Federal Aviation Administration

Research Highlights

Predicting LED Signal Brightness

Study Goals

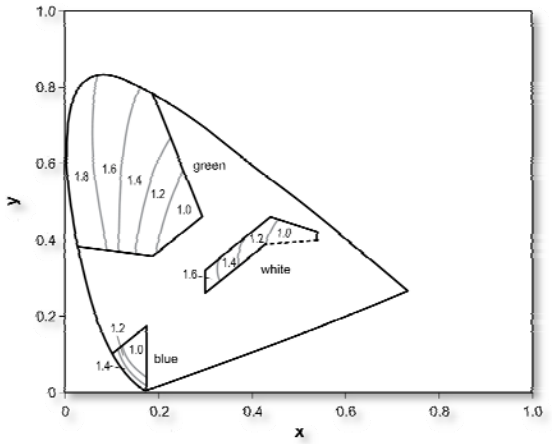
Light-emitting diodes (LEDs) are being used more frequently for airfield lighting. LEDs differ from incandescent lights in color saturation and correlated color temperature, and LED airfield lights can appear brighter than incandescent lights of the same nominal color and luminous intensity. These differences can be distracting to pilots, and some have questioned whether LED airfield lights are too bright. The goal of this study was to develop a model that could be used to quantify the brightness perception for blue, white, and green LED signal lights relative to incandescent lights.

Research Activities

The LRC conducted human factors experiments comparing LED and incandescent signal lights. Subjects viewed LED and incandescent lights varying in intensity and judged which appeared brighter. The results confirmed that LED signal lights are perceived as brighter than incandescent signal lights at matched luminous intensities. Brightness relationships were unaffected by signal light intensity, background light level, or the number of signal lights viewed.

Previously published models of brightness appearance did not accurately predict the brightness differences. Therefore, the LRC developed and validated a new model that could be used to predict the brightness-to-luminous-intensity ratio (B/L) for FAA blue, white, and green LED signal light colors relative to incandescent. B/L values for typical LEDs ranged from 1.4 to 1.6.

The LRC's brightness prediction model for blue, white, and green LED aviation signals was published in an FAA Technical Note and incorporated into FAA Engineering Brief 67, *Light Sources Other Than Incandescent and Xenon for Airport and Obstruction Lighting*. Following several complaints about the brightness of LED lights at Raleigh-Durham International Airport (RDU) installed prior to the model development, FAA engineers adjusted the LEDs' intensity according to the model and no further complaints were received.



Chromaticity regions of equal brightness/luminous intensity (B/L) values for blue, white and green signal lights.

The model is specified by the equation:

$$B/L = 2.32 D_v S_r f + 1.09$$

In this equation, D_v represents the chromaticity difference between the incandescent and LED lights, S_r represents the relative saturation of the LED's dominant wavelength, and f represents how closely the LED's chromaticity is to that of its dominant wavelength.

For More Information

- http://www.airporttech.tc.faa.gov/DesktopModules/FlexNews/DownloadHandler.ashx?id=467430e5-d2dd-44e2-9f15-1910a4825830&f=TC-TN15-32.pdf
- http://www.airporttech.tc.faa.gov/DesktopModules/FlexNews/DownloadHandler.ashx?id=4b709f63-94f3-4643-887b-259004c431c1&f=S10103-Bullough.pdf
- http://cormusa.org/uploads/2016_Federal_Aviation_Administration_Lighting_Research_and_Development-Donald_Gallagher__Federal_Aviation_Admini.pdf

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