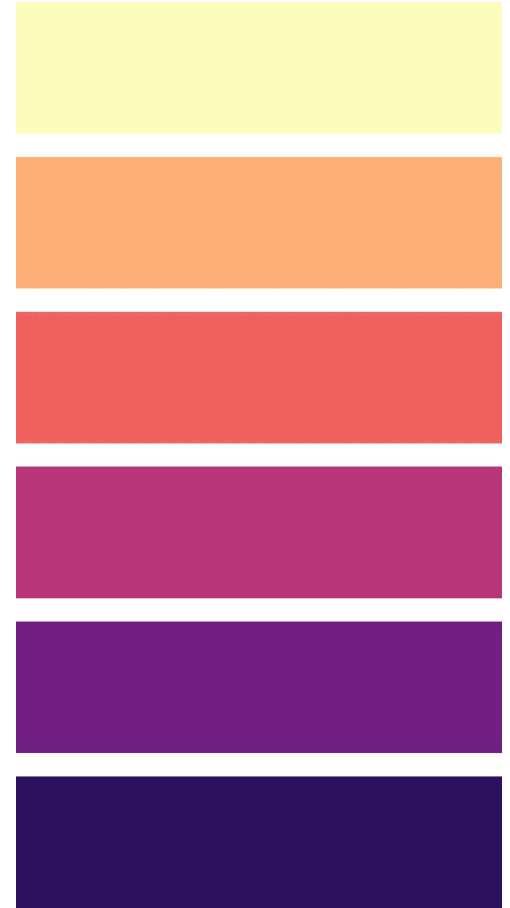


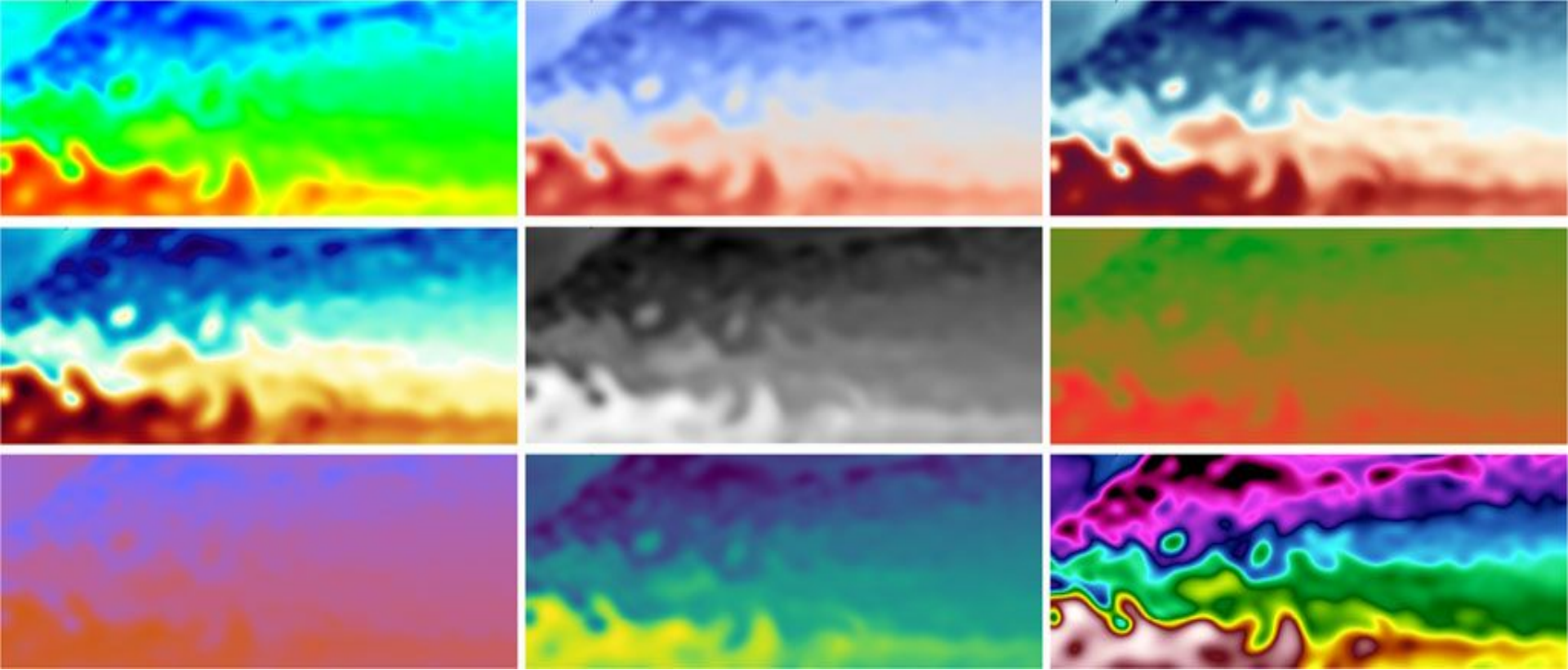
IEEE Trans. Visualization and Computer Graphics 2019

Colin Ware, Terece L. Turton, Roxana Bujack,
Francesca Samsel, Piyush Shrivastava, David H. Rogers

Measuring and Modeling the Feature Detection Threshold Functions of Colormaps

Presented by Jerry Yin





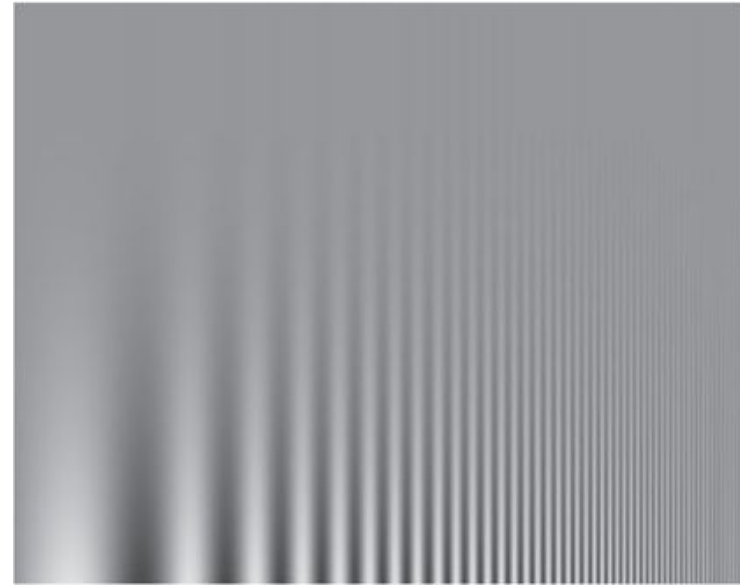
Which colourmap is the best at visualizing the data?

Paper contributions

- Paper type: evaluation
- Describes way to measure frequency-dependent discriminative power function of a colourmap
 - *Discriminative power*: ability to distinguish different colours
 - *Frequency-dependent*: more later
- Defines metric for “overall discriminative power” across entire range of a colourmap

Spatial frequency

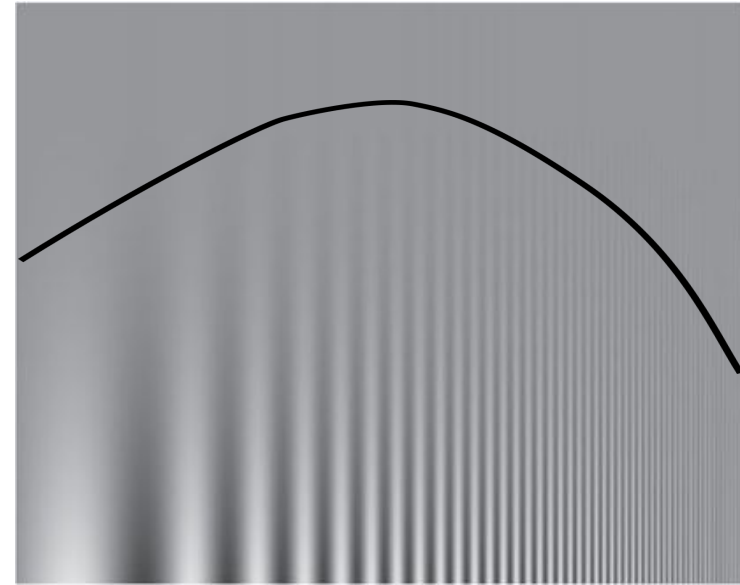
- Discriminative power depends on spatial frequency
- Uniform colour spaces (UCS) intended to be *visually* uniform
 - Based on measurements between *large* patches of uniform colour
- Thus, uniform colour spaces may not actually appear uniform in high-frequency datavis contexts!



The bands visually disappear at different heights along the image.

Spatial frequency

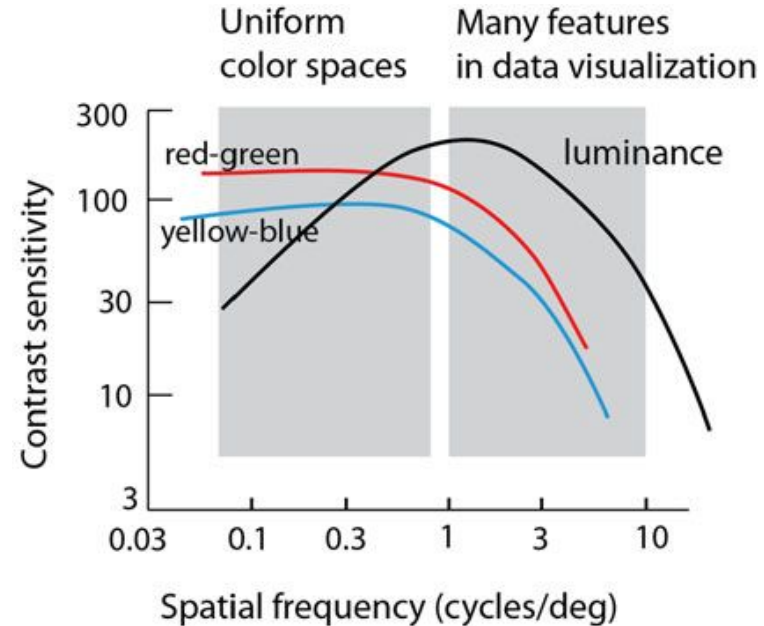
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The bands visually disappear at different heights along the image.

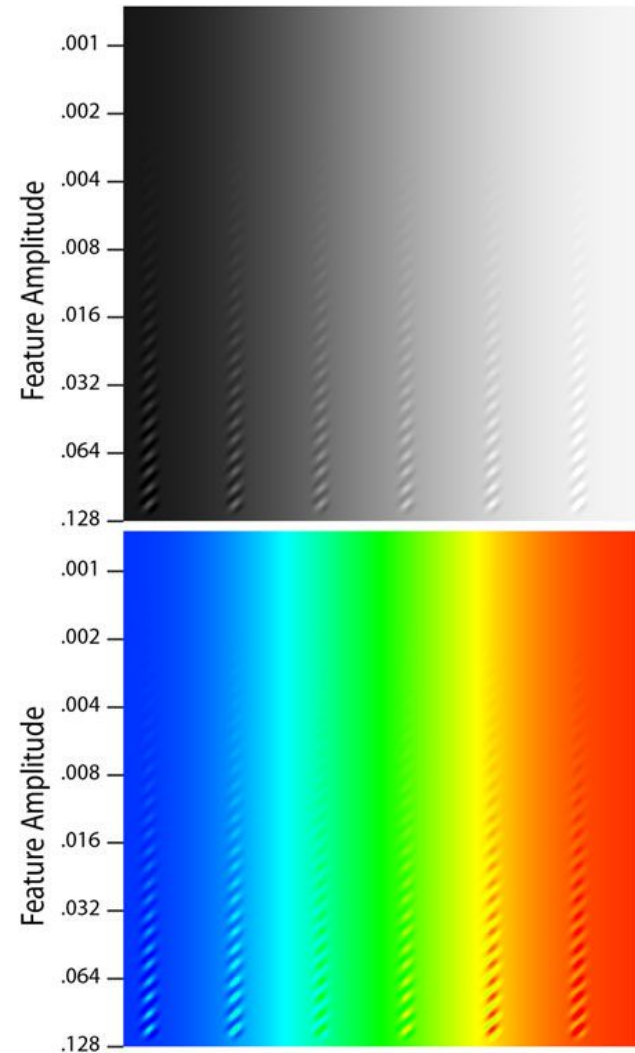
Spatial frequency

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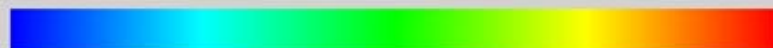
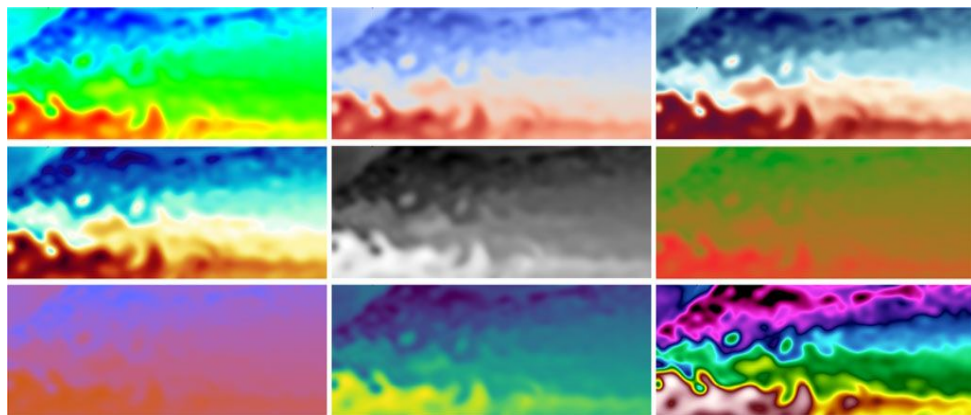


Empirical study

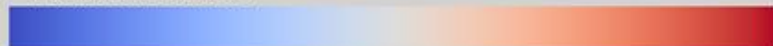
- Paper devises empirical study for measuring discriminative power across multiple spatial frequencies
- Used 600×600px images
- For each column, participants click the area where the sinusoidal pattern disappears
- Tested nine colour sequences and three frequencies (10px, 15px, 45px)
 - For each sequence, tested 30 locations



Tested colourmaps



RA: Rainbow colormap. This version comes from Paraview software



CW: The Moreland cool-warm colormap



ECW: Extended cool-warm colormap from Samsel



BOD: Blue-orange-red divergent colormap from Samsel



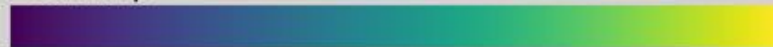
GP: A uniform grey colormap



GR: Approximately equiluminous green-red colormap



BY: An approximately equiluminous yellow-blue colormap

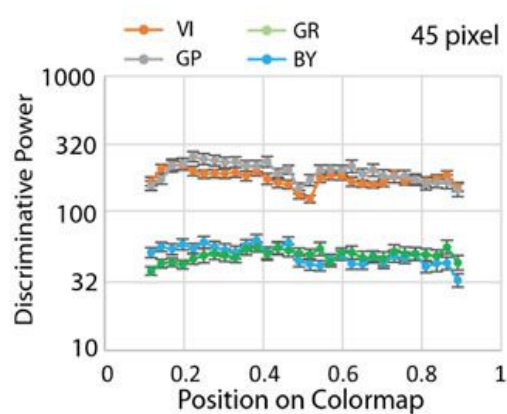
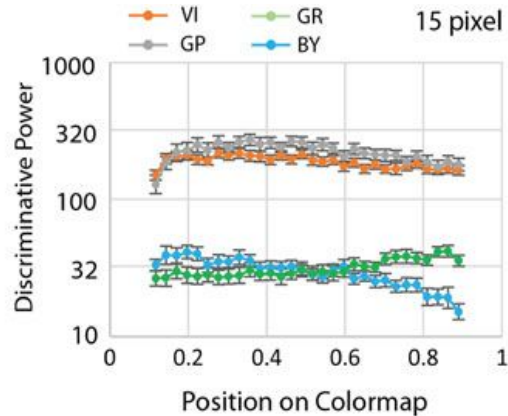
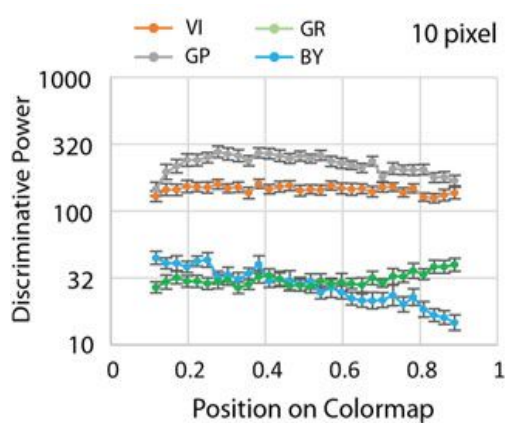


VI: Viridis colormap prized for its uniformity

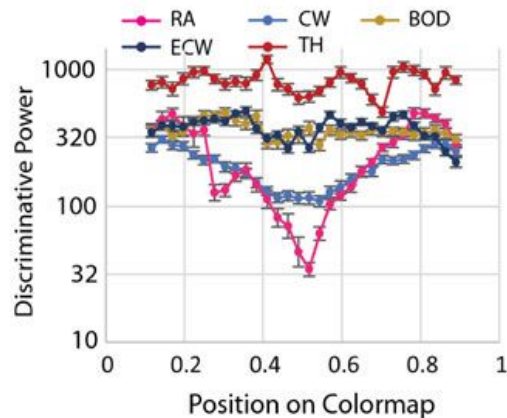
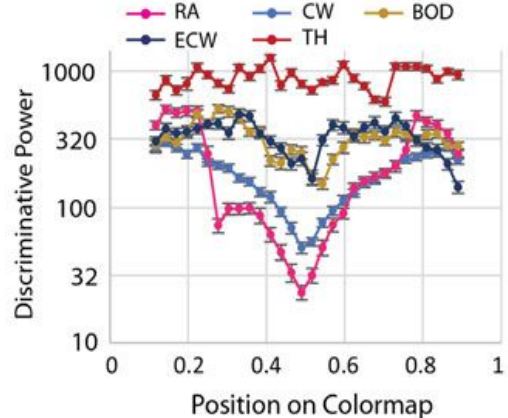
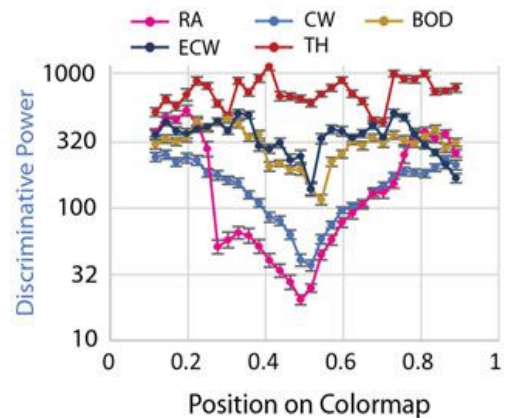


TH: A colormap sometimes used in thermal imaging

Results

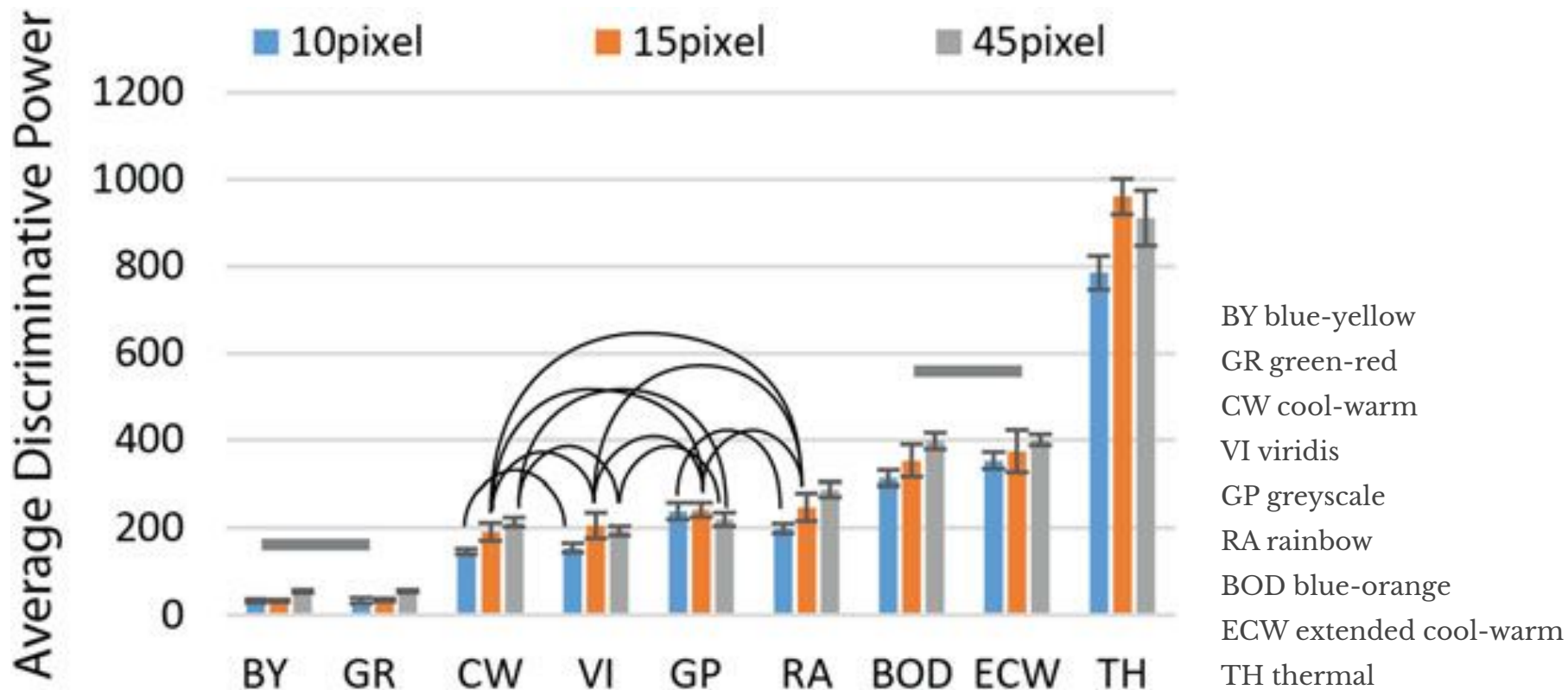


VI viridis
GR green-red
GP greyscale
BY blue-ylw



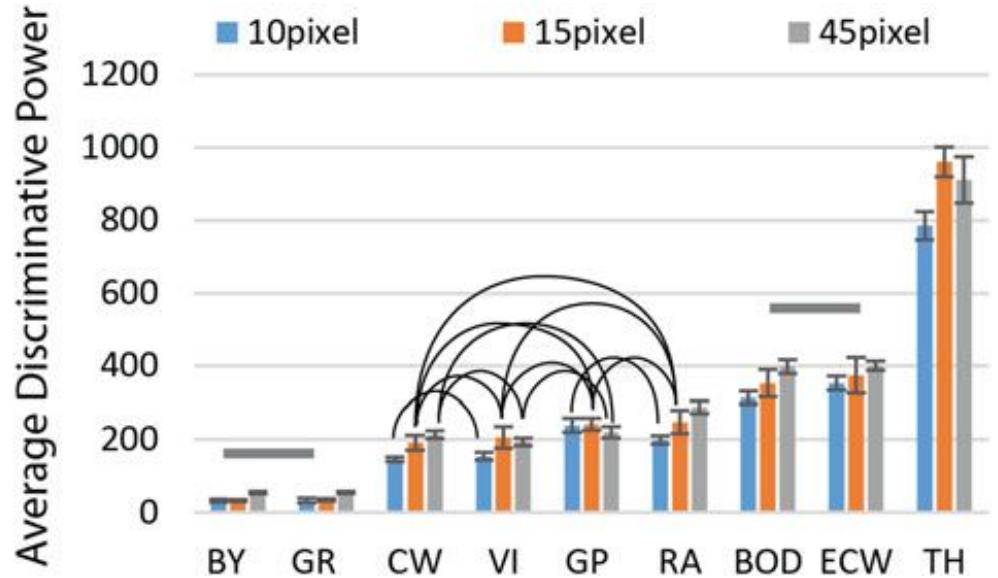
RA rainbow
CW cool-warm
BOD blu-orang
ECW ext. cool-warm
TH thermal

Results



Results

- Ran 2-way ANOVA
- Arcs indicate where differences not statistically significant
- Ran Tukey HSD test (another significance test), horizontal bars show cases where colourmaps were not significantly different

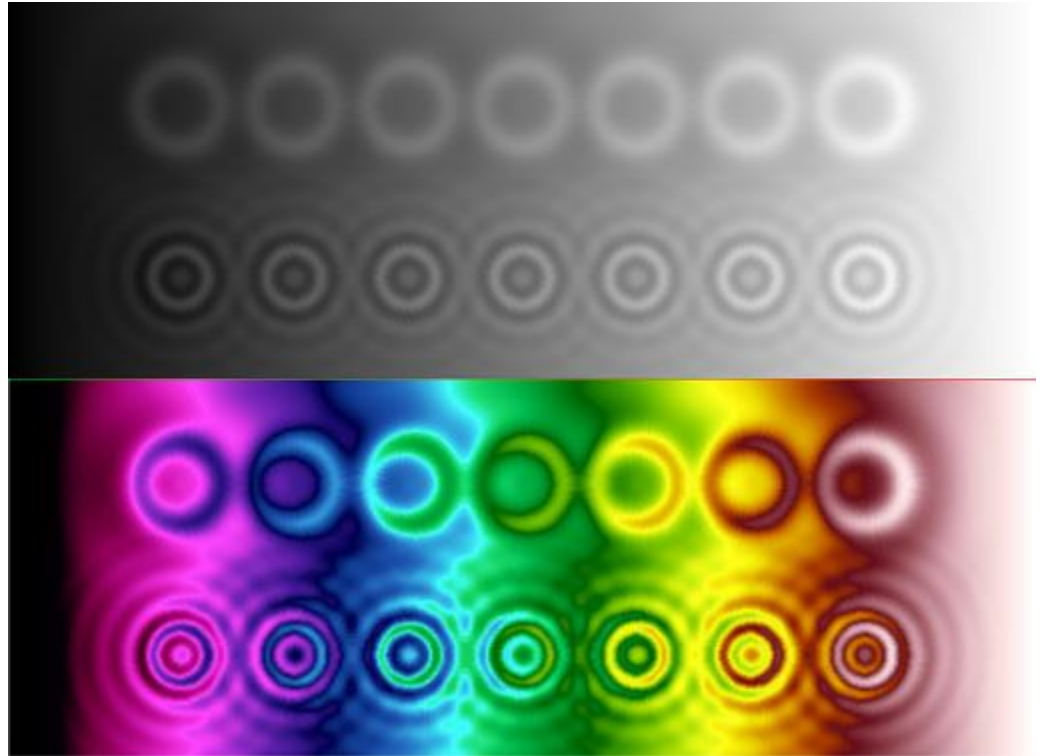


BY blue-yellow
GR green-red
CW cool-warm
VI viridis
GP greyscale

RA rainbow
BOD blue-orange
ECW extended cool-warm
TH thermal

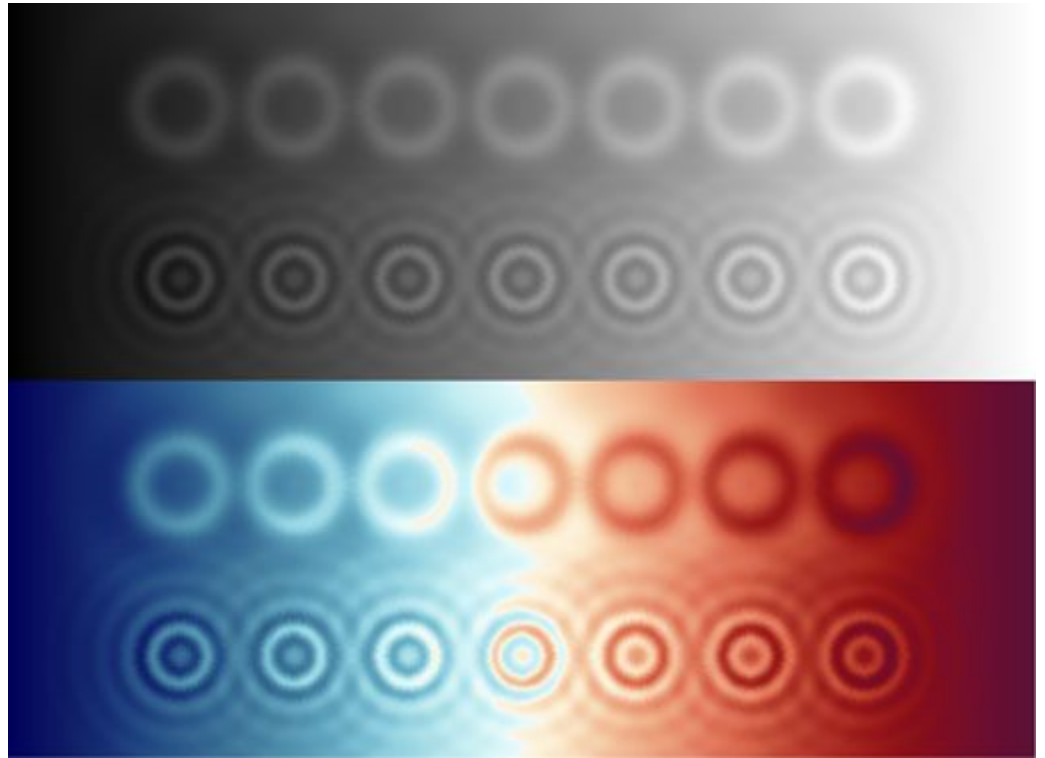
Which colourmap should I use?

- Despite having the highest discriminative power, the thermal colourmap is *confusing*.



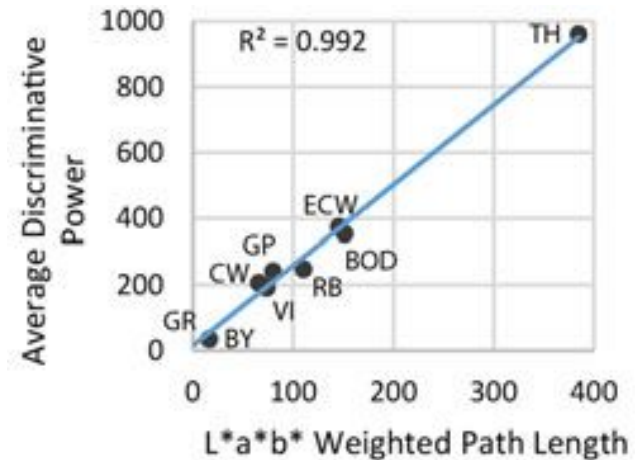
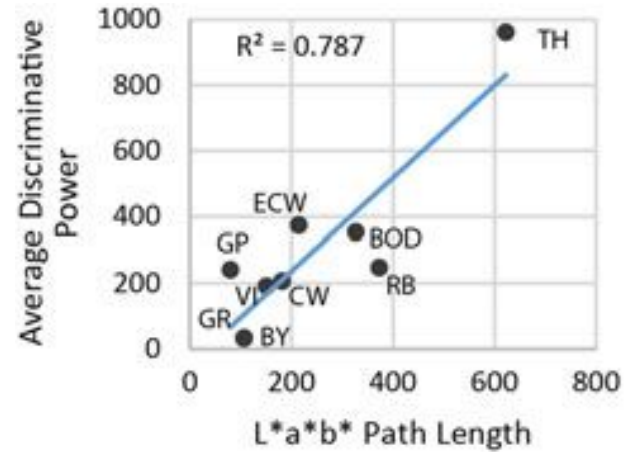
Which colourmap should I use?

- Despite having the highest discriminative power, the thermal colourmap is *confusing*.
- Same also applies to divergent colourmaps, to some degree.



Reweighting CIELAB

- Discriminative power should correspond to distance traversed by colourmap in uniform colour space
- Paper describes simplistic way to reweight CIELAB space to take into account the measured values in the paper
 - Equal weight is given to the 10px, 15px, and 45px cases



(Own) critique

- Instead of reweighting CIELAB in a way that is good for all datasets, maybe it would be better to collect data for many frequencies and reweight based on data that is currently being plotted
- Minimum discriminative power may be a better metric than mean discriminative power
- Outliers were manually removed
- Sample size a bit small: only 21 - 35 participants per colourmap

