Modeling Observer Metamerism through Monte Carlo Simulation (Poster)

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Modeling Observer Metamerism through Monte Carlo Simulation

Abstract:
Metameric color matches depend on the observer’s color matching functions. Data were collected on observer variability in typical metameric matches. A Monte Carlo simulation, using a model of color matching functions and physiological data, was performed to derive a complete colorimetric system capable of predicting inter-observer variability in addition to mean color matches.

Monte Carlo Experiment:
- 10,000 Sets of Color Matching Functions Generated
- Mean and Covariance Functions Established
- Standard Error Propagation to CIELAB Covariance Matrices for Observed Metamers
- Predicted Covariance Dependent upon Metameric Properties

Monte Carlo Results:
- Gray Print: 10,000 Color Matching Functions
- Blue Transparency: 10,000 Color Matching Functions
- Gray Print: 3 Sets of 20 Color Matching Functions

Monte Carlo Model:

\[ \bar{X}(\lambda) = 10^{-k_1} \cdot \text{d_L}(\lambda) \cdot 10^{-k_2} \cdot \text{d_M}(\lambda) \cdot [k_{3L}(\lambda) + k_{4M}(\lambda) + k_{5S}(\lambda)] \]

\[ \bar{Y}(\lambda) = 10^{-k_1} \cdot \text{d_L}(\lambda) \cdot 10^{-k_2} \cdot \text{d_M}(\lambda) \cdot [k_{3L}(\lambda) + k_{4M}(\lambda) + k_{5S}(\lambda)] \]

\[ \bar{Z}(\lambda) = 10^{-k_1} \cdot \text{d_L}(\lambda) \cdot 10^{-k_2} \cdot \text{d_M}(\lambda) \cdot [k_{3L}(\lambda) + k_{4M}(\lambda) + k_{5S}(\lambda)] \]

Inter-Observer Variability

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Experimental Results:

CMI Model:

Visual Data Starting Point:

Conclusions:
- Observer Variability in Practical Color Matching is Significant
- Previously Published Techniques Underpredict Variability
- A Monte Carlo Model Produced Better Results
- Further Data and Model Refinement are Required