Colin Ware, Terece L. Turton, Roxana Bujack, Francesca Samsel, Piyush Shrivastava, David H. Rogers
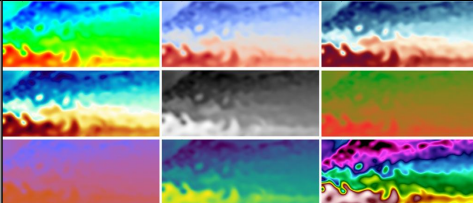
Measuring and Modeling the Feature Detection Threshold Functions of Colormaps
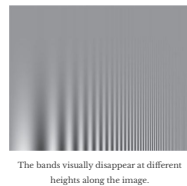
Presented by Jerry Yin

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
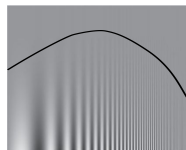
Spatial frequency

- 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.
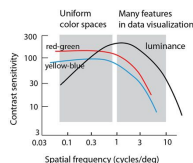
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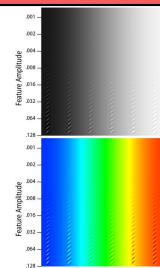
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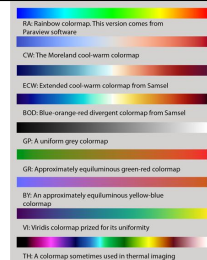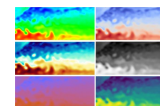- Thus, uniform colour spaces may not actually appear uniform in high-frequency datavis contexts!
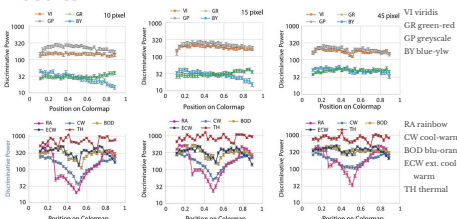

Empirical study

- 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)
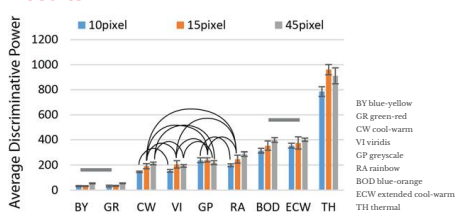 - For each sequence, tested 30 locations

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

BY blue-yellow
GR green-red
CW cool-warm
VI viridis
GP greyscale
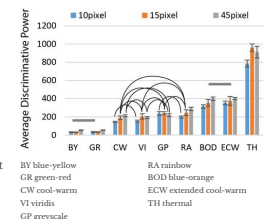RA rainbow
BOD blue-orange
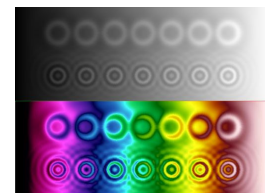ECW extended cool-warm
TH thermal

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*.
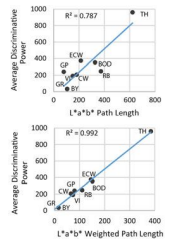

Which colourmap should I use?

- 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