nlir
MEMBER OF THE NYNOMIC GROUP

NLIzeR

Software Manual

2025

Contents

To run the NLIR Spectrometer software, use the provided *NLIzeR.exe* file. No installation is required.

1. Connecting to Spectrometer

When the spectrometer is turned on and connected to a computer with the USB cable, the computer should recognize the device as “Spectrometer”.

As soon as the spectrometer is recognized by the computer, the NLIzeR software can be started. If the connection to the spectrometer is not properly established, the software will display "Attempting connection to device" and will continuously attempt to reconnect. The user can either close the software or dismiss the pop-up message, but the software's functionalities will be limited until a successful connection is made. The main interface of the NLIzeR looks like this:

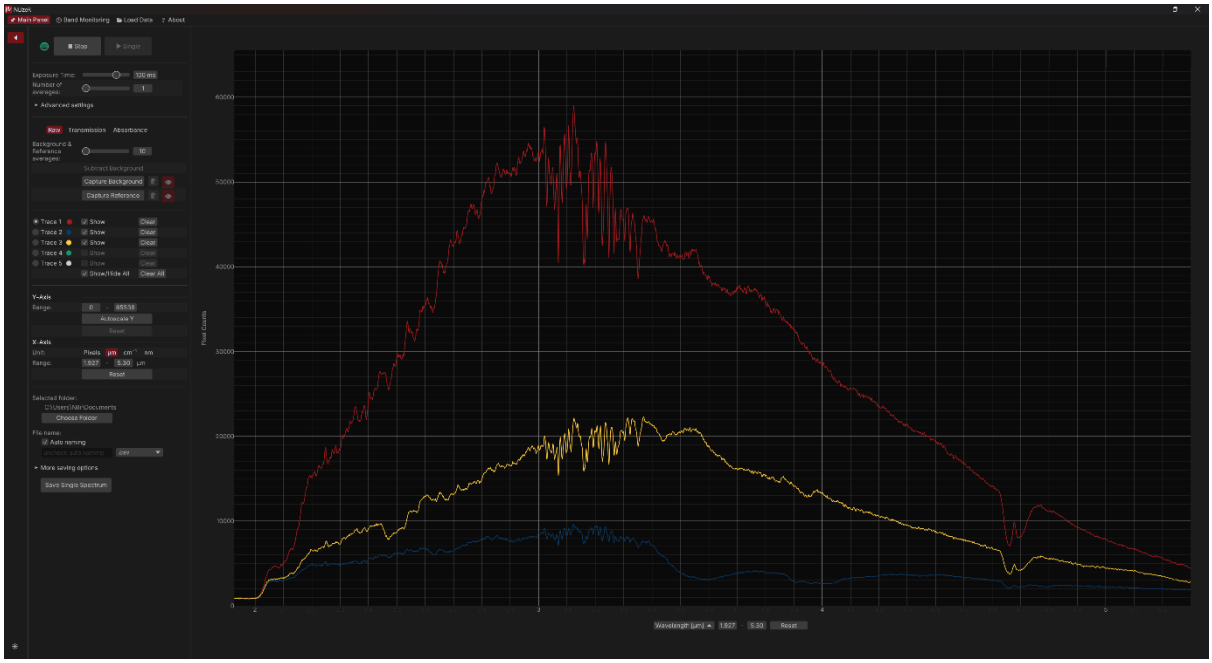

Figure 1: NLIzeR's Main Tab

If the software closes even though the spectrometer is connected and turned on, check that a COM port on the computer is allocated to the spectrometer by inspecting the Device Manager on Windows. If there are one or more active COM ports, try and unplug the spectrometer and observe if one active COM port disappears. If no COM port is allocated for the spectrometer even though it is connected and turned on, check if the computer is running Windows 10. If this is the case, contact NLIR for support.

2. Main Tab - Basic Settings and Operation

When the software is successfully started, the spectrometer is ready to measure. The software detects what specific spectrometer the computer is connected to and adjusts the interface accordingly.

A green indicator in the top left corner shows that the spectrometer is successfully connected. If the indicator is red, no device is detected, and the features of the software will be limited. If orange, try restarting the application. If it persists, please contact NLIR for support.

You can hover over the indicator to view relevant information: if the indicator is green, the device's serial number will be displayed; if red, a message indicating that no device is connected will appear.

The far-left panel features two buttons: one at the top to toggle the settings panel visibility [*Figure 2: left*] and the other at the bottom to switch between dark and light themes [*Figure 2: right*].

Figure 2: The buttons for toggling the settings panel and for switching themes

The top panel contains different tabs that are explained in the next sections and at its far-right corner, user messages are displayed, providing real-time updates, such as "File saved successfully," "Waiting for device," and other relevant notifications.

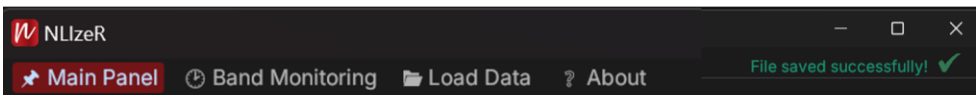

Figure 3: The Top Panel

The left panel contains all the settings needed for a measurement, allowing you to configure and adjust parameters as needed before starting or during the measurement process.

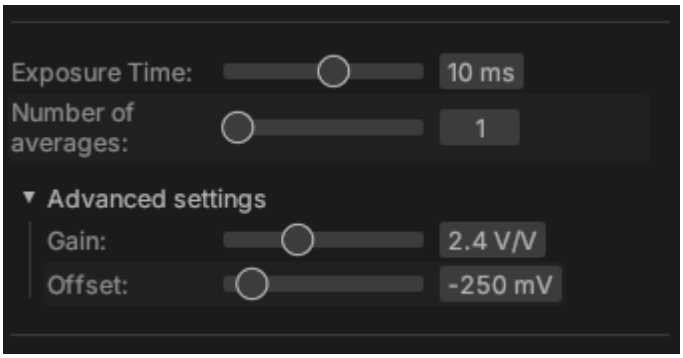

Figure 4: Settings block

2.1. Exposure Time

The ***Exposure Time*** is the period in which the spectrometer pixel array collects light. The minimum and maximum values are shown in the specifications above. It is recommended to set the exposure time as high as possible without saturating the sensor to achieve the best signal-to-noise ratio.

2.2. Number of Averages

For better data quality, the spectrometer can do averaging of measured spectra. The ***Number of Averages*** is the number of spectra subsequently measured, and the average spectrum is shown on the graph. The output is still a 16-bit value.

2.3. Advance Settings

In the *advanced settings* block, the ***Gain*** (1 – 5) and ***Offset*** (-0.3 – 0.3) can be adjusted. The gain and offset apply to the analog signal before AD convention.

Suggested usage:

1. With minimum exposure time: Block the input and adjust the offset until all pixels show a value slightly above zero.
2. With a “long” exposure time: Saturate the input and adjust the gain until the highest pixel values are just below 65535.

The factory setting of gain and offset are already adjusted for the instrument.

2.4. Measure Spectrum

To measure a spectrum, press ***Single***, which will immediately capture a single spectrum with the chosen exposure time and number of averages, or press the Space key (view all keyboard shortcuts in *Section 7*).

To continuously acquire spectra (not saved), press ***Continuous*** (or *CTRL+Space*).

Use the ***Stop*** button to stop acquiring spectra, (or *Space* / *CTRL+Space*).

Note: While measuring in continuous mode, if the settings cause the application to lag (e.g., setting a very high exposure time or averaging), you can press the spacebar once to stop the continuous acquisition and halt the lagging application.

2.5. Choose Active Trace

Measurements can be done with up to five different traces. A non-active trace is still shown in the graph. To activate a trace, click its corresponding radio button (or *Ctrl+1*, *Ctrl+2*, and so on, for the desired trace). Check the ***Show*** box to see the respective trace or uncheck it to hide them. Use the ***Show/Hide All*** box to toggle visibility for all traces at once. To zero all values for a specific trace, click ***Clear*** next to it (or right-click it), or select ***Clear All*** (or *Ctrl+0*) to clear all traces.

Figure 5: Traces block

Note that only values from the currently shown traces are saved when pressing the save button.

2.6. Plot Axes

The axes on the graph are controlled through the block shown in *Figure 6*.

By default, the x-axis is displayed in wavelength [µm], but it can be switched to wavelength [nm], wavenumber [cm^{-1}] or pixel numbers by selecting the corresponding unit. The same x-axis settings are available below the graph for easy adjustments *[Figure 7]*.

Both axes can be reset to their default values using the ***Reset*** button, and the y-axis can be auto scaled by clicking the ***Autoscale*** button.

The x-range and y-range values are interactive and allow to manually set the axis limits. They can be dragged left (down) or right (up), or clicked and then filled with a desired value directly.

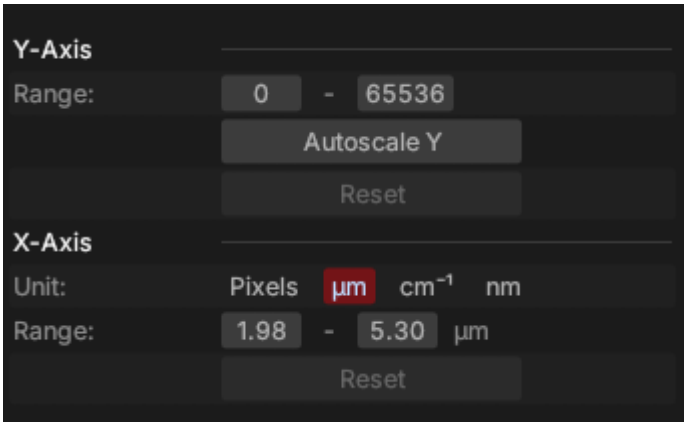

Figure 6: Axes settings on the left panel

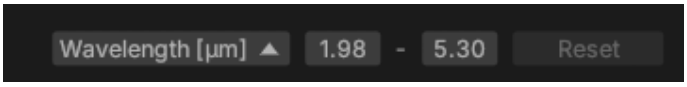

Figure 7: X-axis settings below the graph

2.7. Transmission Options

It is possible to measure a background to subtract intrinsic noise from the spectrometer and measurement setup. The background is measured using the chosen exposure time and averaging settings.

Note: "Background & Reference averages" in transmission block not to be confused with "Number of averages" in the settings block [Figure 4].

Note 2: It is recommended that the ***Background & Reference averages*** number is set higher than the signal average number *(Number of averages)*.

By measuring a reference, the spectrometer can perform transmission (relative) measurements directly. You can switch between **Raw** (counts), **Transmission**, and **Absorbance** view.

Like the background, the reference is measured using the active exposure time and averaging settings. The transmission (T) is calculated as

$$T=\frac{D-B}{R-B},$$

where B is the background and R is the reference. The absorbance (A) is calculated as

$$A=-\log_{10}(T).$$

Note: When capturing the background and reference it may prove advantageous to use a high number of averages to avoid their noise contributions in all subsequent measurements.

Subtract background in *Raw* mode: If selected, the measured background is subtracted from all count values showed in the graph when measuring.

Toggle the visibility of background and reference data by clicking the corresponding 👁 button and clear them by clicking the 🗑 button.

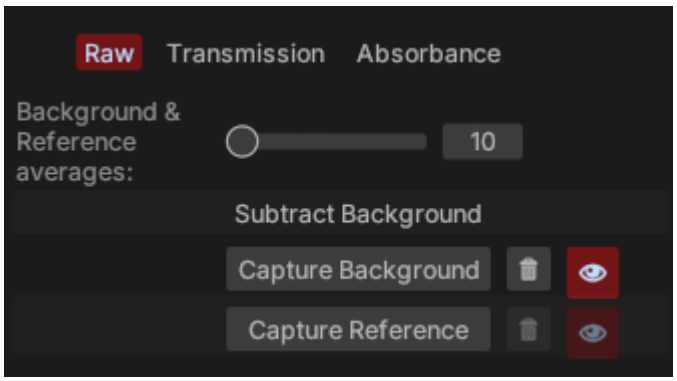

Figure 8: Transmission block

2.8. Save Data Options

The default save location is the Documents folder and the file format is csv.

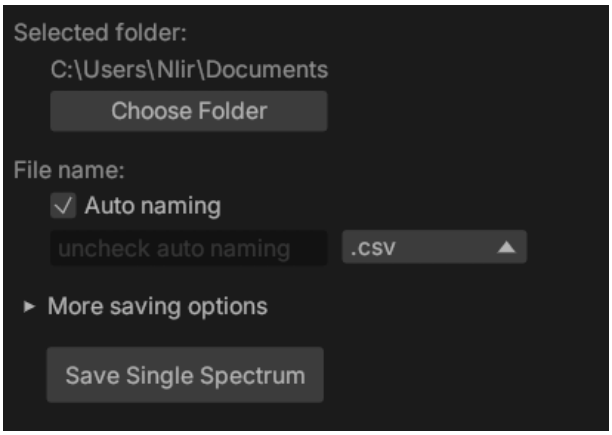

Figure 9: Save File block

If ***Auto naming*** is enabled, the file will automatically be named in the format "NLIR-*Type_Year-Month-Day-Time.csv*" (e.g., "***NLIR-Spectra_****2025-01-01_18-30-55.csv*", ensuring each file is uniquely identified by its creation timestamp. If auto-naming is disabled, the user must manually enter the desired file name. If a file with the selected name already exists in the chosen directory, an index will be appended to the file name to prevent overwriting. For example, the file "*File_name.csv*" will be saved as "*File_name(1).csv*". If another file with the same name already exists, the index will increment accordingly, ensuring each file has a unique name.

By default, the raw input data of the active traces, along with the wavelength axis, background (if any), and reference (if any), are saved. You can modify the save file settings by expanding the ***More Saving Options*** and selecting from the available options.

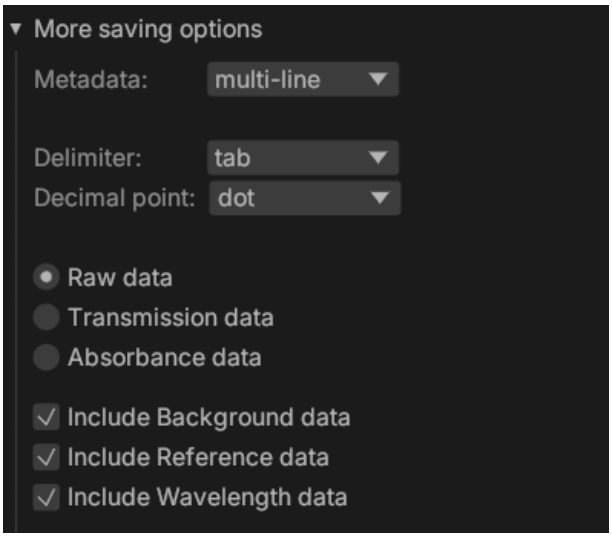

Figure 10: More Saving options

A file can then be saved by pressing the ***Save Single Spectrum*** button (or *Ctrl+S*). As previously mentioned, only values from the currently shown traces are saved when pressing the save button. The date and time are saved as metadata, along with the software version, device serial number, exposure time, number of averages and trace mode. The saved file starts with the metadata line(s) starting with "#", followed by eight rows (or nine rows for multi-spectra capture, see *Save Multi-Spectra* section below) rows of captured data. The metadata can be displayed either as multi-line, as shown in *Figure 11*, or in a single line as JSON, shown in *Figure 12*.

```
# Software: NLIzeR v1.0.0
# Device Serial Number: 1111s11
# Start DateTime: 2025-01-01T12:30:55.04+01:00
# Exposure Time [ms]: 10
# Number of Averages: 1
# Trace Mode: Raw
# Rows: Wavelength [pixels], Background, !Reference, Trace*
# Columns: Pixel[0:2047]
#
0   1   2   3   4   5   6   7   8   9   10  11  12  13  14  15
2177    2181    2170    2167    2148    2164    2187    2179
NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN
44930   44877   44703   44612   44146   44000   43883   43622
NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN
NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN
NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN
NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN
```

Figure 11: "Save Single Spectrum" output file example, with multi-lined metadata

```
# {"Software":"NLIzeR v0.1.0","DeviceSerialNumber":"1111s11","StartDateTime":"2025-01-01T18:30:55+01:00","ExposureTimeMs":0.7, ....}
#
1.9269  1.928   1.9292  1.9303  1.9314  1.9326  1.9337  1.9349  1.936   1.9371  1.9383  1.9394  1.9406  1.9417  1.9429  1.944   1.94
274 267 259 260 256 266 275 263 256 250 267 259 255 250 258 241 232 252 260 256 256 255 249 239 244 255 251 242 242 247 254 230 240
19131   19196   19180   19237   19113   19066   19076   19067   19082   19043   18961   18986   18955   18964   18973   18906   1881
2591    2644    2644    2584    2604    2559    2616    2645    2648    2593    2582    2620    2594    2577    2611    2512    2476
4421    4457    4400    4353    4391    4403    4383    4357    4398    4370    4347    4355    4358    4333    4393    4350    4294
7098    7070    7090    7069    7078    7057    7046    7011    6992    6990    6974    6952    6985    6972    7020    7022    6954
NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN
NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN
```

Figure 12: "Save Single Spectrum" output file example, with JSON metadata

The metadata includes two additional fields, "*Rows*" and "*Columns*," which define the structure of the subsequent data. A prefix of "!" in the *Rows* field indicates that no data is available for that entry (NaN value), while a prefix of "*" signifies that multiple rows follow for that entry.

As an example, in the file above, the first data row contains the wavelength data in pixels, the second row represents the background, the third row holds the reference data (NaN), followed by the trace data.

2.9. Multi-Spectra Capture

Aside *Single* capture mode, the spectrometer can capture data in a second mode, which is available under ***Multi Spectra Options*** in the ***More saving options*** section. The different modes are *Burst*, *Periodic* and *External Trigger*.

*Note: The **Number of averages** is not considered in Burst and External Trigger modes. This means that regardless of the user's setting, it is always fixed to 1.*

Burst

Acquires and saves spectra as fast as possible. Set ***Number of measurements*** to how many spectra the device is to capture with the chosen exposure time and press ***Capture Multi Spectra*** (or *Ctrl+M*). The device doesn't show the spectra in this mode but saves them in a buffer internally and finally to a file when it has finished capturing.

Note that the device is inaccessible when capturing the chosen number of spectra.

For the above reason, if the total time to acquire the desired number of data with the given settings is long (more than 1s), a confirmation message is shown together with the estimated time of this action, as shown in the next picture.

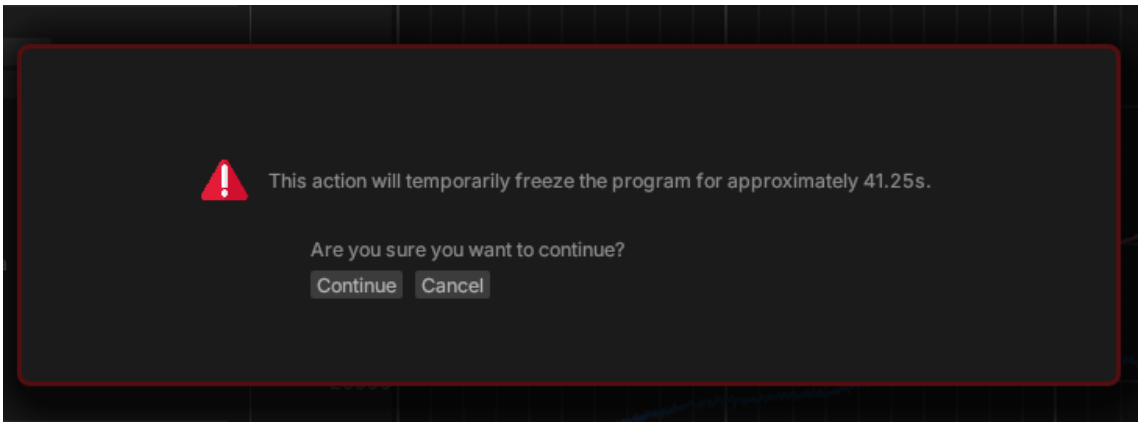

Figure 13: The confirmation message in burst mode

Periodic

The device will capture spectra with the frequency set by the ***Interval*** field. Since the read-out and saving times are system-dependent and include significant jitter, the *Periodic Mode* is not recommended for measurements that require millisecond precision; instead use the *External Trigger Mode*. This is because in the *Periodic Mode*, the spectra are shown live on the screen which results on each spectrum of the captured data introduces a delay on the order of tens of milliseconds to the minimum achievable time between measuring two spectra. This means that if the chosen *Exposure time* is close to the value of the *Interval*, the device might not be able to keep that value. In any case where the value does not match the device, the device measures as often as possible.

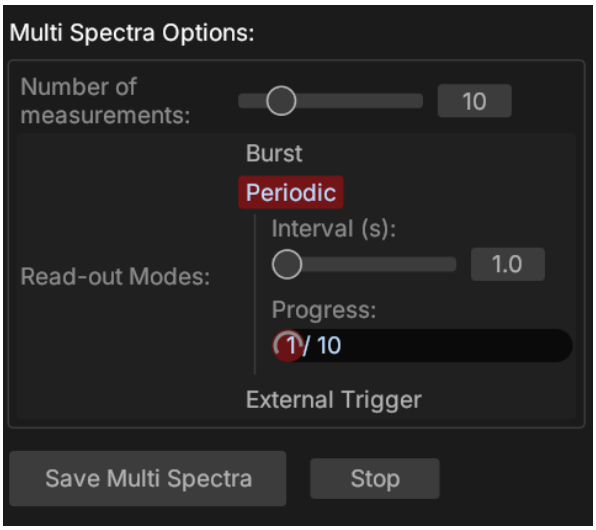

Figure 14: The Periodic Mode options

External Trigger

Allows the user to control the measurement timing externally with a trigger signal connected to the trigger port on the spectrometer. Make sure to connect the trigger cable and have the trigger ready before starting trigger mode. In external trigger mode, the device only measures a spectrum when it receives a trig, i.e. a rising edge to 5 V.

*Note that the device is inaccessible when capturing the chosen number of spectra and waits for until it receives all of them or until **Time-out** seconds have passed.*

Note that in external trigger mode, the maximum acquisition rate is 160 Hz.

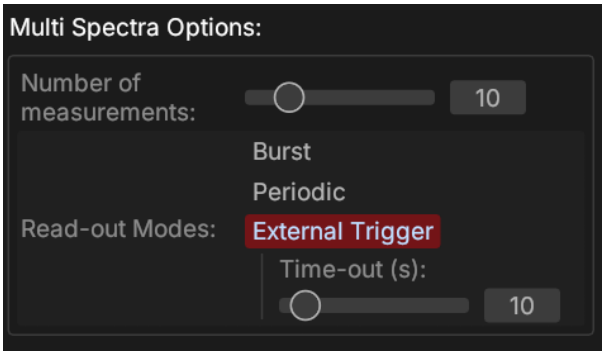

Figure 15: The External Trigger Mode options

Save Multi-Spectra

To save multi-spectra data press the ***Save Multi Spectra*** button (or *Ctrl+M*). The metadata of a multi-spectra file includes all the information described in *2.8*, along with an additional field called "*Capture Mode*", which can be set to either “Burst”, “Periodic”, or “Triggered”. If the capture mode is set to “Periodic”, the interval will also be saved. An example file, with 10 spectra and auto naming “***NLIR-MultiSpectra_****2025-01-22_09-12-15*.csv” is shown below:

```
# Software: NLIzeR v1.0.0
# Device Serial Number: 1111s11
# Start DateTime: 2025-01-01T18:30:55+01:00
# Exposure Time [ms]: 0.012
# Number of Averages: 1
# Trace Mode: Raw
# Capture Mode: Periodic (1 s)
# Rows: Wavelength [um], Background, Reference, Trace*
# Columns: Pixel[0:2047]
#
1.9269  1.928   1.9292  1.9303  1.9314  1.9326  1.9337
306 304 300 294 294 301 304 296 295 288 296 301 302 284
7250    7283    7257    7254    7266    7282    7280
1012    994 936 955 970 956 1013    1008    986 965 981
954 960 931 943 976 976 988 1003    947 948 976 980 983
942 956 964 964 960 952 944 981 981 952 952 944 958 942
1021    1005    995 982 970 986 1003    1014    1041
1256    1247    1240    1267    1236    1244    1254
5869    5952    5882    5818    5866    5851    5853
3550    3583    3596    3623    3556    3604    3646
12968   13083   12931   12940   13003   13008   12971
12946   13069   12942   12923   12814   12784   12850
13189   13130   13141   13181   13194   13254   13161
```

Figure 16: Multi-spectra output file example

3. Band Monitoring tab

The Band Monitoring tab allows you to track the average of a selected spectral range over time.

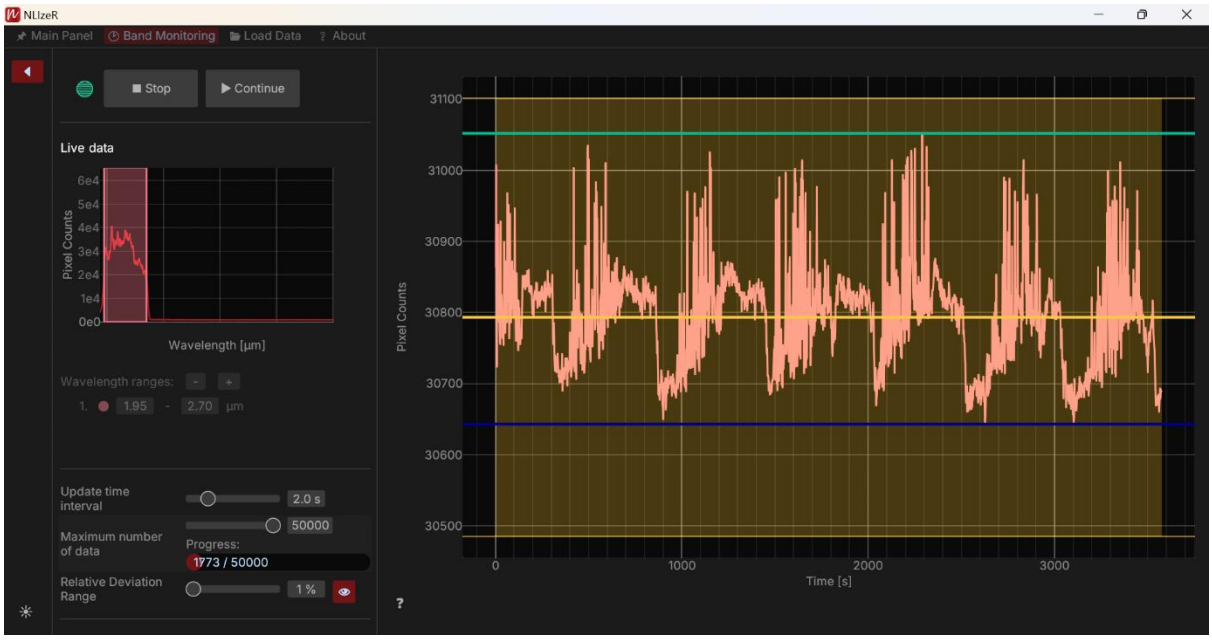

Figure 17: The Band Monitoring tab

In the upper-left corner of the panel, you'll find the ***Start***/***Stop*** (or *Ctrl+Space*) and ***Pause***/***Continue*** (or *Space*) buttons for initiating and controlling band monitoring. Below,

a small graph provides a live representation of the input data. The pink-highlighted area indicates the selected spectral range for the band monitoring.

You can track up to three different ranges. Use the **+** and **-** buttons to add or remove ranges. The two values represent the range limits, which can be adjusted by dragging them left (down) or right (up), or by clicking and entering a specific number.

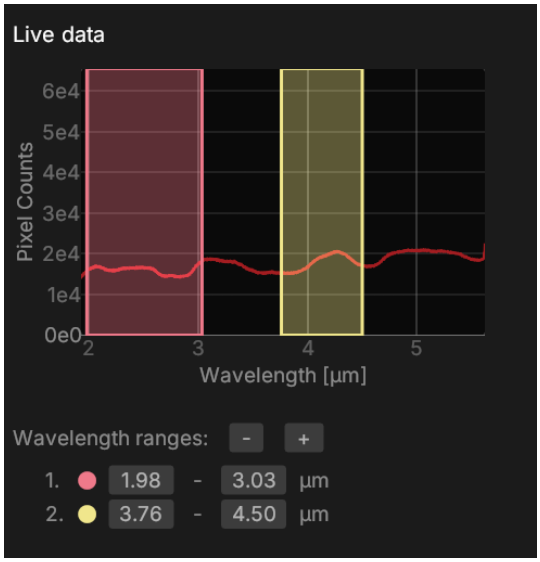

Figure 18: Live data graph and selection of bands

The monitoring process collects new data at each ***Update time interval*** and will stop either when the ***Maximum number of data*** entries is reached or when the ***Stop*** button is pressed. The ***Pause*** button temporarily halts the monitoring—while no new data is recorded (nor saved) until the ***Continue*** button is pressed. When resumed, the monitoring picks up from the current time and continues collecting data.

Note: During a paused state, no data is saved to the file.

Additionally, a progress bar is displayed to track the status of the current band monitoring, showing how much data have been acquired relative to the ***Maximum number of data***. The ***Relative Deviation Range*** slider creates a highlighted area on the graph to visualize the relative deviation range specified.

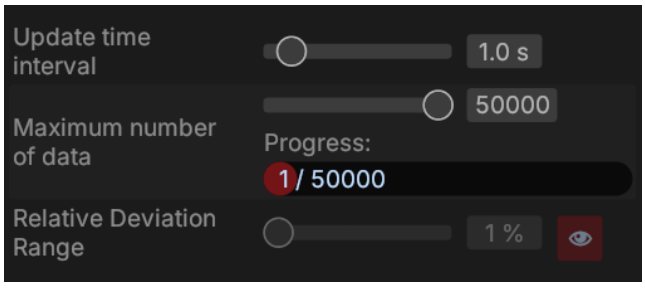

Figure 19: Band monitoring options

During a band monitoring, the instantaneous average of the selected spectral range is logged ("*Value*"). In addition, mean, max, min, relative deviation and standard deviation of the *Value* are displayed.

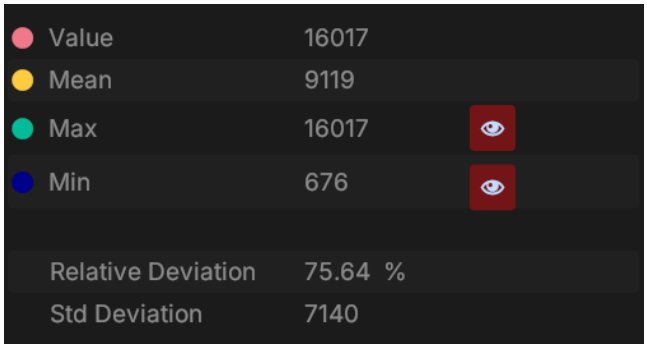

Figure 20: The statistical measures that are monitored when one wavelength range is selected

The table in *Figure 20* is displayed when only one wavelength range is selected. However, if multiple ranges are selected, the monitoring process will keep track of the mean band values (*Value*) for each range over time, as shown in *Figure 21*.

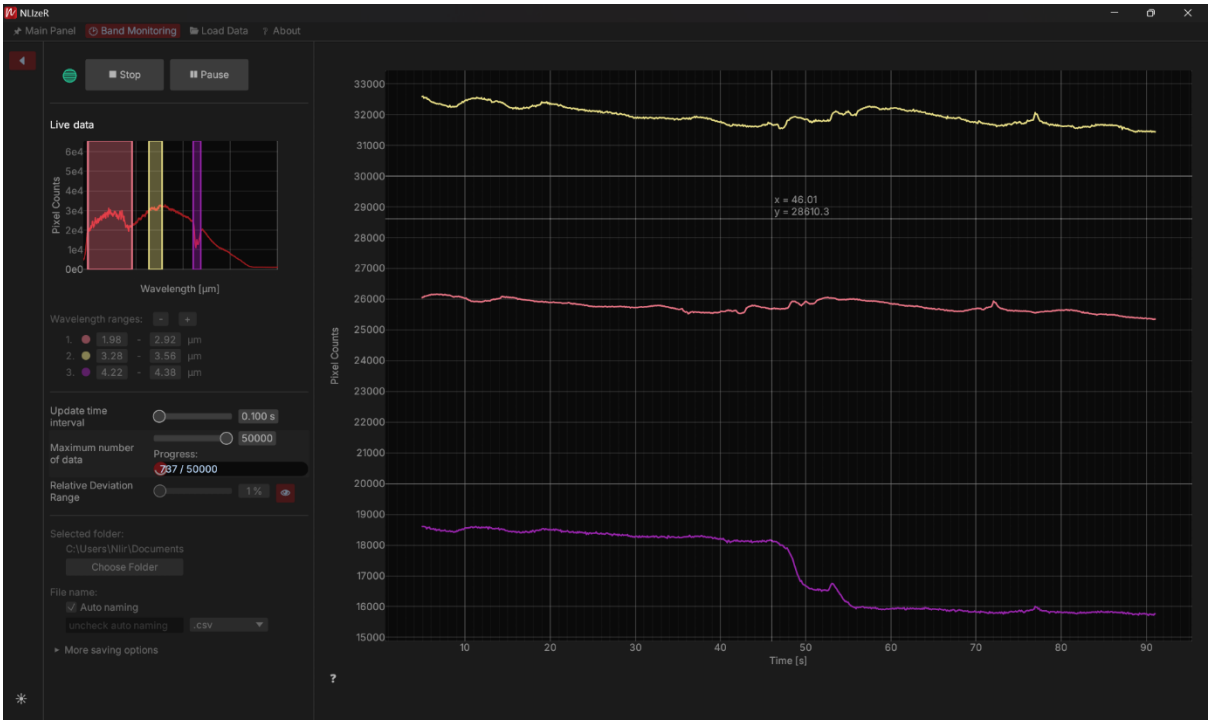

Figure 21: Band monitoring of three selected wavelength ranges

3.1. Save Band Monitoring Data

When band monitoring is initiated, a new file is created in the selected folder using the specified name and settings. As the monitoring process continues, data is automatically appended to this file in real-time, ensuring that all captured information is stored, until ***Maximum number of data*** is reached or until ***Stop*** button is pressed.

The automatic file name follows the format "***NLIR-BandMonitoring_****Year-Month-Day_Time*.csv". The file contains metadata, followed by the data that are stored in columns. The metadata fields *Columns* and *Bands* provide explanations for the data structure. An example of a band monitoring file is shown below.

```
# Software: NLIzeR v1.0.0
# Device Serial Number: 1111s11
# Start DateTime: 2025-01-01T18:30:55+01:00
# Exposure Time [ms]: 10
# Number of Averages: 1
# Trace Mode: Raw
# Bands: 1.980:3.034
# Columns: Time [s], MeanBand1
#
0.1 3362.5
0.2 3362
0.3 3370
```

Figure 22: Example of band monitoring output file

In this file, the first column contains the time data in seconds, while the second column holds the mean values of only one band, Band 1, which corresponds to the wavelength range of 1.980–3.034. Each subsequent column represents additional bands.

In the *More saving options,* there is an additional setting for the band monitoring called ***Save all data***. When enabled, a second file that contains all the spectral data will be created, with the suffix "raw", e.g. "***NLIR-BandMonitoring_raw_****Year-Month-Day_Time*.csv" or "*File_name****_raw****.csv*".

4. Load Data tab

This tab serves as a data viewer and can also be used to compare the spectrometer's live data with data loaded from a file for reference. It can also be used as a data viewer when no instrument is connected, by loading data from a file.

Figure 23: The Load Data tab

The first three blocks of the left panel refer to the spectrometer settings, as explained in *Section 2*. In the fourth block of this panel, you can load a file's data by clicking ***Import File***. If the ***Import Settings*** box is checked, the settings from the loaded file (exposure time and number of averages) will be automatically imported into the app. The ***Reload File Settings*** button allows loading the settings from the imported file at any time.

Once the file is successfully loaded, the imported file's metadata will be displayed in the ***Imported File Metadata*** table, and the corresponding data will appear on the graph.

Up to five different traces can be loaded, as well as a background and a reference, alongside the live data. You can toggle the visibility of those by using the 👁 button or the ***Show/Hide All*** checkbox.

Additionally, the ***Target Range*** slider shows an area corresponding to values within ± *x*% of the currently selected trace.

5. About tab

The About page provides details about the software version you're using, update information (see *Updates* section for details), documentation link, and contact information.

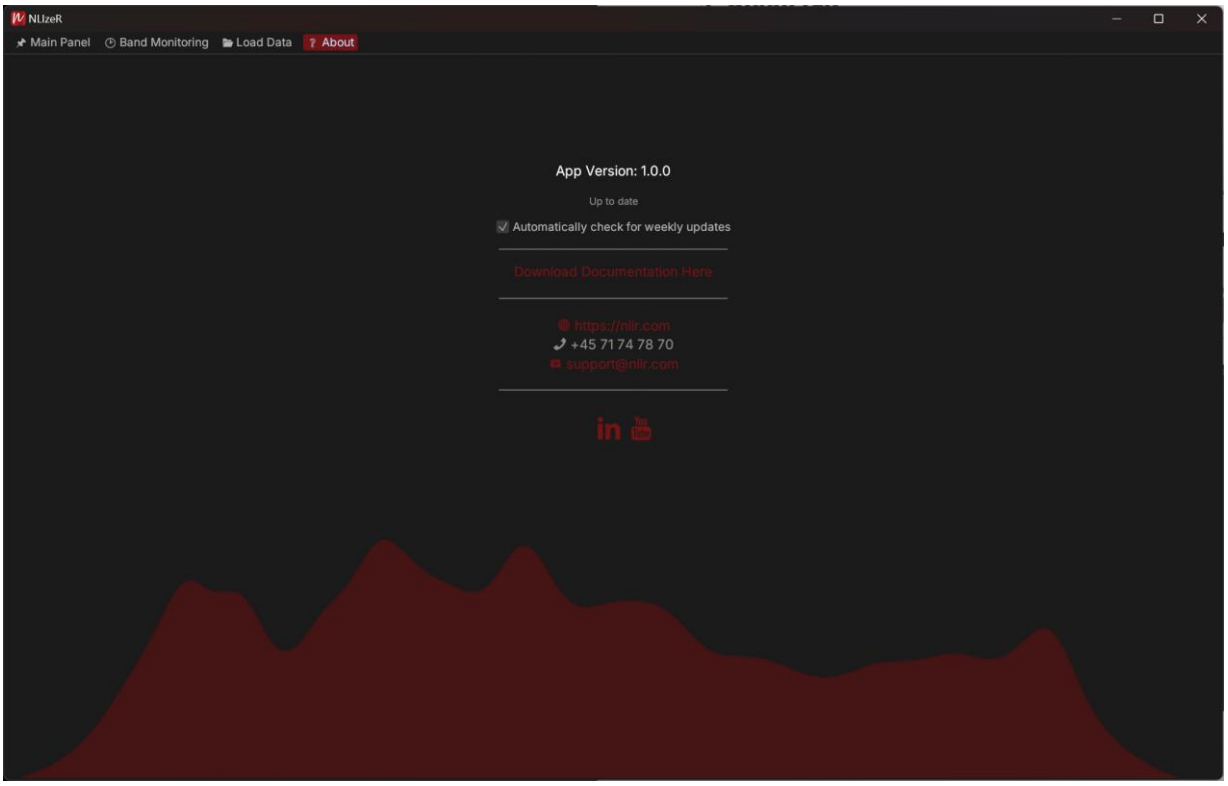

Figure 24: The About tab

6. Updates

By default, the software checks for updates weekly. If a new update is available, a pop-up message will appear as shown below.

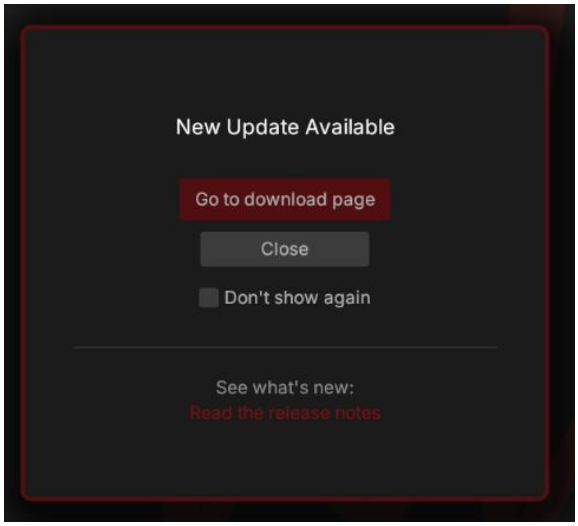

Figure 25: New update available pop-up message

You can disable future update notifications by checking the ***Don't show again*** box. This setting can be changed at any time on the *About* tab by toggling the ***Automatically check for weekly updates*** checkbox.

7. Keyboard Shortcuts

App	
Esc / Ctrl+Q	Quit
F1/F2/F3/F4	Switch to the respective tab
Ctrl+F	Full screen on/off
Ctrl+H	Show/hide left panel

Main tab	
Ctrl+Space	Start/Stop continuous acquisition
Space	Capture single spectra
Ctrl+1/2/3/4/5	Switch between traces
Ctrl+0	Clear all traces
Ctrl+S	Save single spectra
Ctrl+M	Save multi spectra

Band Monitoring tab	
Ctrl+Space	Start/Stop band monitoring
Space	Pause/continue

Load Data tab	
Ctrl+Space	Start/Stop continuous acquisition
Space	Capture single spectra
Ctrl+1/2/3/4/5	Switch between traces

8. Contact

In case of malfunction or questions, contact NLIR at:

NLIR
Hirsemarken 1C
DK-3520 Farum
Denmark
+45 71 74 78 70
support@nlir.com