TELEMARK

Application Note: Spectral Matching Algorithms

Telemark's Spectral Matching Algorithms provides straightforward methods for accurately and repeatedly calling cut-points based on provided reference spectra or color. This Application Note provides an overview of the algorithms and an explanation of the parameters that are required.

Spectral Matching

The Spectral Match algorithm compares the current spectra to the reference spectra using the sum of least squares:

$$SLS = \sum_{\lambda=\lambda_{\min}}^{\lambda=\lambda_{\max}} (S_{\text{curr}}(\lambda) - S_{\text{ref}}(\lambda))^2,$$

where S_{curr} is the current spectra and $S_{\text{ref}}(\lambda)$ is the reference spectra. This sum of least squares value is normalized by the sum of least squares value at the start of the layer, SLS_0. The "Goodness of Fit" value the Telemark Spectral Matching algorithm uses is

$$GoF = 100 \cdot \frac{SLS}{SLS_0},$$

which can be considered as a percent distance metric from the starting spectra to the end reference spectra. The spectral match requires two additional parameters, a minimum threshold value (greater than zero) before calling a cut-point is allowed, and a smoothing parameter (integer values greater than zero) which defines the number of GoF points included in a moving average of the data.

Color Matching

The Telemark Color Match algorithm replaces the above GoF distance with a color difference distance. A reference color, input in Yxy, $\mathrm{L^*a^*b^*}$, or $\mathrm{L^*C^*_{ab}h_{ab}}$ color spaces is internally converted into $\mathrm{L^*a^*b^*}$ values. During color matching, the current spectra, $S_{\text{curr}}(\lambda)$, is converted into calculated $\mathrm{L^*a^*b^*}$ values and the distance between the current color and reference color are calculated by the CIELAB ΔE^*_{ab} 2000 distance metric. This distance metric provides a "just noticeable difference" between colors to be taken somewhere in the range of 0.5-2.3. The color match algorithm takes a minimum threshold value in units of ΔE^*_{ab} and a smoothing parameter as discussed above.

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