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  Metamer based sensor estimation without minimization

  Estimating the sensitivity functions of a camera from its response to surfaces of a calibration target is an important problem in color image processing and of great practical value in many applications. It is often treated as an inverse problem and constraints, such as the non-negativity of the sensor sensitivities, are used to improve the estimation. In this paper we model the camera as a linear projection operator from the high dimensional space of color signals to the low-dimensional space of response vectors. Every response vector can therefore be generated by different color signals and two color signals that result in the same measurement vector are known as metamers. The response vectors of the camera form a convex set and can therefore be described as a convex combination of extreme points of the set. From every measurement vector we obtain color signals in at least two different ways. (1) we can measure the "true" color signal defined by the illumination and the reflectance spectrum used in the measurement. (2) We can compute a "numerical" color signal from the color signals of the extreme points. To find this color signal we find first the two extreme points in the set of response vectors such that the measured response vector is the convex combination of these extreme points. The weights obtained are then used to find the corresponding linear combination of the color signals of the extreme points. This color signal obtained as a convex combination and the measured, true color signals are metamers by construction. The paper describes the use of these metamers to recover the camera sensors without the need for minimization.

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