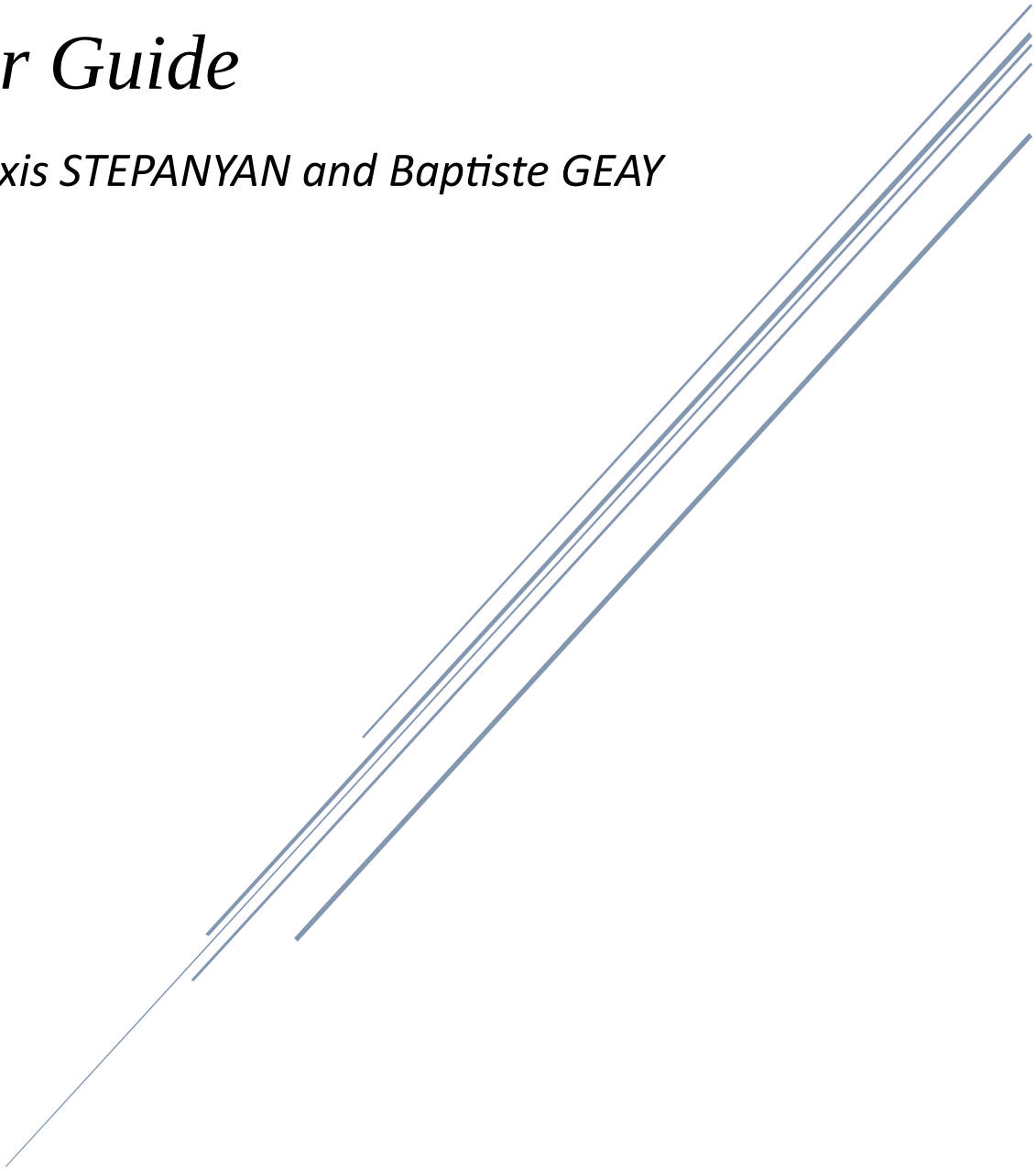
ABspectro

User Guide

by Alexis STEPANYAN and Baptiste GEAY



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1. Overview

For this program, we are using an optical installation containing two OceanInsight spectrometers that allow, thanks to a USB connection with a computer, the visualization of data provided by the spectrometers via a transmittance graph, as well as their recording and the determination of the angle's impact on this transmittance. The program enables the determination of the transmittance for undetermined optical filters depending on the wavelength.

2. Installation and setting-up

There are different ways to install ABspectro. You can simply use one of the standalone executables or the installers that allow the installation of the program step by step with different options such as creating an application shortcut on your desktop for quick access or changing the repertory folder. The second option will allow the application to launch quicker because the needed files will be directly installed on the computer and not contained in a unique file. You can also just download a compressed file containing what you need.
In fact, there are two different versions of ABspectro. The basic one that has all the functions and a second one that is indicated by “-na”. The second one doesn’t have options to adapt the plotting in real-time to the light source spectrum. Even though the two versions will have the same data in saved files, the second one will always display the specific wavelength ranges for each spectrometer without considering if the light source is contained in these ranges.

You also need an optical set-up that allows collimating the light source that will pass through the unknown optic and then go through a fiber directly connected to one of the spectrometers. The spectrometers have to be used independently as the software doesn't allow simultaneous usage of multiple spectrometers and the fiber has to be connected to the desired spectrometer each time. Mounting and dismounting the unknown optic is also necessary to have a reference spectrogram for the chosen spectrometer each time.

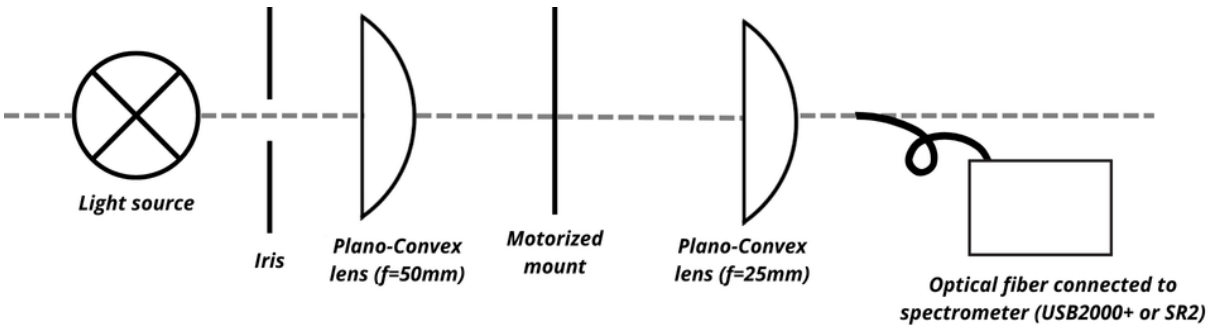
To use the angle impact determination function, a motorized mount for the unknown optic is required. The use of an Arduino card with a motor seems to be the simplest way to achieve this.

It is also important to check the characteristics of every component concerning different wavelength transmissions so they can all work correctly together. To do so, we need to take in count the main light source spectrum that has a certain range. We also need to consider specific components such as the optical fiber that also has its own range and finally, the spectrometer range that will be used.

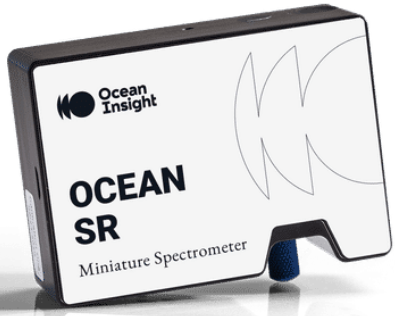
Explanations given in this part were global and concerned any possible configuration. However, the following explanations will concern the original set-up and the software that has been conceived to work with it (different adaptations for specific cases should be easily done).

List of items needed to reproduce the same installation:

- 1 Thorlabs Breadboard
- 1 OSL2IR Fiber illuminator lamp
- 5 Thorlabs supports
- 3 KM100 Thorlabs
- 1 KM100T
- 1 FMP1/M
- 1 Iris Thorlabs
- 1 Plano-convex Lens Thorlabs (f=50 mm)
- 1 Plano-convex lens Thorlabs (f=25 mm)
- 1 Stepper motor 28BYJ-48 5V DC
- 1 Arduino uno
- 1 Driver ULN2003
- 1 Optical fiber 250nm-1200nm
- 1 Spectrometer Ocean Optics USB2000+ 200nm-850nm
- 1 Spectrometer Ocean Insight SR2 649nm-1300nm

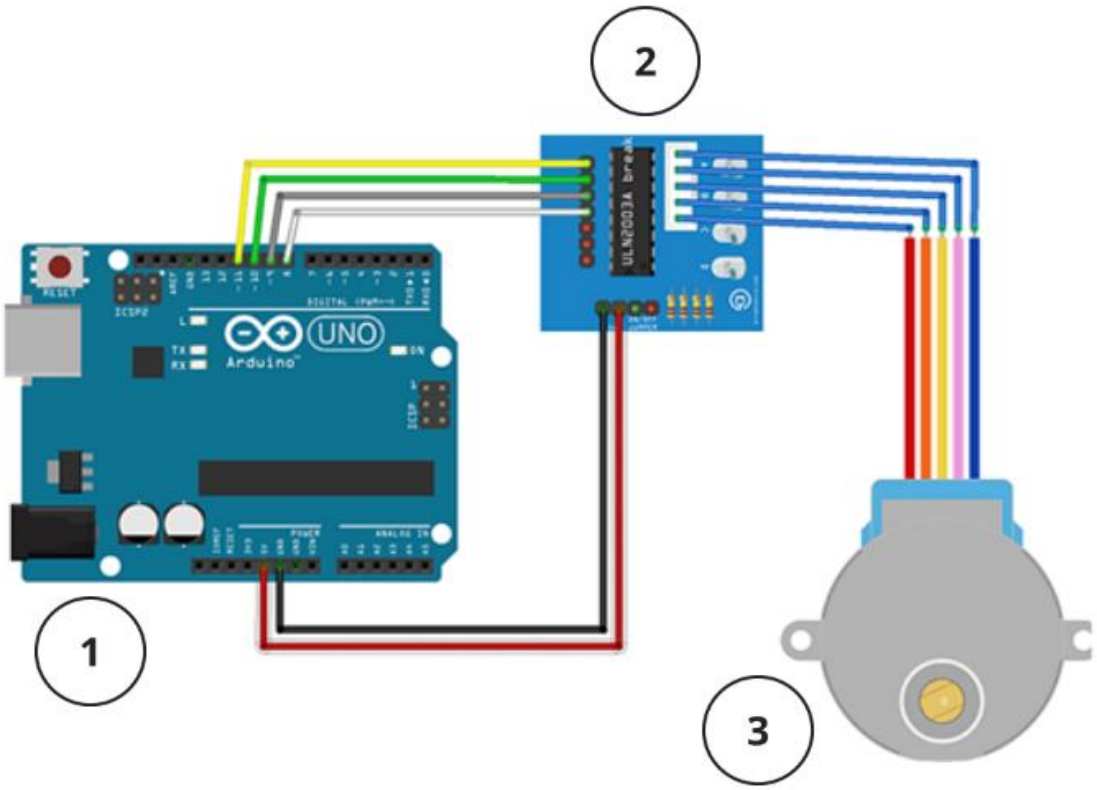


Optical diagram of the installation used to realize the project

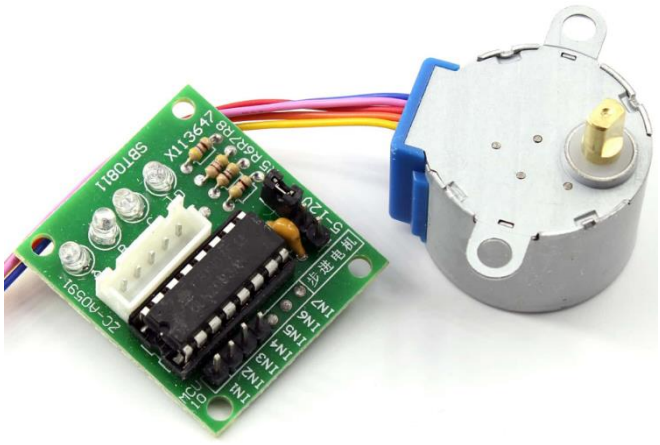


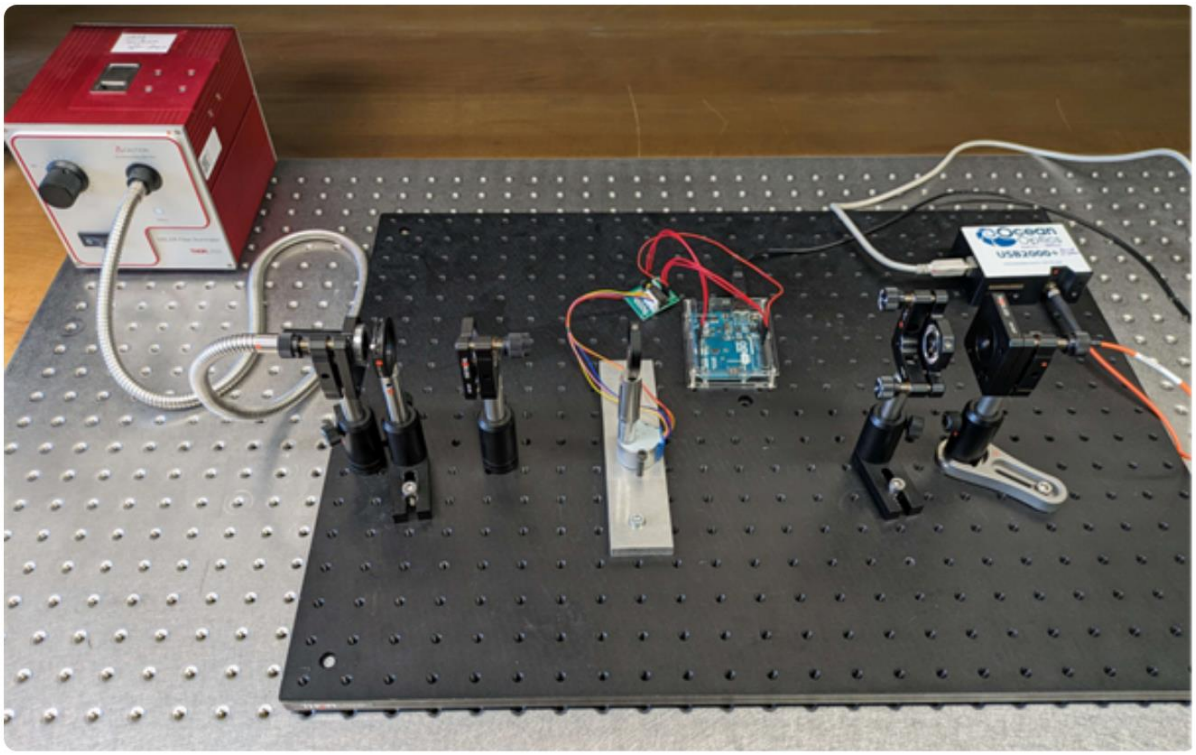
Spectrometer SR2
649nm-1300nm

Spectrometer USB2000+
200nm-850nm



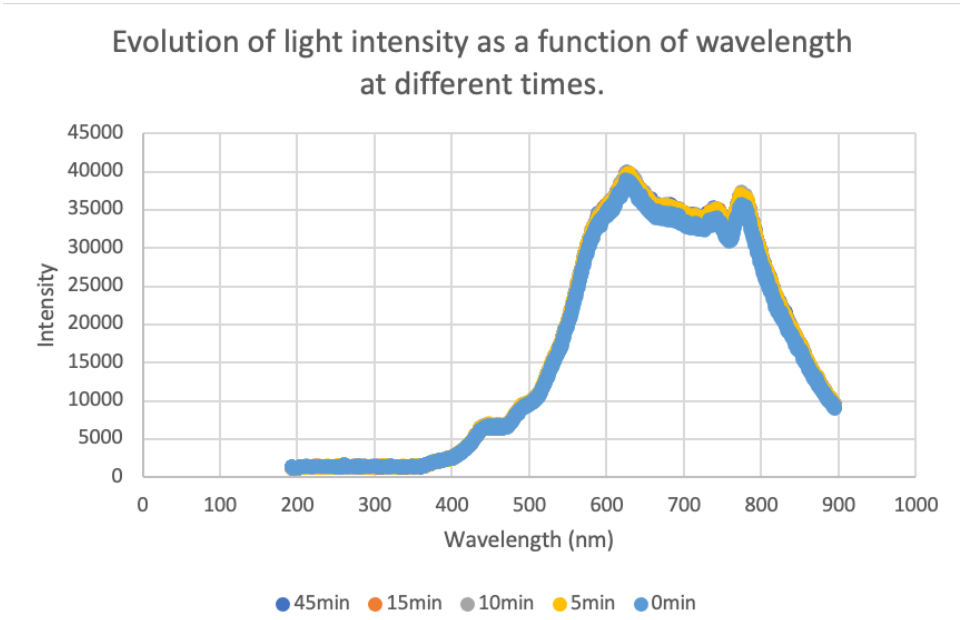
***1**. Arduino card* ***2**. ULN2003 Driver* ***3**. Stepper motor 28BYJ-48*

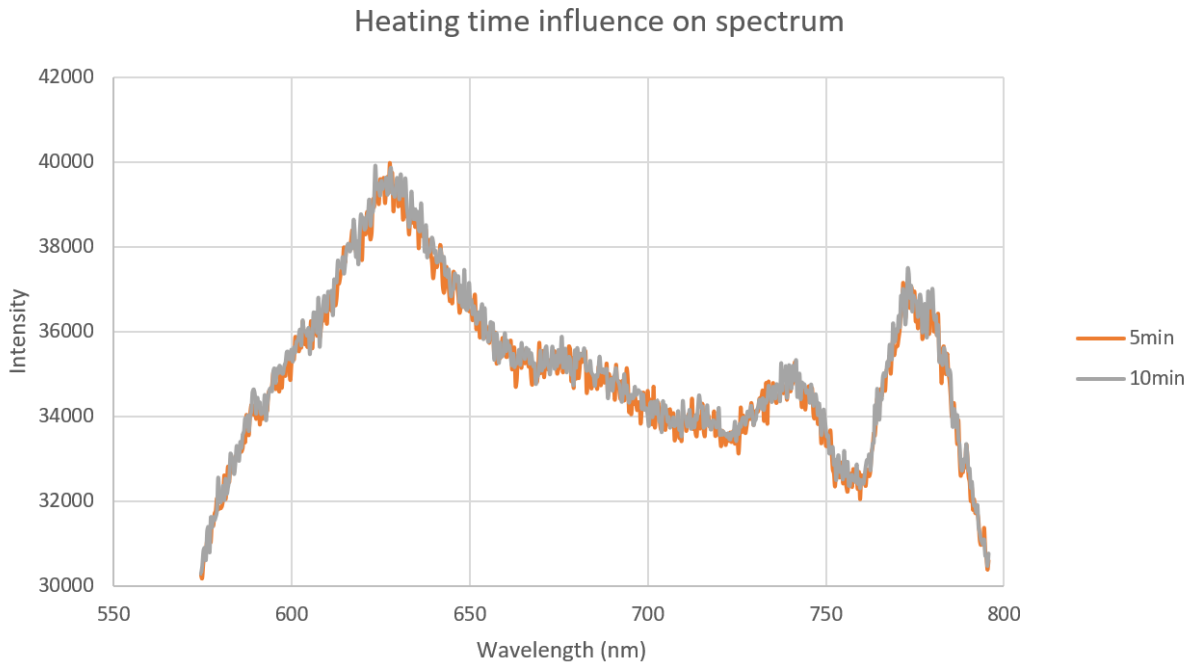




Optical installation used to realize the project

At the beginning of this project, we determined the impact of heating on the fiber illuminator (light source). The main impact of the heating can be observed between 600-800nm and for only a limited amount of time. As you can see on the first graph describing the heat influence on intensity, the only curve that is distinguishable is the one at time zero. After 5 minutes, all the curves overlap themselves, intensity is constant and not depending of the heating time anymore.





This is why we preconize waiting approximately 5 minutes after switching on the light source the first time. When a correct setting is selected, there is no need to switch off the light between every measure when analyzing multiple optics as it will not have any impact on the application functioning.

When launching the program, the chosen spectrometer and the Arduino card should already be connected to the computer via USB. The program is supposed to works as intended even if it's not the case but it's better to do so to limit any bugs or problems that could possibly happen.

3. Usage of the software

The main goal of the software is to provide a visual interface for users to visualize and save graphs of transmittance as a function of wavelength for different optics. It also allows launching the code inside the Arduino card to initialize the motor rotation and record data at different angles. This then enables plotting a three-dimensional graph that can be saved. You can check the video linked in the resources section to see how the application works with the optical installation.

4. Possible errors and troubleshooting

As the program isn't very complex, errors or problems during the program execution should not be recurrent and most of them will be resolved by simply closing the application and opening it again.
As mentioned beforehand, USB devices should always be connected before launching the application to limit any possible errors.

If the Arduino card is connected to the computer but not detected, it may be because of missing drivers. Normally, drivers are automatically installed when plugging the Arduino in via USB but administrator rights might be needed. If it's not the case, installing the Arduino IDE could also resolve the problem. In case it's still not detected, please check that the Arduino card and its cable are both working correctly and are not damaged.

5. Resources

A video showing how to use the optical installation with the application:
https://youtu.be/egTQwvu5YpU?si=xyuqS4yEhd6RMKyw

The GitHub page of our project includes this document, the source code of the application and the Arduino as well as other important information:
https://github.com/allsteps/ABspectro