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I. INTRODUCTION

This test concerns only the microscopes that can acquire fluorescence emission spectra.

Fluorescence microscopes, although conceived preliminary to be imaging systems, can also acquire emission spectra, with a better spatial resolution but poorer spectral resolution than conventional spectrometers. The spectral response of a microscope expresses the responsivity of the imaging system versus the emission wavelengths.

Correct interpretation of the emission spectra measured with a microscope requires the knowledge of its spectral response.

The “spectral response” analysis provides the normalized **detection efficiency** versus the emission wavelengths, as well as quantitative parameters such as the spectral **roll-off**.



II. SPECTRUM ACQUISITION PROCEDURE

The “*spectral response*” analysis is associated with the “*target*” (Pattern A), “*word Argolight*” (Pattern J), or “*repositioning cross*” (Pattern H) patterns (see Figure 1).

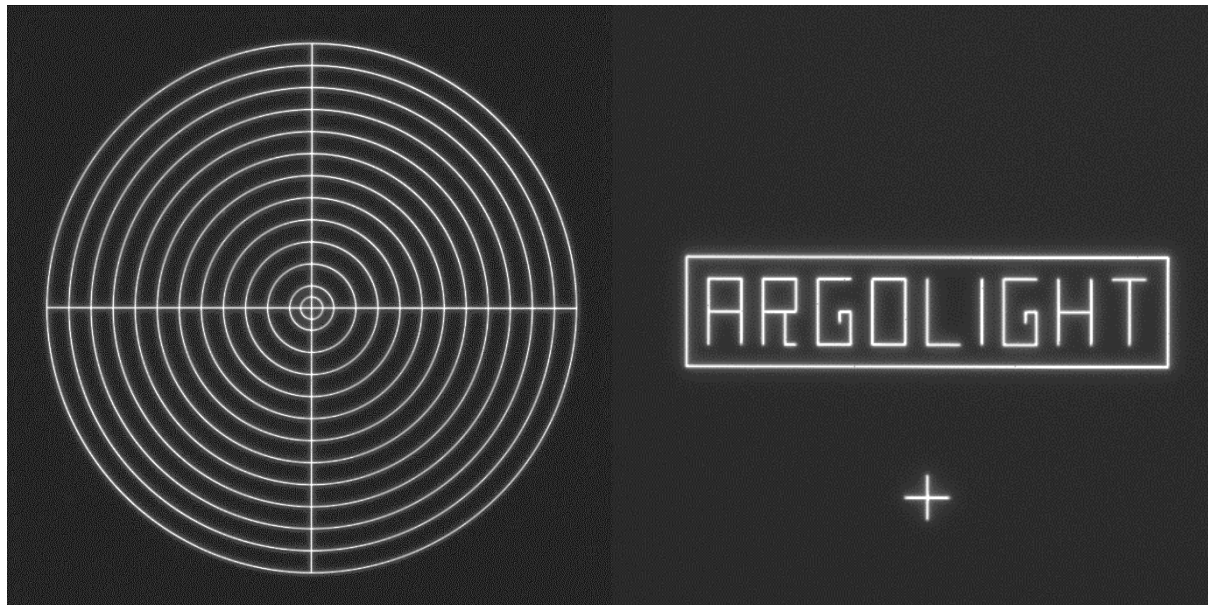


Figure 1: Image example of the “target”, “word Argolight” and “repositioning cross” patterns.

1. ACQUISITION RECOMMENDATIONS

This test concerns only the microscopes on which the spectrum measurement mode is available.

- **Recommended file type**

Z stack	No
Multi-channel	Recommended but not mandatory: acquire emission spectra with specific excitation wavelengths (365, 375, 405, 488, 514 and 543 nm)
Tiles	No
Lambda-scan	Yes

Do not zoom in, this could damage the pattern.

The area of the scanned zone should not be smaller than the area of the pattern.

- **Data organization in the CSV file**

The data in the CSV or TXT file should be organized as follow (cf. Figure 2):



- Data should be organized in columns:
Wavelength (in nm);
Intensity (in arbitrary units).
- Data should be separated by a comma or a semicolon.
- Rational numbers should be written with dots (no comma).
- There can be several header lines (text format).

```
wave_length,measured_intensity
430;6.727938307449222e-05
435;0.00015864457236602902
440;0.00022089271806180477
445;0.00024471088545396924
450;0.000414153968449682
455;0.0007094984757713974
460;0.0014022840186953545
465;0.0029159511905163527
470;0.0061706011183559895
```

Figure 2: Example of a correct file organization.

2. HOW TO ACQUIRE THE SPECTRUM?

1- Find the patterns

- Start with a low mag objective (such as 10× or 20×). Set the DAPI (405 nm) or GFP (488 nm) channel.
- Make coincide the center of the slide with respect to the objective.
- Adjust focus through the eyepieces.
- Switch to the objective you'd like to use. Move the slide to the pattern.

2- Adjust your setup

- Match the center of the pattern with the center of the field of view.
- Adjust the focus.
The best focus usually corresponds to the Z-plane for which the central cross looks the clearest (qualitative approach) and/or for which the intensity histogram is the broadest (quantitative approach).

3- Acquire the spectrum

- Image the pattern by following the acquisition recommendations.
- Save spectra into a CSV or TXT files.



III. SPECTRUM ANALYSIS PROCEDURE

1. HOW TO LAUNCH AN ANALYSIS?

- Select "Spectral response" in the "Select analysis" list.
- Click on "Upload file" to upload the CSV or TXT file of the acquired spectrum.
Click on "Display data" to select the spectrum.
- Set the required and optional settings (see chapter 2 "Analysis Settings").
- Click on "Start the analysis".



- Results are displayed and can be saved as CSV, PDF, or transferred into Daybook Data Manager (if available in your package).

2. ANALYSIS SETTINGS

1- Required settings

- Argolight type of glass**

There are 2 types of ArgoGlass®; they both have slightly different spectral features (excitation and emission) which can influence the analysis.

Select the type of glass according to your slide type:

For an Argo-POWER, Argo-HM, Argo-LM, Argo-SIM and Argo-Check → Select AG02.

For an Argo-Z → Select AG01.

- Central excitation wavelength**

The central excitation wavelength is usually the wavelength of the laser used when acquiring the image.

IV. RESULTS PAGE DESCRIPTION

The picture below shows the results interface for this analysis (cf. Figure 3). Results are displayed in the form of graphs and tables.

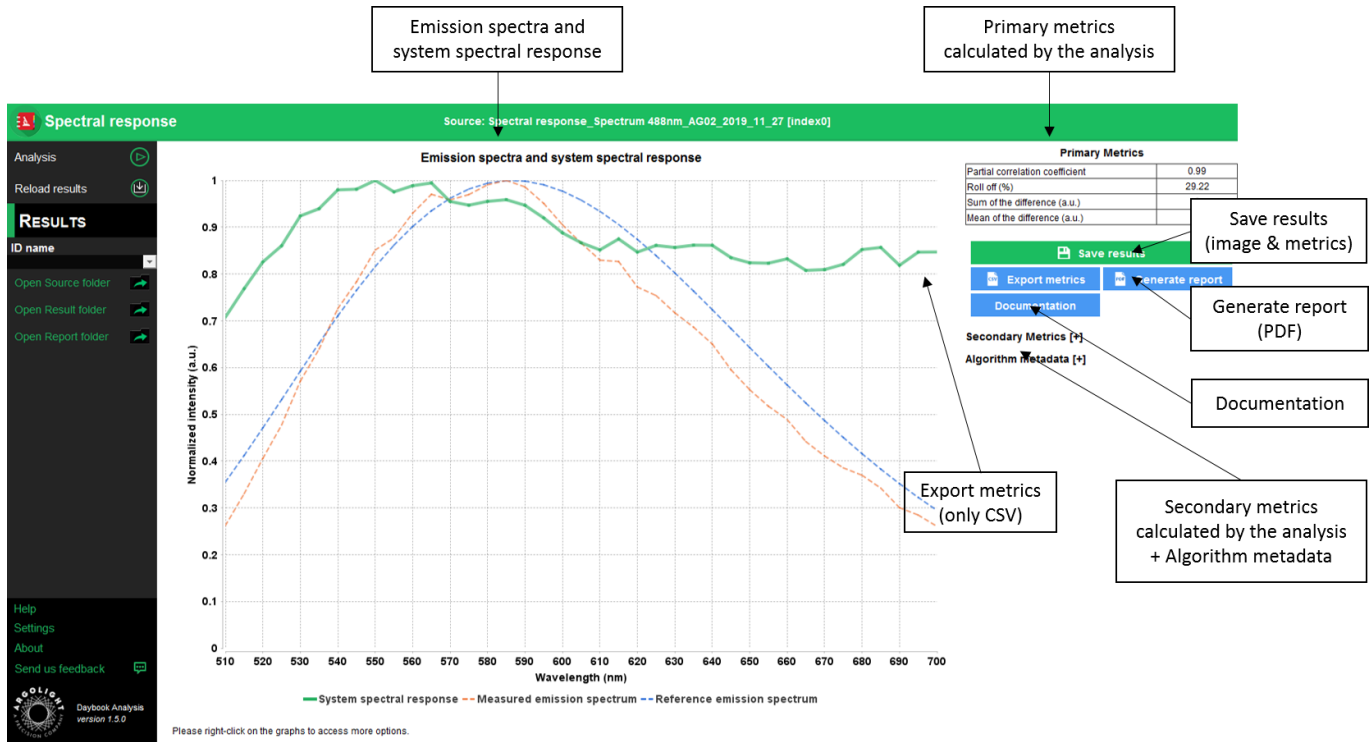


Figure 3: Results page.

When Daybook Data Manager is disabled, the results can be saved into a CSV file thanks to the “Save results” or “Export metrics” buttons.

Reports (in a PDF format) containing the results (maps, graphs, metrics) can be generated and saved by clicking on the “Generate report” button (cf. Figure 3).

By default, the results will be saved in the “/Daybook results” folder, located within the Daybook directory. To modify the default folder, go to the “Settings” menu at the bottom left corner.

When a valid Daybook Data Manager license key is registered, the “Save results” button becomes “Save into Data Manager”. Results are therefore transferred into Daybook Data Manager when clicking the “Save in Data Manager” button. In the saving window interface, select the system, acquisition profile and associated channel for which you would like to save the results.

By default, the results are saved at the acquisition date of the image. If the acquisition date is not in the metadata of the image, it is possible to save the results at the present date (date of analysis) or at a custom date (cf. Figure 4).



SAVE RESULTS IN DATABASE

Please choose your configuration used for the Field uniformity analysis

Select your system
Demo microscope ▾

Select your acquisition profile
Profile 1 ▾

Select the associated channel
DAPI #1 ▾

Select the saving date
Present date (2020-01-20 15:43:56) ▾

Save results **Cancel**

Figure 4: Interface window for saving the results in the database.

- **Graph options:**

- Zoom in and out: Hold the left or right button of the mouse and move it towards the bottom right to create a selection rectangle. To go back to the initial size, hold the left or right button of the mouse and move it towards any direction.
- Optional features. Right click on the graph to have access to:
 - “Properties”: Edit the chart properties.
 - “Save as”: Save an image into a PNG or JPEG file, or the graph values into a TXT file.
 - “AutoRange”: Adjust automatically the ranges of the axes.



V. ANALYSIS ALGORITHM DESCRIPTION

The diagram below describes the algorithm that allows the extraction of the spectral response from one spectrum of the target, the word Argolight or a repositioning cross (cf. Figure 5).

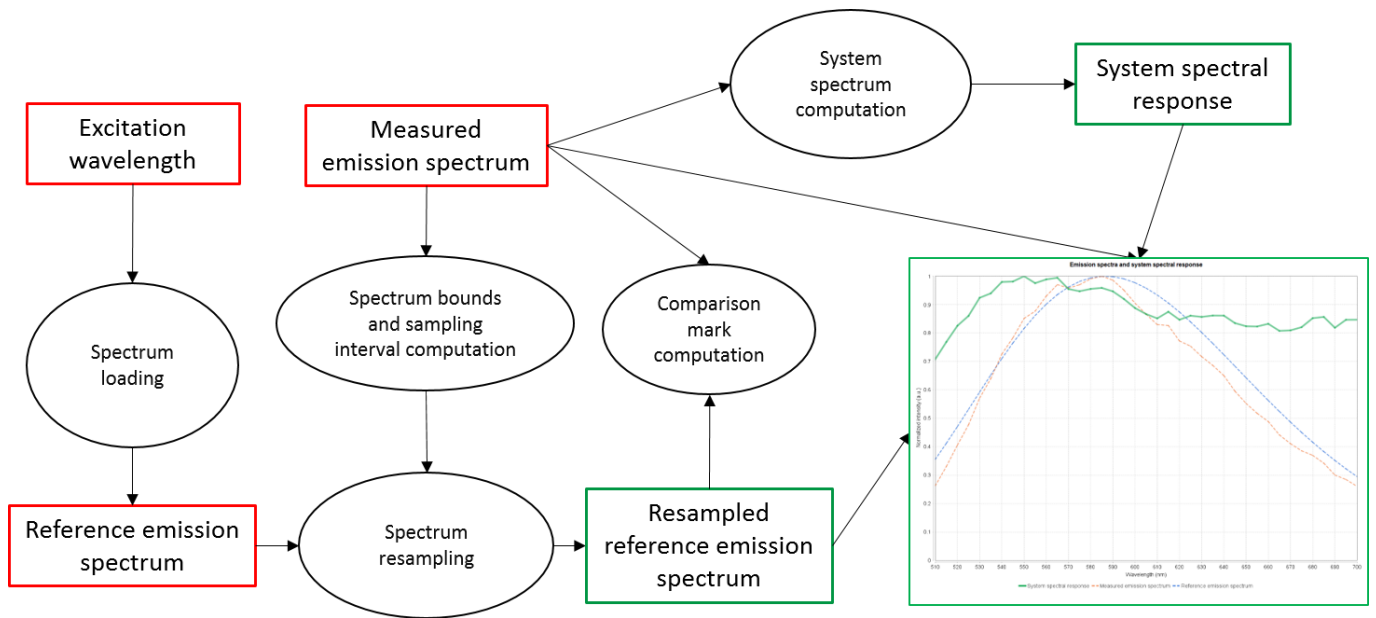


Figure 5: Schematic description of the different steps of the analysis algorithm.

In short, the algorithm works as follows:

- It resamples, if needed, the measured spectrum.
- It divides the measured spectrum by the reference spectrum to deliver what is called the spectral response of the system.
- It displays the spectral response with the measured and reference spectra into the same graph.



VI. OUTPUT METRIC DESCRIPTION

- *Spectral response* is the ability of a device to detect photons within a given spectral range. It is expressed as the ratio between a measured reference spectrum by a “true” reference one, both acquired at the same excitation wavelength. It is unitless.

1. PRIMARY METRICS

- *Partial correlation coefficient (r')* provides information about how close the measured spectral response is from the reference one, stored in Daybook database. It is unitless, and is given by the following formula:

$$r' = \frac{\text{mean}(Intensities_{ref} \times Intensities_{mes}) - \text{mean}(Intensities_{ref}) \times \text{mean}(Intensities_{mes})}{\sigma(Intensities_{ref}) \times \sigma(Intensities_{mes})}$$

Where *mean* denotes the mean (average) value and σ the standard deviation.

- *Roll-off* is a measure of the flatness of the spectral response. It is expressed in %, and is given by the following equation:

$$\text{Roll-off} = 100 \times \frac{I_{max} - I_{min}}{I_{max}}$$

Where I_{max} and I_{min} are the maximum and minimum intensities, respectively, in the spectrum. A roll-off of 0 % denotes a system with a perfect spectral response.

- *Sum of difference* is the sum of the absolute value of the difference between the measured and the reference spectra. It is expressed in arbitrary unit, and is given by the following formula:

$$\text{Sum of difference} = \sum |I_{measured} - I_{reference}|$$

Where $I_{measured}$ is the measured spectral intensity values and $I_{reference}$ the reference spectral intensity values.

- *Mean of difference* is the mean of the absolute value of the difference between the measured and the reference spectra. It is expressed in arbitrary unit, and is given by the following formula:

$$\text{Mean of difference} = \frac{1}{n} \sum |I_{measured} - I_{reference}|$$

Where n is the number of experimental points, $I_{measured}$ is the measured spectral intensity values and $I_{reference}$ the reference spectral intensity values.

2. SECONDARY METRICS



- *Wavelength at maximum intensity of the reference spectrum* corresponds to the wavelength at which the intensity of the reference spectrum is maximal. It is expressed in nm.
- *Wavelength at maximum intensity of the emission spectrum* corresponds to the wavelength at which the intensity of the measured spectrum is maximal. It is expressed in nm.

3. ALGORITHM METADATA

- *Analysis date* is the date at which the analysis has been performed.
- *Software version* is the version of the software.
- *Product type* is the type of Argolight product selected in the panel settings.
- *Glass type* is the type of Argoglass® selected in the analysis settings.
- *Central excitation wavelength* corresponds to the wavelength of the illumination source used to acquire the fluorescence spectrum. It is pre-set by the user. It is expressed in nm.



Encountered an issue or a question when using Daybook Analysis?

Please send a screenshot and your issue description at:

customer@argolight.com