

Using Color Contrast to Explore and Communicate Scientific Data

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1. Strategies for Exploration and Rendering of Data.

Color provides the ability to reveal and convey large amounts of information and detail often obscured with in the data.

2. <u>Color Theory Principals that assist in Creating Effective of Visualizations</u> Color Contrast Theory overview, applied visualization and methods for selecting colormaps schemes geared to task and data

3. Easy-to Use Tools - SciVisColor.org and ColorMoves

Quickly and easily creating colormaps specific to your domain, data distribution, task and audience

1. Strategies for Exploration and Rendering of Data

Examples of the possible.

Breaking down the decision process.



single variable 2D data



A good clear detailed visualization of ocean asteroid impact simulation (rho).





yA31 yB31 yC31

Galen Gisler, LANL Asteriod simulation yA31 250m at 45%

The motivation: Potentially more information Easier means of seeing and digesting material.



The Roadmap

single variable data



- Considerations:
- 1. domain convention
- 2. historical comparison
- 3. task
- 4. level of detail
- 5. areas of interest
- 6. intuitive physical properties
- 7. intuitive scientific focus

lidar data, C. Wilson, LANL

1. Domain conventions



environmental data often uses the viridis colormap



2. historical convention

3. task



4. level of detail



traditionally used for high detail



a luminance inclusive option





"Neutron spectroscopy data often has features of interest on many orders of magnitude of intensity. ColorMoves allowed for a custom color map to emphasize the intensity variation. The ease with adjusting the color map expedites the identification of features of interest in the data." Garrett Granroth, ORNL





5. area of interest

highlighting areas of interest

Daughton, LANL

6. intuitive physical properties



ponds verses foliage

7. intuitive scientific focus



small topological changes impact foliage distribution and creation of dry zones

C. Wilson, LANL

Pulling it all together



Colormap construction in ColorMoves





The Rainbow, so widely used....



An alternative, both *Effective* and *Affective*

Tracking Features



kinetic energy, MPAS – Ocean, Petersen



Visualizing 3D data

H3D, Daughton

Common Tasks of 3D Visualization



Kinetic energy in the Gulf of Mexico, MPAS, Ocean

3D multivariate data

Considerations



objectives of visualization multiple variables in one vis or ensembles connections between variables seeing inside 3D form placing focus on the content and location of interest

3D Data, single variable



Exposing interior structure Experimenting with the **opacity distribution** is key.



Selecting color palettes that enable on to see multiple features of different sizes and importance.

SciVisColor.org





The key is the design and selection of the color palette. See Section 7 for color sets. Downloadable on SciVisColor.org



Visual conflicts:

The blue dots become a single mass because they are too large.

The pink dots and pinkish-grey forms disappear into the background because they are close in value and not so different in hue.

The lime green shapes dominate the visualization because lime green is a highly saturated color.

The elements of the visualization, including the background, blend together because other than the lime green they are all similar in value.



Solutions: By reducing the size of dots it is easier to see the distribution.

Changing the blue dots to a gold-tan color creates a better contrast with the background without competing for conflicting with the other colors.

The pink dots were changed to orange. Because these dots are hard to see, three types of contrast are used - complimentary color contrast, saturation level contrast and value contrast. This dots needed to stand out against the background, the green shapes, the gold dots and the white forms thus they needed three types of contrast.

The pinkish-gray forms were changed to white. White is a high contrast neutral, enabling them to standout behind the green forms, gold dots and pink dots while still contrasting with the background so that they remain visible.

The green forms were desaturated to remove their dominance. Using a desaturated green removes their dominance and increases our ability to see detail within the forms.

The original background is a very blue gray. The gray here is neutral and darkened. Changing from a blue gray to a neutral gray decreases its importance. The darkened gray recedes to the back. Thus the visualization appears to sit in a 3-D space.







Quantification

opacity and contrast

Gisler



contextual color

isolating and highlighting a variable

color sets – SciVisColor.org

Heart with surgical instruments, evaluating stresses



multiple types of contrast are needed in 3D multi-variate vis

Color palettes for 3D multivariate vis are tricky.





G. Gisler Asteroid impact simulation

lots of information, lots of detail



From one dataset, many types of information and visualization showing different characteristics



isolated variables for comparison purposes.

Combining the quantitative analysis with the physical structures.



water vapor from asteroid ocean impact, G. Gisler





vtkProcessId

Pre-designed colormap sets

SciVisColor.org

