Modelovacie a renderovacie techniky

Zuzana Berger Haladová

Informácie

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zhaladova@gmail.com

M153

Hodnotenie

10 * 2p Účasť
3 * 15p Domáce (programovacie úlohy)
35p Prezentácia (povinná)

Prezentácie

Na začiatku cvičení
20 minút
2-3 ľudia v týme
20 minút prezentácia
Tutorál/Zaujímavé články/Prehľad metód

Prezentácie

Raytracing
Shadows
Particle systems
Hair and fur
Volume rendering
Point based rendering
Photorealistic rendering
Advanced optical effects

Prezentácie

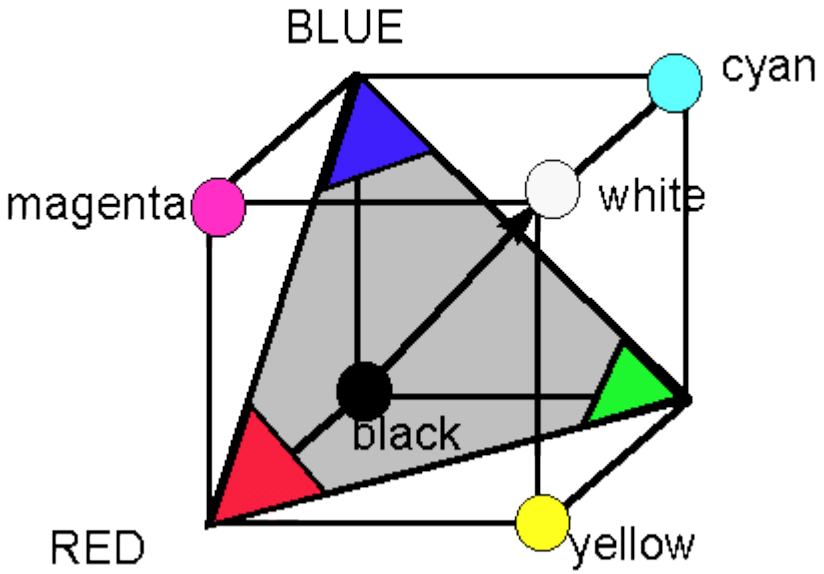
Material representation models
Car paint representation models
Computer graphics API comparison
Modeling software and renderers
M&R in game industry
M&R in film industry
M&R in research and medicine

Programovacie úlohy

- 3 počas semestra
- V akomkoľvek jazyku/prostredí ste doma
- Spustiteľné pod Windows
- GUI
- Priložený zdroják

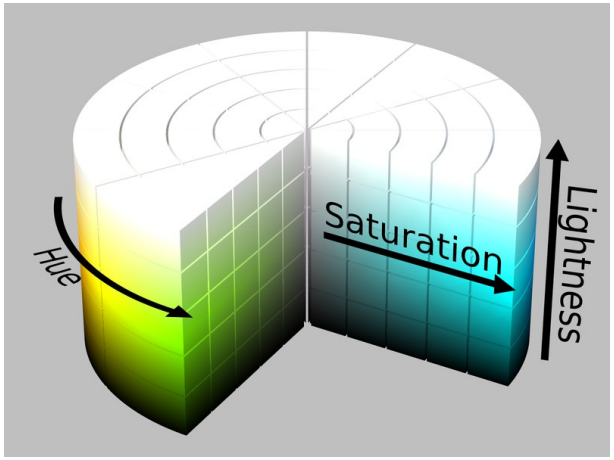
Svetlo a farby

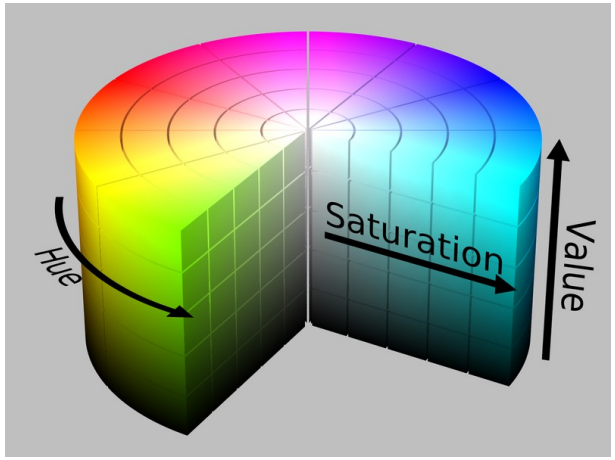
- RGB

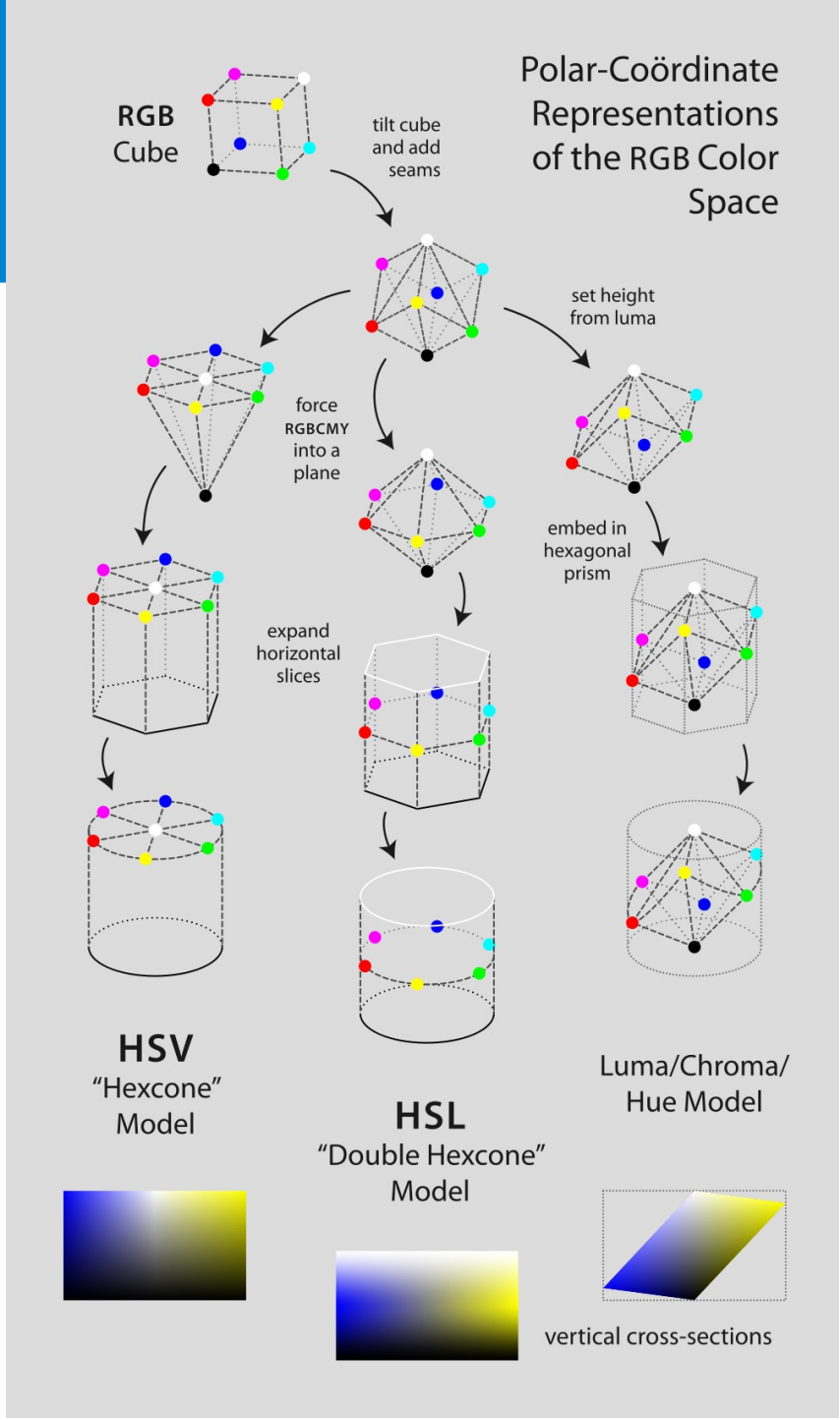


Svetlo a farby

- HSV, HSL
- Orientované na používateľa
- Maliarovo vnímanie farieb







RGB -> HSL

$$M = \max(R, G, B)$$

$$m = \min(R, G, B)$$

$$C = M - m$$

$$H' = \begin{cases} \text{undefined}, & \text{if } C = 0 \\ \dfrac{G - B}{C} \bmod 6, & \text{if } M = R \\ \dfrac{B - R}{C} + 2, & \text{if } M = G \\ \dfrac{R - G}{C} + 4, & \text{if } M = B \end{cases}$$

$$H = 60^0 \times H'$$

RGB -> HSL

$$V = M$$

$$L = \frac{1}{2}(M + m)$$

$$S_{HSV} = \begin{cases} 0, & \text{if } C = 0 \\ \frac{C}{V}, & \text{otherwise} \end{cases}$$

$$S_{HSL} = \begin{cases} 0, & \text{if } C = 0 \\ \frac{C}{2L}, & \text{if } L \leq \frac{1}{2} \\ \frac{C}{2 - 2L}, & \text{if } L > \frac{1}{2} \end{cases}$$

- Normalize V,L an interval <0..100>, S is already normalized

RGB -> HSL

Prevedte R = 120, G = 120, B = 120 do HSV

Prevedte R = 0, G = 250, B = 0 do HSL

http://colormine.org

RGB → XYZ

Súradnice základných farieb Súradnice bieleho bodu

$$\begin{bmatrix} a(1) \\ a(2) \\ a(3) \end{bmatrix} = \begin{bmatrix} x_R & x_G & x_B \\ y_R & y_G & y_B \\ z_R & z_G & z_B \end{bmatrix}^{-1} \begin{bmatrix} x_W/y_W \\ 1 \\ z_W/y_W \end{bmatrix}$$

$$\begin{bmatrix} M(1,1) & M(1,2) & M(1,3) \\ M(2,1) & M(2,2) & M(2,3) \\ M(3,1) & M(3,2) & M(3,3) \end{bmatrix} = \begin{bmatrix} x_R & x_G & x_B \\ y_R & y_G & y_B \\ z_R & z_G & z_B \end{bmatrix} \begin{bmatrix} a(1) & 0 & 0 \\ 0 & a(2) & 0 \\ 0 & 0 & a(3) \end{bmatrix}$$

RGB-to-*XYZ*

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} M_{1,1} & M_{1,2} & M_{1,3} \\ M_{2,1} & M_{2,2} & M_{2,3} \\ M_{3,1} & M_{3,2} & M_{3,3} \end{bmatrix} \cdot \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

RGB → XYZ

The numbers in the conversion matrix below are exact, with the number of digits specified in CIE standards.[10]

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \frac{1}{b_{21}} \begin{bmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix} = \frac{1}{0.17697} \begin{bmatrix} 0.49 & 0.31 & 0.20 \\ 0.17697 & 0.81240 & 0.01063 \\ 0.00 & 0.01 & 0.99 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

While the above matrix is exactly specified in standards, going the other direction uses an inverse matrix that is not exactly specified, but is approximately:

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} 0.41847 & -0.15866 & -0.082835 \\ -0.091169 & 0.25243 & 0.015708 \\ 0.00092090 & -0.0025498 & 0.17860 \end{bmatrix} \cdot \begin{bmatrix} X \\ Y \\ Z \end{bmatrix},$$

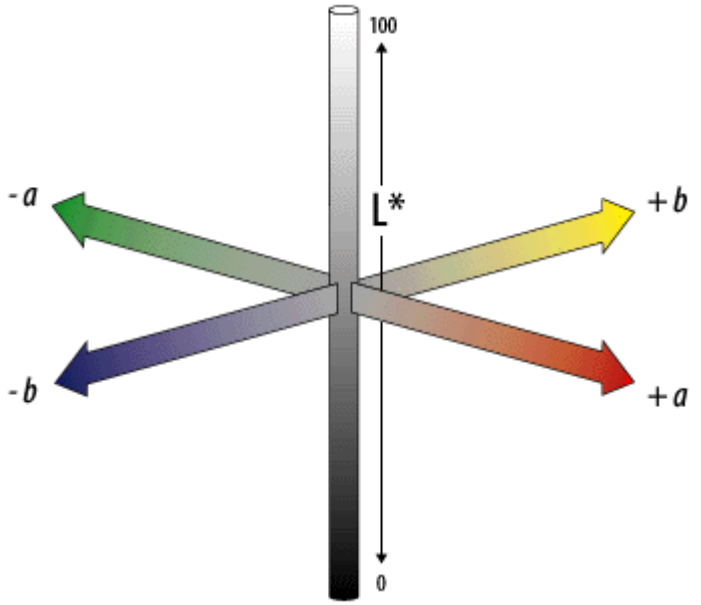
Svetlo a farby

- LAB
- Vnemovo rovnomerný
- L - achromatický
- A,B – chromatické
  - Červená – zelená
  - Žltá - modrá

$$L^\star = 116 f(Y/Y_n) - 16$$
$$a^\star = 500 [f(X/X_n) - f(Y/Y_n)]$$
$$b^\star = 200 [f(Y/Y_n) - f(Z/Z_n)]$$

where

$$f(t) = \begin{cases} t^{1/3} & \text{if } t > (\frac{6}{29})^3 \\ \frac{1}{3}\left(\frac{29}{6}\right)^2 t + \frac{4}{29} & \text{otherwise} \end{cases}$$



Svetlo a farby

- Priamo odvodiť hodnoty R,G,B pre konkrétny svetelný zdroj

$$X = K_m \int L(\lambda)\bar{x}(\lambda)d\lambda,$$

$$Y = K_m \int L(\lambda)\bar{y}(\lambda)d\lambda,$$

$$Z = K_m \int L(\lambda)\bar{z}(\lambda)d\lambda$$

$$R = K_m \int L(\lambda)\bar{r}(\lambda)d\lambda,$$

$$G = K_m \int L(\lambda)\bar{g}(\lambda)d\lambda,$$

$$B = K_m \int L(\lambda)\bar{b}(\lambda)d\lambda$$

$$K_m = 680\ lm/W$$