



Digital Images

HSV Color Space

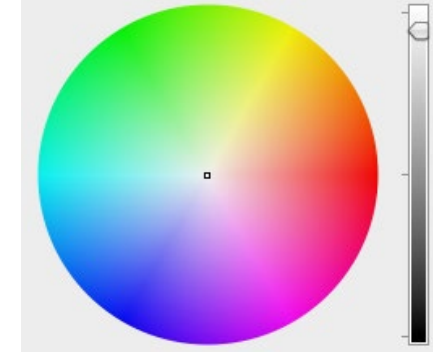
Scientific Visualization
Professor Eric Shaffer

HSV Color Space

For artists...or anyone...color picking in RGB is difficult



RGB Color Picker



HSV Color Picker

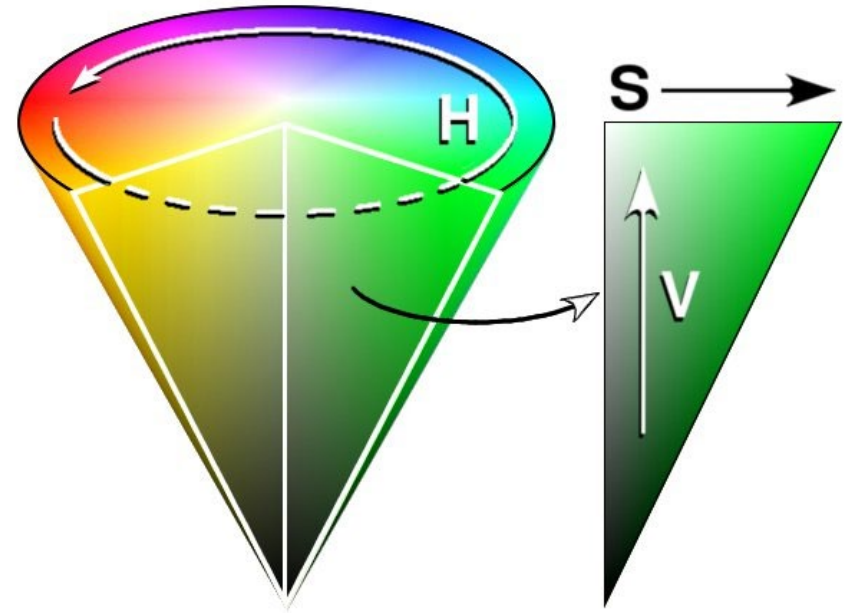
Hue, Saturation and Value (HSV) is an alternative color space

Equivalent to RGB in the colors it can represent

Easier to design color picking interfaces

HSV Color Space

- Hue $[0, 360]$ is angle about color wheel
0° = red, 60° = yellow, 120° = green,
180° = cyan, 240° = blue, 300° = magenta
- Saturation $[0, 1]$ is distance from gray
- Value $[0, 1]$ is distance from black



RGB to HSV Conversion

We have 3 channel values R, G, and B

- All in [0.0, 1.0]
- Let $\text{maxRGB} = \max(R, G, B)$
- Let $\text{minRGB} = \min(R, G, B)$
- $S = (\text{maxRGB} - \text{minRGB}) / \text{maxRGB}$
- $V = \text{maxRGB}$
- To compute H

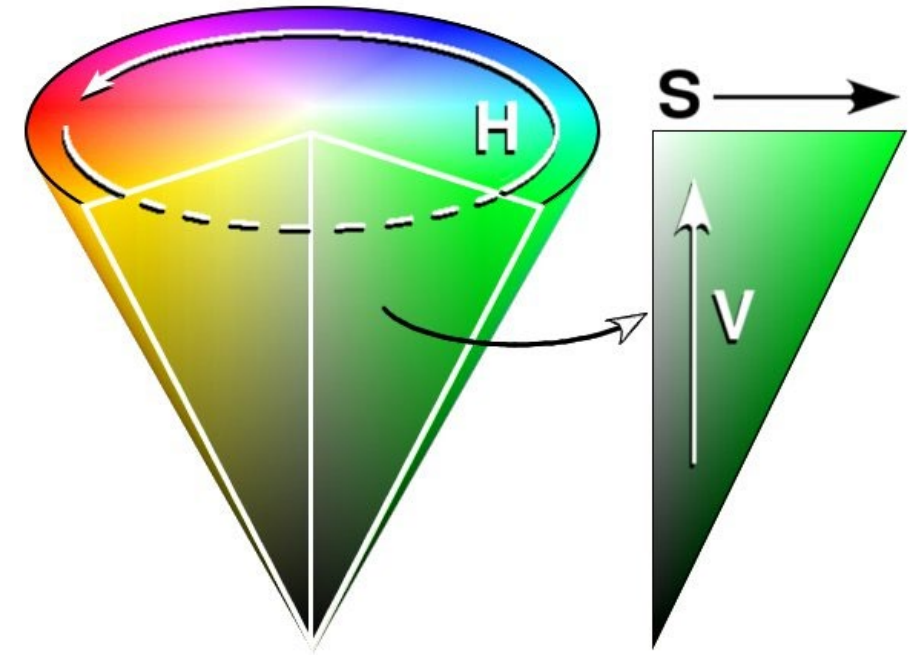
$$\Delta = \text{maxRGB} - \text{minRGB}$$

$$\text{if } \text{maxRGB} == R \rightarrow H = (G - B) / \Delta$$

$$\text{if } \text{maxRGB} == G \rightarrow H = 2 + (B - R) / \Delta$$

$$\text{If } \text{maxRGB} == B \rightarrow H = 4 + (R - G) / \Delta$$

$$H = (60 * H) \bmod 360$$



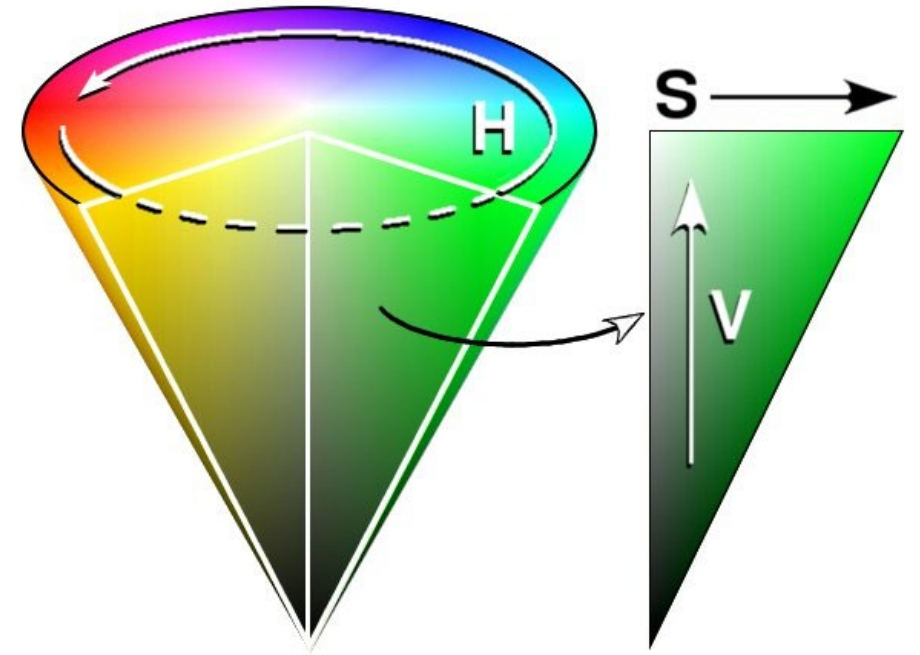
HSV to RGB Conversion

We have H in $[0, 360]$, S in $[0, 1]$, and V $[0, 1]$

$$f(n) = V - VS \max(0, \min(k, 4 - k, 1))$$

$$k = \left(n + \frac{H}{60^\circ}\right) \bmod 6$$

$$(R, G, B) = (f(5), f(3), f(1))$$



Color Spaces: Lies Your Kindergarten Teacher Told You

- Red, Yellow and Blue are not *The Primary Colors*
 - Taken from Cyan, Magenta, Yellow color space used for reflective displays
 - Printing...or finger painting
- Any set of wavelengths can serve as primaries
 - Defines a set of colors you can create by mixing
 - Some let you generate more colors...some fewer
- A 3 wavelength color space **cannot** produce all the colors a person can see
 - To understand why, we need to look at perceptually-defined color spaces

