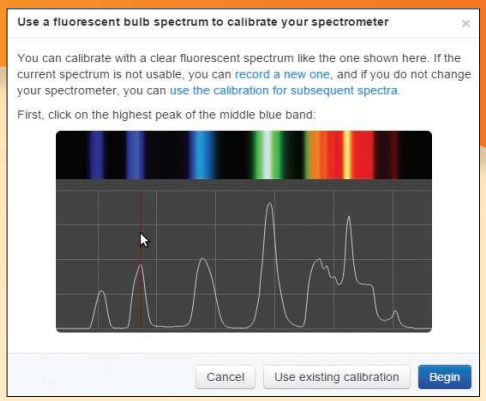

Figure 6 *- Spectral Workbench - Calibration.*

That brings up a menu (Figure 5).

Click on 'rotate image' and you should soon see something vaguely like the one above.

Another point you need to be aware of is that the analysis software only works if the blue lines are at the left.

If, like in the illustration above, they are on the right, you need to click on 'Flip image horizontally'.

And finally, to get the best graph of your spectrum, click on 'Auto-detect brightest spectrum'.

Now you have your spectrum loaded, you need to set it to be your reference sample.

Click on 'Calibrate' (the blue button on the left below the spectrum) and you will see this screen (Figure 6)appear.

Click 'begin' and then find the brightest part of the appropriate blue band and click.

That brings the screen back, this time telling you to find the brightest part of the green band.

Click on this and after a few seconds your spectrum will reappear with the wavelengths along the bottom.

You will now have something like Figure 7 (which looks very like Figure 4 but you will note there is now a scale along the bottom of the graph).

If you want to get a graph you can print, or otherwise manipulate (to look a bit more impressive), you can export the data. The options are circled in red in Figure 7 - .csv is the best format to choose as it will open directly in Excel.

Once you have exported your data, you can process it to give a much clearer result. Instructions on how to do this are on the SSERC website.

Figure 8 shows an Excel version of the same graph: still with the wavelength along the bottom. (I just used a picture of a spectrum as a background to make it look prettier!).

Now you have your calibration graph, things are much simpler. Upload another image (rotating and flipping it as before if you need to) and the software will automatically interpret it using your reference spectrum. So the graph will appear with the wavelengths along the bottom. The same will be true of all the other spectra you photographed in this session. Here (Figure 9) is one of a white LED (section shown only).

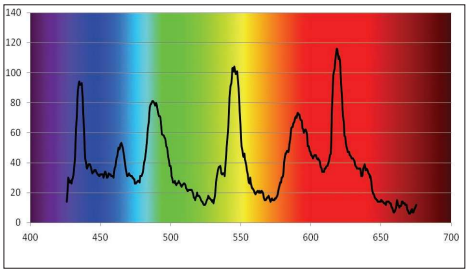

Figure 8 *- Spectrum processed in Excel.*

Figure 7 *- Spectral Workbench – Finished spectrum and exporting.*

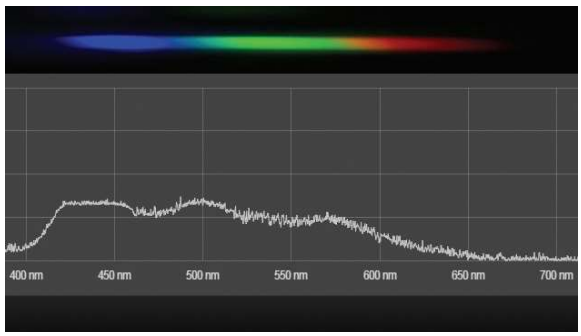

Figure 9 *- Spectral Workbench - new spectrum interpreted using the reference photo.*