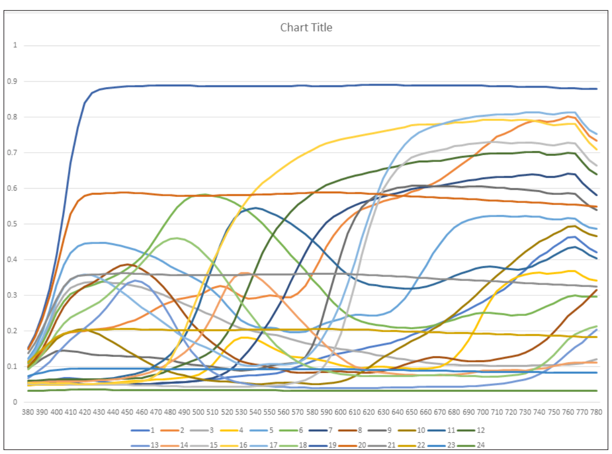
Multi-Spectral Engine for Calibration of UAV RGB-NIR Guidance and ISR Cameras



Technical Challenge

Unmanned or Autonomous Vehicles (UAV) use RGB CMOS cameras to provide vision for their drivers and guidance for their artificial intelligence (AI) computer guidance systems. In most cases these cameras must be “good enough” for the driver to see at reasonable distance and recognize real-life objects. In tactical applications and more and more in autonomous applications, the RGB camera’s continuous data stream is not only being used for guidance, but also as a time-record of surrounding activity during the missions. These time-stream videos can be very useful in identifying activity within the scene that provide context and history for critical decisions. An example is a drone that provides observation of a specific area for long periods (hours) and “sees”, over time lapse, that human beings are conducting repeated activity that might imply surveillance, patterns of behavior or a potentially dangerous tactical situation. The cameras can provide excellent record of absence or presence within its resolution, but now, in many cases color and real-rendering of the details of observed situations provide critical details. What is the true color of a car? Shirt? Details that may make a difference in seeking the right target, or not. The duration and conditions of flight over a long period (8+ hours) mean that the light conditions for observation are not constant as daylight spectrum changes and weather conditions may also change light conditions. Currently, these RGB cameras are tested using rudimentary methods (IQPC #) devised for cell phone use that do a poor job of rendering true color under actual use conditions. A better method for testing and validating the color rendering of these cameras is needed to improve the fidelity of the mission video and facilitate better decision-making capability.

Business Challenge

Customer is currently doing radiometric color calibrations using a Macbeth ColorChecker illuminated by a xenon light source as shown below. This roughly simulates “daylight” conditions of illumination – or D65 (6500K). It does not account for lower or higher color temperatures (dawn, dusk, cloudy days), or man-made lighting conditions (street lights, headlights, building lighting). A better solution would be to have a spectrally tunable light source to render these color charts under actual light spectrums to validate the camera performance in real world conditions. Specifically, the customer wanted to spectrally measure the reflective color of these charts in all relevant conditions, and then simulate each of these measured colors to the cameras. Cloudy day, full cloudless sky, time-of-day (dawn, dusk) evolution, and various man-made sources were only a few illuminants of interest where the colors of the charts would be measured.

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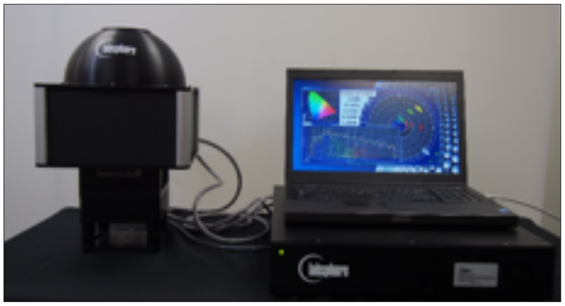
Critical colors for the customer were Macbeth colors red, green, blue, cyan, yellow, magenta, purple, orange. An instrument is needed that has the versatility to "learn" any color and replicate those spectrums quickly and with absolutely-calibrated x,y chromaticity coordinates sphere as a nexus point for complete testing. The customer had always assumed that the sphere really could only be used for one thing.



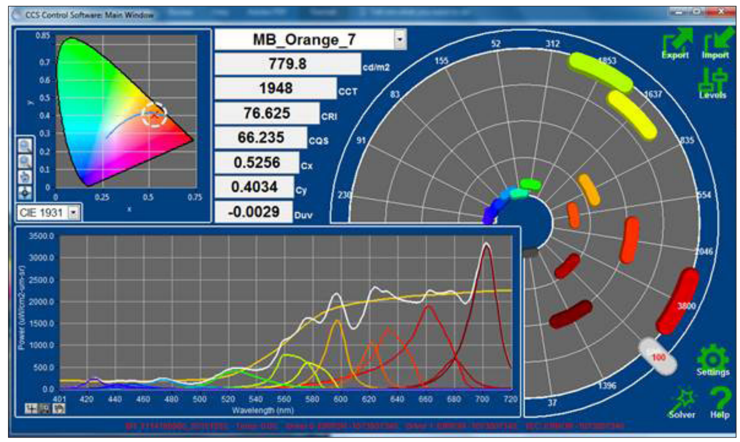
Labsphere's Solution

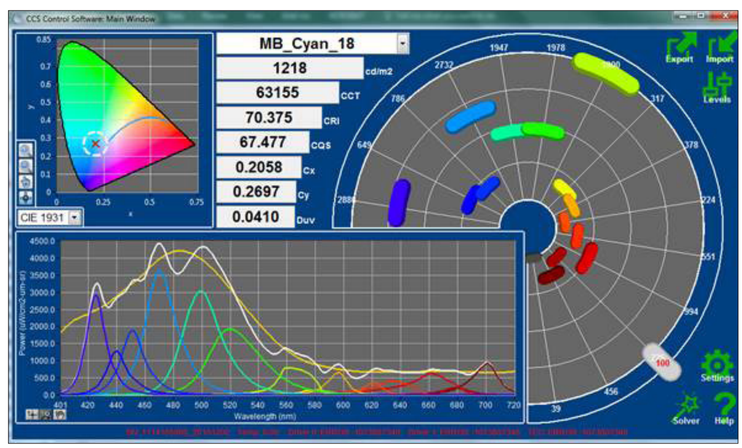
Labsphere's CCS technology presents a number of advantages by offering direct control of spectrum and intensity of a single surface. The standard system uses a 16-channel board; an improvement of the spectral "fit" or an increase in the spectral range can be accomplished by a light engine with more channels. The custom system proposed would accomplish this using a 24-channel light engine and selection of light sources that optimize desired spectrums. The customer simply needs to provide the measured reflected color spectrums under the relevant illumination. The CCS provides a mathematical solver that fits the system spectral channels to the closest possible spectral and magnitude match to the measured color spectrums. Once solved, the new test spectrum can be saved and accessed with absolute accuracy. Spectrums can be switched in less than one second to enable rapid testing through a huge range of colors and conditions.

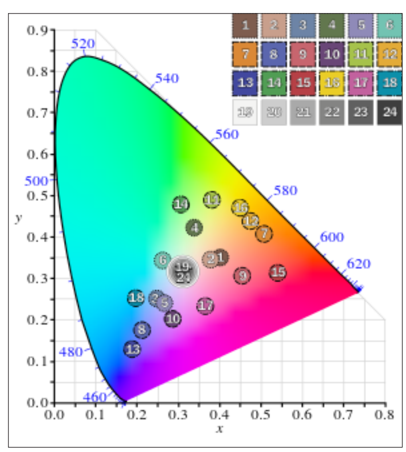
Objective	Benefits Achieved
Rapidly simulate colors under a variety of sources for guidance camera test	Virtual unlimited spectral corrections with <1s test times
Achieve real world color correction	High accuracy and fidelity on color images from production testing solution

Benefits

- Real color, real spectrum, real condition validation for tactical and guidance cameras
- Accurate x,y, rendering values for simulated spectrum
- Spectral engines variations that can cover visible spectrum, 400-900nm or beyond
- Spectral solver to import and create spectrum in minutes.
- Thermally and DC current stabilized LED technology to provide several thousand hours of absolutely calibrated operation
- Compact form factor for production or R&D use
- Easy to program system to control directly or remotely
- Fast switching time between learned spectrums with <1s of stabilization







Advancing the Technology of Light: Measure. Create. Reflect.

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