Developing a Peripheral Color Tolerance Model for Gaze-Contingent Rendering

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WHY
• Higher resolution
• Higher frame rate
• Immersive VR/AR

with WHAT
• Human peripheral vision property
• Eye tracking embedded headsets
• Gaze-contingent rendering

HOW
Peripheral color tolerance model

Model Peripheral Chromatic Discrimination

Describes small color difference
CIE DE2000
Standard color difference evaluation formula with adjustable parameters for viewing conditions.

Describes foveation
Eccentricity dependent
Measured chromatic discrimination at parafovea and periphery.

Runs in real time with eye tracking
Ellipses parameter stored as look-up table to accelerate calculation.

Experiment 1: Discrimination Threshold
8K display & EyeLink II tracker
3 image types: simple / vector / natural
2 chromatic directions
10 levels (chroma vector length)
Question: Do you see foveation?

Simple image example
Natural image example

Result:
Model can be used in real time gaze-contingent rendering. The measured threshold slightly lower than model suggested. The threshold is content dependent.

Experiment 2: Visual Difference Prediction
Same setup & question as Exp 1
All natural images
Inside 10° disk: original
Outside 10° disk: modified
5° - 10° linear blending

Result:
• Small inter-subject variance but large inter-stimulus variance
• Threshold highly depends on image statistics
More chromatic discrimination data at different eccentricity would help interpolation. Image statistics (spatial filtering) should be included. Chromatic contrast and crowding effect should be considered.

Reference

*Figures are adopted from the data reported in the paper