Measuring Light spectra, Illuminance levels and Rendering index with the new Ultra instrument

Report summary

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Research Report	Summary of report TR26.01
Status of Report	Finished
Research question	For a range of light conditions, determine the accuracy of the new Ultra instrument (Lighting Recipe Studio Limited) to measure spectral irradiance and illuminance.
Conclusion	We determined the accuracy of a new instrument to measure the spectrum and properties of light. This Ultra instrument from Taiwanese company Lighting Recipe Studio Limited offers a much easier to use, much lighter weight and much lower cost alternative to widely used instruments such as the CL500A (Konica Minolta) and the Specbos 1211UV (Jeti). We compare the accuracy of the Ultra with those two benchmark instruments for a wide range of light conditions. Our results show that for many important lighting parameters the Ultra is less accurate than the benchmark instruments, but sufficiently accurate for many applications. For example, its deviation from benchmark instruments for measuring illuminance is less than 100 lux (median deviation: 76 lux). This should be sufficient for many practical applications except for the most critical ones. Similar conclusions were found [1] for measuring Correlated Color Temperature, chromaticity coordinates (*x,y*), the distance to Planckian locus *duv*, the dominant and peak wavelength and Color Rendering Index R_a and R_1 up to R_{15}. Also under dim lighting conditions (we tested as dark as 60 lux) the Ultra performs well. For applications that need high accuracy, for example to identify all the details of the spectrum of multi-LED luminaries or of natural daylight, the wavelength resolution of the Ultra is not sufficient. Also for applications where wavelengths below 430 nm are important the Ultra is not suitable. The current document is a summary of the full research report, which can be ordered through www.ColorsAI.nl [1].

1 Introduction

In July 2025 Lighting Recipe Studio, a Taiwanese research institute, launched the In. Licht Ultra instrument (in this report referred to as the Ultra). This irradiance spectrometer is remarkable because of a number of unique features. With 59 gram it is much lighter and smaller than other irradiance spectrometers, making it easy to carry. It is operated via Bluetooth through an app on the smartphone, making the barrier to do light spectrum measurements very low. And finally, the price of the Ultra is considerably lower than from other irradiance spectrometers.
The specifications [2][3] mention that the wavelength data increment is 2 nm, and the spectral bandwith (FWHM) is 10 nm. This makes it unclear what the effective spectral resolution is of this instrument in practical applications: is it closer to 2 or to 10 nm? In order to find out, we decided to test the instrument.

The specifications of the Ultra look promising, and also the certifications of this instruments are good. According to the manufacturer [3], the Ultra instrument is officially certified by the Shanghai Institute of Measurement and Testing Technology (also known as the National Center of Measurement and Testing for East China). This is one of China's most prestigious metrology institutes, authorized by the government to conduct both legal and scientific metrology. The Ultra was also certified by the Taiwan Accreditation Foundation (TAF)—Taiwan's national accreditation body responsible for accrediting calibration and testing laboratories to international standards.

Here we use a pragmatic approach to determine the accuracy of the instrument versus reference instruments. This report presents a short summary of the research, results and conclusions [1].

2 Research question

For a range of light conditions, determine the accuracy of the new Ultra instrument to measure spectral irradiance and illuminance.

3 Experimental

3.1 Test procedure

We test the accuracy of the instrument by comparing its output to measurements with two widely used reference instruments (Figure 1). These are the CL500A (supplier: Konica Minolta) and Specbos 1211UV (supplier: Jeti). Both can be used as spectral irradiance meters according to their suppliers.

Figure 1 The three instruments used in our test: Jeti Specbos (top left), Ultra (top right) and Konica Minolta CL500A (bottom).

Apart from accuracy we also tested the reproducibility of all three instruments. In each lighting condition, we did 9 measurements: 3 with each instrument.

3.2 Light conditions included in this test

We tested a total of 23 different light conditions.
In the first part of the test, we determined the accuracy of a set of numerical values that are in the output report of the Ultra instrument. This was tested under the following 11 light conditions:

- inside a light booth with setting D65 illuminant we tested different illuminance levels: 1000, 1500, 2000 and 2400 lux
- inside a light booth we tested illuminants D50, D75, A and Retail, all at 2400 lux
- light on a desk inside a standard office with bright window and office lights switched on
- light on the same desk inside the standard office with bright window and office lights switched off, at two positions on the desk that are nearer or further away from the window

In the second part of the test, we examined the spectra that are measured by the Ultra. For this we selected twelve other light conditions.

- We chose two typical lighting conditions in the office, where most of the light comes from the window and where we switched the office ceiling lighting on or off. Both measurements result in relatively low light intensity.
- In a different office we tested a different type of office lighting, which is LED-based. Also here, we have a low light intensity.
- We included two conditions outdoors, because this is often needed in practice. We chose situations in the shadow and in direct sunlight. Both conditions represent very intense lighting.
- We also included 5 tests inside a light booth (Figure 2). The goal of this part of the test was also to determine how well these instruments characterize some standard illuminants as created in a multi-LED-based light booth.
- Finally, we simulated an R&D environment for display characterization, for the iPad display (10th generation iPad, released in 2022, LCD display) and for a display of Honor (Honor Magic 7 Pro, released in 2024, OLED display).

In this summary report, we only discuss results for some of these lighting conditions. For the other lighting conditions we refer the reader to the Full Research report [1].

Figure 2 The three instruments, sequentially placed in exactly the same position and height inside the Thouslite GT light booth.

4 Results on numerical output of the Ultra

In the app and in the reports that it produces, the Ultra provides a wealth of numerical output. Part of this output concerns parameters that are not measured by the reference instruments, such as parameters quantifying flicker and human health indices (circadian factor). Although these parameters may be important for some applications, we did not test their accuracy since we have no benchmark data for these parameters.
The more classical output parameters that we do include in our numerical test are the illuminance (lux) level E_v, chromaticity coordinates (*x,y*), correlated color temperature CCT (often referred to as T_{CP}), distance to Planckian locus *duv*, dominant wavelength λ_{dom}, peak wavelength λ_{peak}, and the Color Rendering Index R_a and R_1 up to R_{15}.

For this part of the investigation, the numerical output of the Ultra was tested under the 11 different lighting conditions mentioned before.

The numerical results for some of these parameters are as follows:

Illuminance (lux) level E_v

The illuminance levels measured by the Ultra and the CL500A agree quite well. The median value of the absolute difference between the two instruments is 76 lux, which is good enough for applications that are not very critical.

Chromaticity coordinates (x,y)

The chromaticity coordinates (x,y) characterize “the color” of the light source. We find that the median absolute difference between measurements from Ultra and from CL500A is 0.0012 for chromaticity coordinate *x*, and 0.0061 for *y*. These values are much larger than the reproducibility errors in (*x*,*y*) for the Ultra (Δx: 0.000050, Δy: 0.000042) and for the CL500A (Δx and Δy: 0.0). They are also much larger than the median absolute difference between measurements from the CL500A and the Specbos (*x*: 0.00055, *y*: 0.0012).

For the results on other parameters, we refer the reader to the Full Research report [1].

5 Results on spectral output of the Ultra

5.1 Lighting conditions in office

We first tested practical lighting conditions in an office. Figure 3 shows that for such conditions, the three instruments agree quite well, especially if we ignore the parts that have little consequences for color perception (below 420 nm and above 700 nm). These results are a first indication that the Ultra is indeed useful for users who do not deal with narrow band light sources.

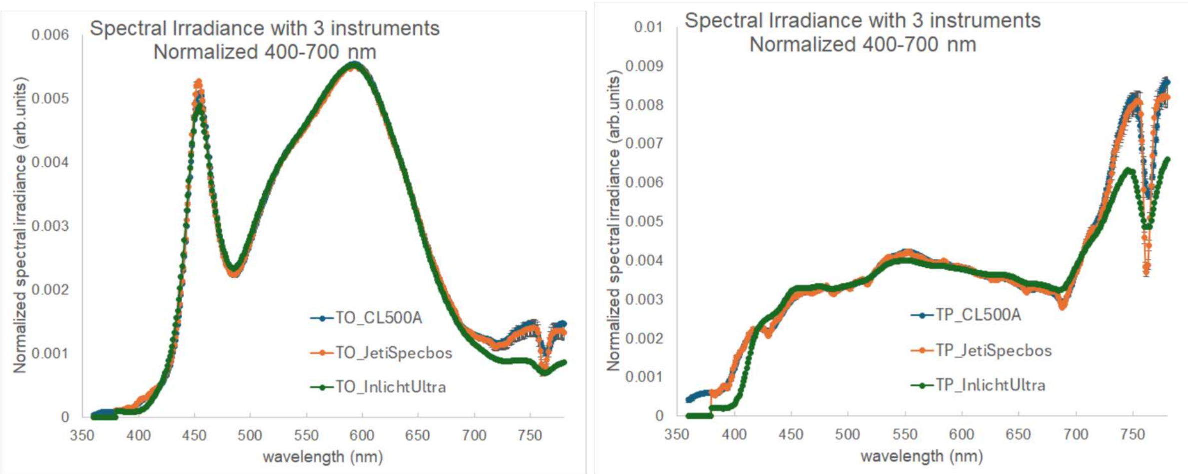


Figure 3 Measurements on spectral irradiance for light conditions TO (Natural daylight from windows and artificial ceiling lighting switched on) and TP (Same, but artificial celing lighting switched off).

Figure 4 shows the results for the light spectrum in a different office, which has LED-based lighting. In this case, we see some differences between the results of all three instruments, perhaps due to the relatively narrow band at 450 nm. However, for these conditions the Ultra does not deviate more from the other two instruments than the other instruments deviate from each other.

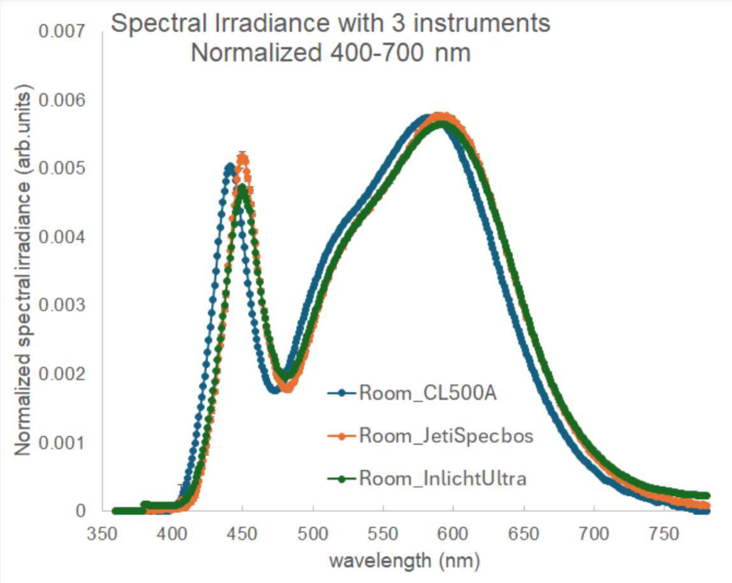
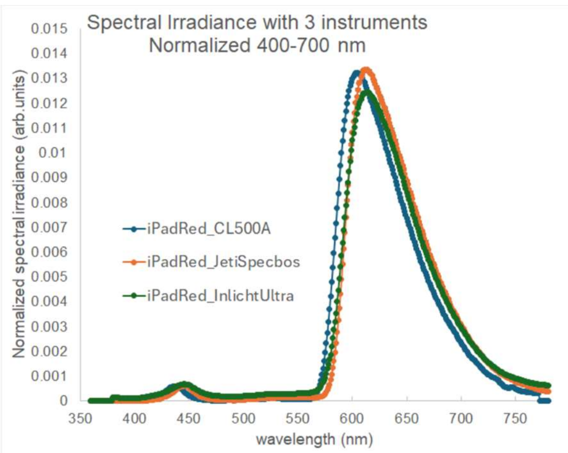


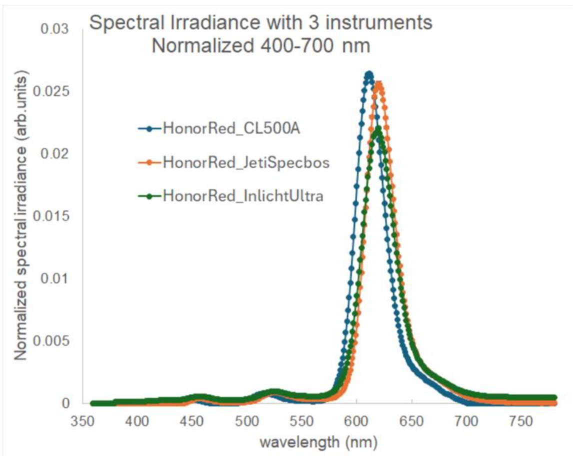
Figure 4 Measurements on spectral irradiance for light conditions LO: LED-based office lighting.

5.2 Display characterization

We tested the instruments for a particular technical application. We simulated technical tests for display characterization. In such tests, inside an otherwise dark room a display is measured from a very small distance. A purely red image is first shown on the display. After the measurement, successively a pure green, pure blue and pure white image is shown and measured. The measurements are again done threefold.
This test was done both with an iPad display of the tenth generation (launched in 2022), and a Honor Magic 7 Pro display (launched in 2024). The iPad has an LCD display, the Honor has an OLED display.

Figure 5 shows that the Ultra is quite well able to characterize the SPDs from these displays.





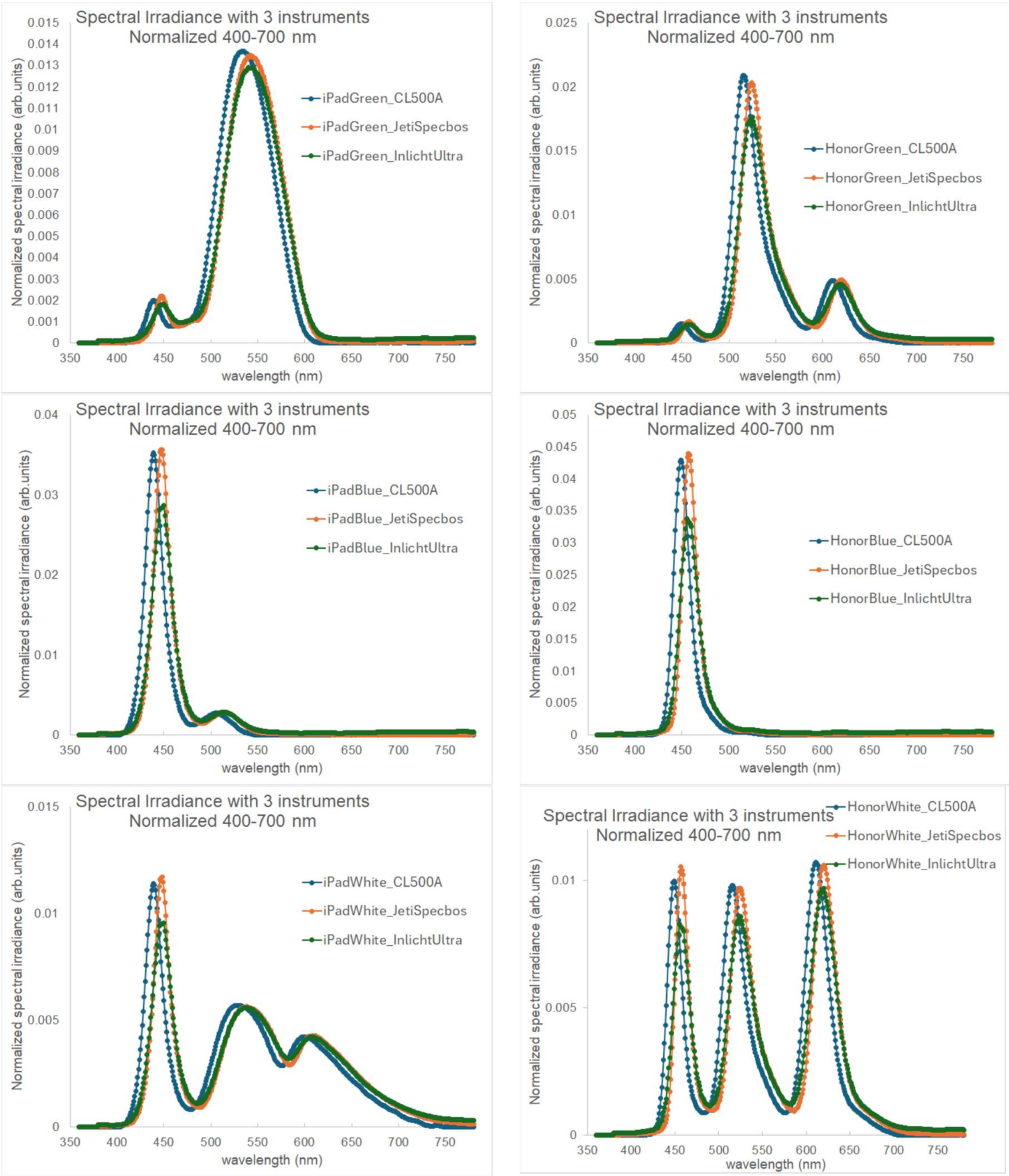


Figure 5 Spectral power distribution (SPD) from Apple iPad display (left) and Honor Magic 7 Pro display (right). The four rows show the measured SPDs when the display shows a red, a green, a blue and a white image, respectively.

5.3 Other lighting conditions

The results for other lighting conditions, as mentioned in section 3.2, can be found in the Full Research report [1].

6 Conclusions

We tested the accuracy of the Ultra spectral irradiance meter in a wide range of lighting conditions.

When it comes to measuring the values of standard output parameters, the Ultra generally performs less good than two widely used reference instruments, the Konica Minolta CL500A and the Jeti Specbos 1211UV. For example, the illuminance (lux) level deviates from values by the reference instruments by 76 lux (median value), whereas the two reference instruments deviate by less than the 15 lux (median) from each other.
Similar conclusions were found for measuring Correlated Color Temperature, Chromaticity coordinates (*x,y*), distance to Planckian locus *duv*, dominant wavelength λ_{dom}, peak wavelength λ_{peak} and Color Rendering Index R_a and R_1 up to R_{15}.
Our data also shows that the Ultra has a lower wavelength resolution than the two reference instruments.
These results are described in detail in the Full Report [1].

Our findings imply that the Ultra is well suitable for a wide range of applications. For many practical situations where the spectrum is relatively smooth, the Ultra is sufficiently accurate, and measures nearly as accurately as the other, more expensive instruments. Also under relative dark lighting conditions (we reduced illuminance as far down as 60 lux) it performs almost as good as the reference instruments.

For example, for measuring display characteristics of modern LCD or OLED displays the Ultra does a remarkably good job. Since these displays produce smooth spectra, the Ultra is as good as the other instruments in determining peak heights and locations, and sometimes even better than the Konica Minolta CL500A.
Only for the most critical investigations, and for those that need to quantify the details of irregular spectra with many peaks and valleys, such as natural daylight or multi-LED luminaires, the Ultra is less useful than the other two instruments because of its lower spectral resolution. Also the fact that it does not measure below 430 nm makes it not suitable for some applications.

At a current retail price of USD 600 the Ultra is an attractive alternative to the Konica Minolta CL500A (more than USD 4000) and the Jeti Specbos 1211UV (more than USD 9000). It should also be mentioned that the Ultra is very light weight and is operated through a user-friendly app. All spectral data can be saved as comma separated value files. Illuminance, Color Rendering Index and other standard output parameters can be saved as nice reports in PDF format. This makes working with the Ultra very convenient.

7 References

[1] E. Kirchner, Measuring Light spectra, Illuminance levels and Rendering index with the new Ultra instrument. Full Research report dated 13.01.2026, can be ordered by sending email to eric.kirchner@colorsai.nl

[2] Brochure In. Licht Ultra – Spectrum/WELL Meter. https://lightingrecipe.com/wp-content/uploads/2025/04/LRS_Ultra_Brochure_EN.pdf, April 2025.

[3] https://www.facebook.com/groups/1047216025873551/posts/1737821803479633/

8 Funding and statement of independence

The author declares that for the measurements that were carried out at Zhejiang University (ZJU) and for the subsequent analysis summarized in this report he received no funding from industry. The Ultra instrument and the other instruments described in this report are owned by ZJU. The manufacturer of the Ultra instrument did not pay the author directly or indirectly for doing this investigation or for writing this report, ensuring the independent character of this report.

9 Author Bio

This report was written by Dr E. Kirchner, owner of Color Science & Applications for Industry (ColorsAI) B.V. (www.ColorsAI.nl).

Dr E. Kirchner is senior color scientist with 25 years of experience in industrial R&D, specialized in multi-angle measurement of color, gloss and texture (sparkle, graininess, coarseness). His color innovation project team at multinational paint company AkzoNobel, together with instrument /manufacturer BYK-Gardner and effect pigment supplier Merck developed the BYK-mac i instrument. This has become the standard color and texture instrument for the global automotive industry as well as many other industries where effect pigments are used, such as the cosmetics industry. Dr E. Kirchner is widely regarded as one of the main scientists working in color science, as evidenced by a publication list of more than 70 peer-reviewed scientific articles and conference proceedings (see www.ColorsAI.nl).