

Chromatic diversity of indoor scenes rendered with CIE illuminants and white LEDs

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The colour quality of a light source is typically evaluated by the colour rendering index (CRI), a quantity with well known limitations. The goal of this work was to evaluate the quality of lighting by estimating instead the chromatic diversity light sources produce in indoor scenarios, using CIELAB and DIN99 colour spaces. Reflectance spectra of objects typically found in indoor scenes (like books, coloured fabrics, children toys, fruits, indoor plants, among others) were obtained using an hyperspectral imaging system with a low-noise cooled digital camera with a spatial resolution of 1024 (H) x 1344 (V) pixels and a fast tunable filter with an infrared filter in front of the lens. Images were acquired from 400 to 720 nm in 10 nm steps. Care was taken to avoid shadows and multiple reflections. Chromatic diversity was estimated for 60 illuminants, 55 CIE illuminants and 5 LED light sources (Luxeon, Philips Lumileds Lighting Company, USA), by computing the CIELAB and DIN99 colour volumes of the objects and by counting the number of non-empty unitary cubes of the segmented volumes. A large variation in chromatic diversity was found across illuminants; in addition, a low degree of correlation between the number of discernible colours and the CRI of the illuminant was also found. The best illuminant was CIE FL3.8, producing about 7.5% more colours than CIE illuminant A and 8% better than D₆₅ if CIELAB was considered and CIE FL11 producing about 7.4% more colours than CIE illuminant A and 4% better than D₆₅ if DIN99d was considered. These results suggest that normal observers may benefit with a careful choice of the illuminant to maximize the chromatic diversity perceived in indoor scenes and this choice is not necessarily based on the CRI.

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