Color Constancy from Image Transformations in JPEG and JPEG2000

German Tischler, Marc Ebner and Jürgen Albert

Lehrstuhl für Informatik II, Universität Würzburg

{tischler|ebner|albert}@informatik.uni-wuerzburg.de

The ability of the human visual system to perceive colors as approximately constant irrespective of the illuminant is called color constancy. The output of a sensor varies with the type of illuminant used and is therefore not color constant. Color constancy algorithms try to compute a color constant descriptor from the measured data (cf. [2]). We show how color constancy can be implemented within JPEG and JPEG2000 by an adaptation of the well-known Retinex algorithm (cf. [5, 4]). Compared to the normal decoding processes only little additional overhead is introduced into the processing pipeline.

According to the gray world assumption (cf. [1]) the world is gray on the average. Suppose that we take a photograph of a scene illuminated by a white illuminant and that the sensors for the color components have linear response characteristics. The gray world assumption implies that the individual channels will all have the same average intensity, i.e. their composition is gray. This average is an arithmetic average of spatially discrete image data. A color constancy algorithm is obtained by dividing each channel-intensity by the average for this channel. There is also a variant of this algorithm that subtracts the geometric average from logarithmic data which also results in a color constant image. See [3] for a thorough discussion.

Most color images compressed using JPEG or JPEG2000 have been subjected to a gamma correction. They can be displayed on a computer monitor without further adjustments. The gamma correction is very similar to a logarithmic function. Both standards usually employ a color space transformation to improve compression-rates. This transformation reduces the number of samples to be considered for color constancy. It also simplifies implementation, as it removes inter-component dependencies, i.e. we only adjust the color channels and can maintain the overall brightness of the image. We process the data in frequency space. Therefore we only need to handle a small fraction of the frequency space coefficients in order to obtain the arithmetic average of the original image. The integration into JPEG-2000 and the Discrete Wavelet Transform is most seamless, while variants of JPEG require some post-processing. If color constancy is implemented inside the image decoders, then the user can choose, whether the original image or a color corrected version should be decoded.

References

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