Revisiting Radiometric Calibration for Color Computer Vision

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Goal
Is a camera an accurate light measuring device?
i.e. Can a pixel value of an sRGB output be transformed to a physically meaningful value?
- traditional radiometric calibration framework: \( i_x = f(e_x) \)

Observations
More than 10,000 images from 33 cameras.

New Imaging Model

\[
\begin{align*}
T &= T_\text{org} T_\gamma T_\text{org} T_\rho T_e T_x \\
E &= E_\text{org} E_\gamma E_\text{org} E_\rho E_i T_e T_x \\
\end{align*}
\]

\[
\begin{pmatrix}
i_x \\
i_g \\
i_b \\
\end{pmatrix} = f(h) \begin{pmatrix}
E_x \\
E_g \\
E_b \\
\end{pmatrix}
\]

\( h: \mathbb{R}^3 \rightarrow \mathbb{R}^3 \)

based on several image-RAW pairs,
- \( f^{-1} \) & \( T^{-1} \) are computed using less saturated points
- \( h^{-1} \) is computed with scatter point interpolation via radial basis func.

Results
Linearization error (\( f^{-1} \) only)

Photo-refinishing application (extension)

Input images  Our results  Camera images  Photoshop  Color transfers between cameras