Computer Graphics, Ray-Tracing

Chang-Mao Yang*
National Chung Cheng University, Department of Physics
(Dated: November 11, 2023)

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Keywords: first keyword, second keyword, third keyword

I. WEBGL

A. Canvas Surface

We consider a subset $\mathbb{I} \subset \mathbb{R}^2$ defined as:

$$\mathbb{I} = \{(x, y) \in \mathbb{Z}^2 \,|\, 0 \le x < m, 0 \le y < n\}, \tag{1}$$

which represents the position of an image, where this image surface has a specified width m and height n. Also, consider a color vector space $\mathbb{C} \subset \mathbb{R}^3$ defined as:

$$\mathbb{C} = \{(r, g, b) \in \mathbb{R}^3 \,|\, r, g, b \in [0, 1]\}. \tag{2}$$

To describe the color at any given point (x, y) on the image, we define a vector function $\vec{f} : \mathbb{I} \to \mathbb{C}$. This function maps each point (x, y) to a color vector, represented as:

$$\vec{f}(x, y) = \begin{pmatrix} r(x, y) \\ g(x, y) \\ b(x, y) \end{pmatrix}, \tag{3}$$

where $r(x, y)$, $g(x, y)$ and $b(x, y)$ denote the red, green, blue components of the color at point (x, y), respectively.

For example we can graph the gradient color in two direction as following

(a) Define $r(x, y) = g(x, y) = b(x, y) = x/m$.

(b) Define $r(x, y) = g(x, y) = b(x, y) = y/n$.

FIG. 1: Two different definition of $\vec{f}$, where the color only change with the direction of x or y.

II. SCREEN

Now, we consider the screen position $\vec{p}_{screen}$ to be

$$\vec{P}_{\text{screen}} = (x, y)\,, \quad x \in \left[-\frac{w}{h}, \frac{w}{h}\right], \quad y \in [-1, 1], \tag{4}$$

see as image below

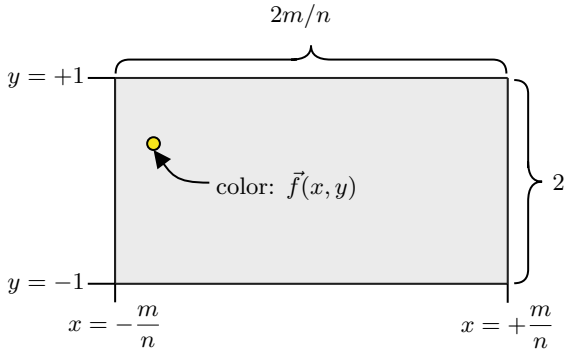

FIG. 2: Screen Coordinates (SC) space.

- Normalized Device Coordinates (NDC) spce

```
// gl_FragCoord.x : [0, 1]
// gl_FragCoord.y : [0, 1]
// screenPos.x : [-1.0 ~ 1.0] * width / height
// screenPos.y : [-1.0 ~ 1.0] * 1.0
```

- Screen Coordinates (SC) space

```
// screenPos.x : [-1.0 ~ 1.0] * width / height
// screenPos.y : [-1.0 ~ 1.0] * 1.0
```

- World Coordinates (WC) space

* Correspondence email address: jeffrey0613mao@gmail.com