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1 Brontes Integrating Sphere

The Brontes Integrating Sphere (Brontes-is) accepts light energy through a 9.6 mm input port and measures the spectral properties of LEDs and other light sources.

With the Brontes Integrating Sphere you're able to measure high speed in line:

- Luminous Flux (lm)
- Luminous Intensity (cd)
- colour coordinates (x,y)
- dominant wavelength

The Brontes-IS consists of a Ø38.2mm Spectralon sphere encased in an aluminium housing.

The interior of the Brontes-IS is made from Spectralon, a white diffusing material that provides a highly lambertian reflecting surface.



Picture 1: Brontes-is

The Brontes-is colorimeter has a fixed tristimulus sensor. The characteristics of the sensor closely match the CIE1931 colour matching curves as used by many spectrometers to calculate colour. Within a spectrometer the measured spectrum can be multiplied by these curves and integrated. The resulting three values are X,Y and Z. The Brontes gives X,Y and Z straight away, so spectral correction can not be performed.

The Brontes relative spectral sensitivity can be seen in the below graph.

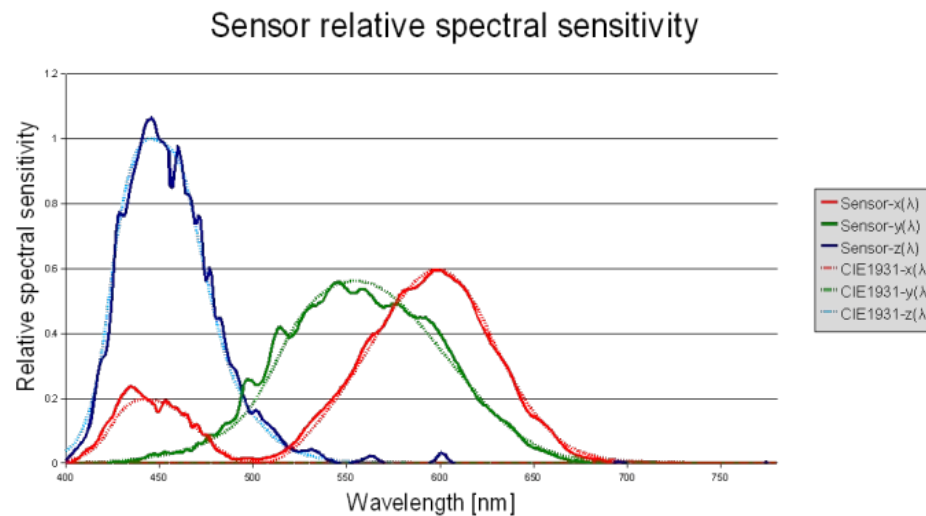


Illustration 1: brontes-is spectral sensitivity

It can be seen that at some wavelengths in the spectrum the Brontes sensitivity differs a little from the CIE1931 colour matching curves.

The Brontes colorimeter provides the user not with the spectral data, but the X,Y and Z value, meaning that only the visible spectrum is taken into account.

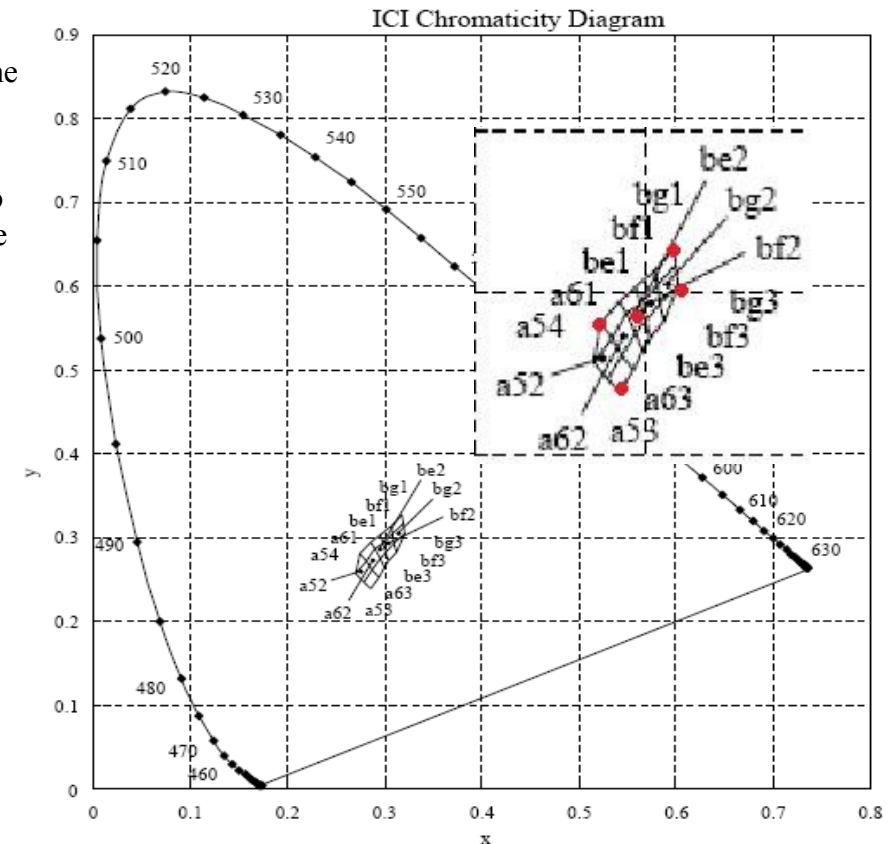
2 Calibrating the Brontes-IS

When calibrating to LED's it is important that all the LED's have (almost) the same spectral response. And to measure precisely it is recommended to match to a wide range of LED's of the same type.

If for example LED's must be measured according picture 2, it is recommended to take a LED from rank A53, A54, BG1, BE2 and BG3. (See the red dots in picture 2.)

It is required that the LED's lay apart of each other and not in 1 line, so it always creates a surface as shown in figure 2.

When calibrating the Brontes-IS the warm-up time of the LED must be taken into account. Because when the LED warms-up a colour point shift takes place of around 0.003 (x,y).

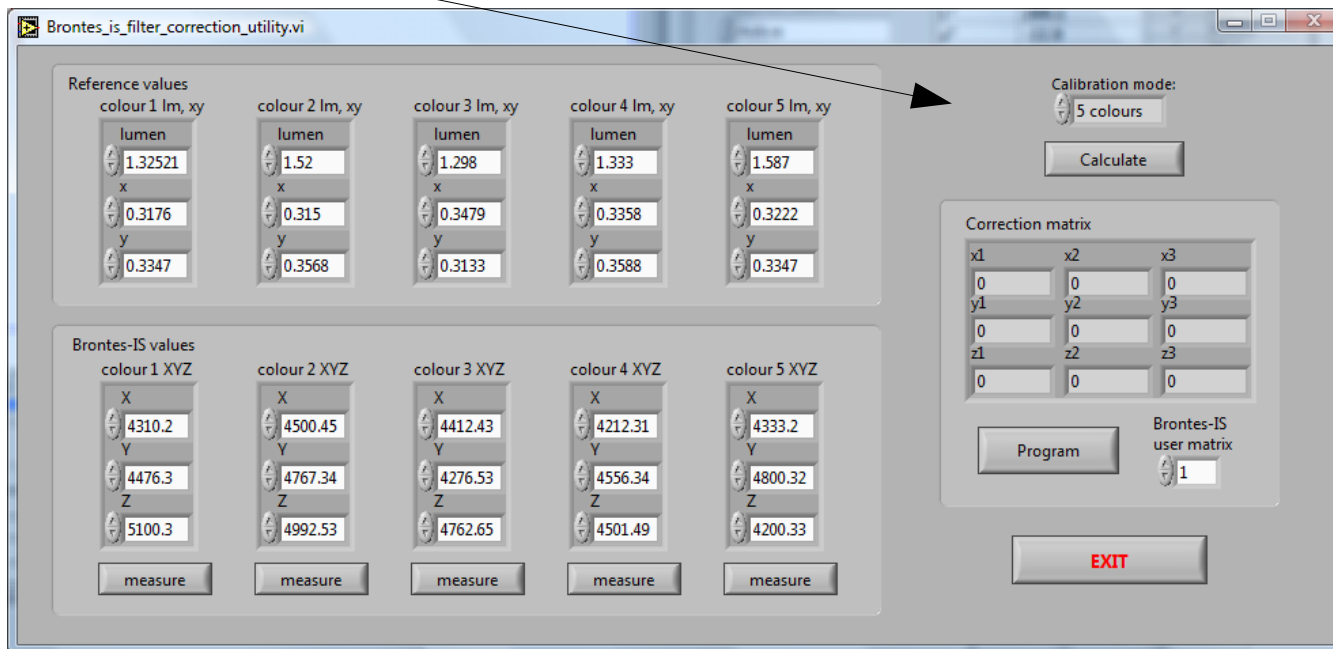


Picture 2: White LED colour ranks

3 Brontes-IS filter correction utility

The Brontes-is can be calibrated by applying a 3x3 matrix. This matrix can be calculated using measured values of both the reference system and the Brontes-is. Admesy supplies software that will calculate the matrix from these measured values. Up to three calibration matrices can be stored in the Brontes. In case more are required, additional methods exist.

As first the calibration mode must be selected, if there is calibrated for 3, 4 or 5 colours.



Picture 3: Brontes-is filter correction utility

Reference values				
colour 1 lm, xy	colour 2 lm, xy	colour 3 lm, xy	colour 4 lm, xy	colour 5 lm, xy
lumen 1.32521	lumen 1.52	lumen 1.298	lumen 1.333	lumen 1.587
x 0.3176	x 0.315	x 0.3479	x 0.3358	x 0.3222
y 0.3347	y 0.3568	y 0.3133	y 0.3588	y 0.3347
Brontes-IS values				
colour 1 XYZ	colour 2 XYZ	colour 3 XYZ	colour 4 XYZ	colour 5 XYZ
X 4310.2	X 4500.45	X 4412.43	X 4212.31	X 4333.2
Y 4476.3	Y 4767.34	Y 4276.53	Y 4556.34	Y 4800.32
Z 5100.3	Z 4992.53	Z 4762.65	Z 4501.49	Z 4200.33
measure	measure	measure	measure	measure

Picture 4: reference and brontes-is values

Calibration mode:
5 colours

Calculate

Correction matrix

x1	x2	x3
13.0777	-2.49995	-5.21063
y1	y2	y3
1.37151	5.51424	-2.01224
z1	z2	z3
9.33855	-0.211608	-3.89402

Program

Brontes-IS user matrix
1

Picture 5: 3X3 correction matrix

After the values have been filled in, in the filter utility, the “Calculate” button can be clicked in order to calculate the 3x3 correction matrix. The matrix can be stored using the “Program” button in either one of the three user matrices calibration areas (User 1, User 2, User 3) in the Brontes and be used in all other Brontes applications.

Note : When measuring not via the measure button, the values using the Brontes-is the calibration matrix in the Admesy colorimeter main application should be set to “OFF”.

4 Considerations

The calibration as shown in this report is valid for the measured LED's only. It may be used for other LED measurements with similar light spectrum but the Brontes needs to be recalibrated for other types of LED's (for example a red, green or blue LED's).

This means that when the Brontes has been calibrated on a LED light source that uses white LED, it can, for example not be used to measure a light source with RGB LED's unless a new calibration is carried out.

When calibrating multiple Brontes devices it is recommended to calibrate one against the reference system and the other Brontes devices toward this reference Brontes.

Starting a calibration with LED's, take into account that the LED must warm up before calibrating, or else deviations due to the fact of warm up time can be seen.

Perhaps the most important in good results is the use of very good mechanics. Keeping spot sizes and distances always equal, reduces the risk of deviations due to these factors.