SEAHA

CENTRE FOR DOCTORAL TRAINING IN SCIENCE AND ENGINEERING IN ARTS HERITAGE AND ARCHAEOLOGY

Assessing Colour Discrimination Capacity of Multiband LED Light Sources

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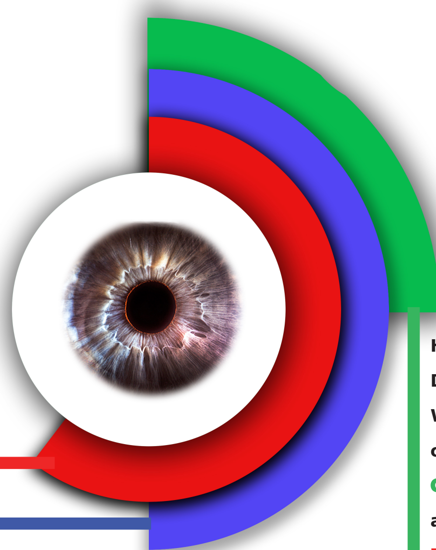
JUSTIFICATION

The introduction of LED technology is offering new opportunities to lighting scientists and designers. However, LED narrowband spectra question the capacity of our existing light characterization means. The two most important parameters of colour quality of light are colour fidelity and colour discrimination. While colour fidelity has been thoroughly discussed in the literature, colour discrimination is an underesearched field. For museum environments in particular, the ability to discriminate subtle hue differences is crucial for the interpretation of art. This work seeks to assess existing colour discrimination indices and investigate colour discrimination as a function of chromaticity coordinates.



HOW DO WE DISCRIMINATE COLOURS?

We discriminate colours by comparing signals of the Red, Green and Blue (L,M,S) cones at the colour opponency stage: Red-Green and Blue-Yellow

METHODOLOGY

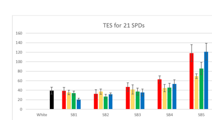
- 25 illuminants following four hue directions
- design and calibration of a tunable multiband LED light source to achieve the 25 SPDs
- characterization of the 25 SPDs for colour fidelity and discrimination with existing indices
- performing the Munsell Colour Vision Test to assess colour discrimination under the 25 SPDs
- Qualitative assessment of the appeal of SPDs
- Data analysis and comparison of characterization with experimental results

RESULTS

- **Existing colour discrimination indices review shows that current indices are incapable of predicting colour discrimination as assessed by the Munsell Test. State of the art TM-30-15 performs worst than GAI**

Illuminant	CCT	TES	Rg	GA
WHITE				
W	3333	39.4	108	68.8
RED HUE DIRECTION				
RHD.SB1	3132	38.9	107	69
RHD.SB2	2832	32.6	111	71
RHD.SB3	2393	46.9	118	71.3
RHD.SB4	1704	62.9	135	64.7
RHD.SB5	1261	118.3	181	44.5
RHD.SB6	N/A	FAIL	N/A	N/A
YELLOW HUE DIRECTION				
YHD.SB1	3247	35.4	104	65
YHD.SB2	3143	37.1	103	61
YHD.SB3	2989	41.7	102	54
YHD.SB4	2753	44.6	99	41.3
YHD.SB5	2563	69.7	93	28
YHD.SB6	2323	211	N/A	4.9
GREEN HUE DIRECTION				
GHD.SB1	3499	33.7	103	66.2
GHD.SB2	3717	26.9	102	63.9
GHD.SB3	4117	37.1	99	58.8
GHD.SB4	4953	45.7	91	45.5
GHD.SB5	5816	85.7	78	31
GHD.SB6	7931	FAIL	N/A	1.1
BLUE HUE DIRECTION				
BHD.SB1	3603	20.6	108	91.2
BHD.SB2	4214	31.4	112	114.8
BHD.SB3	7448	35.4	118	139.4
BHD.SB4	N/A	53.1	N/A	144
BHD.SB5	N/A	121.1	N/A	108.3
BHD.SB6	N/A	FAIL	N/A	N/A

- Colour discrimination of human observers is optimized for illuminants close but not on the Planckian Locus



- Visual clarity is linked to the appeal of illumination

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