Chromatic effects of metameric illuminants on art paintings

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The visual impression of an art painting is strongly influenced by the colour temperature of the illuminant but the perceptual influence of metameric illuminants has not been investigated. The aim of this work was to estimate computationally some chromatic effects of metameric illuminants of the D_{65} on art paintings. Eleven oil paintings from the collection of the Museum Nogueira da Silva, Braga, were imaged by a hyperspectral imaging system. The hyperspectral imaging system had a low-noise Peltier-cooled digital camera with a spatial resolution of 1344×1024 pixels (Hamamatsu, C4742-95-12ER), and a fast-tunable liquid-crystal filter (VariSpec, model VS-VIS2-10HC-35-SQ, Cambridge Research & Instrumentation, Inc., MA, USA) mounted in front of the lens. The spectral reflectance of each pixel of the paintings was estimated from a gray reference surface present in the scene. The metameric illuminants were generated with a variable number of spectral peaks and the radiance reflected from each painting under each metamer was estimated. In each case, the colour rendering index and the average colour for each painting was computed. In addition, the number of discernible colors was estimated by computing the painting representation in CIELAB space and by counting the number of non-empty unit cubes in that space. It was found that the average colour of the paintings changed only a little across the set of metamer used; on the other hand, the colour rendering index and the number of colours changed over a much wider range but a low correlation was found between the two. In addition, the maximum number of colours was obtained in most cases by metamers with three spectral maxima. These results suggest that the visual impression from an artistic painting can change significantly across metameric illuminations and that metamers with three spectral peaks may be the ideal for maximizing chromatic diversity.