Density Slicing

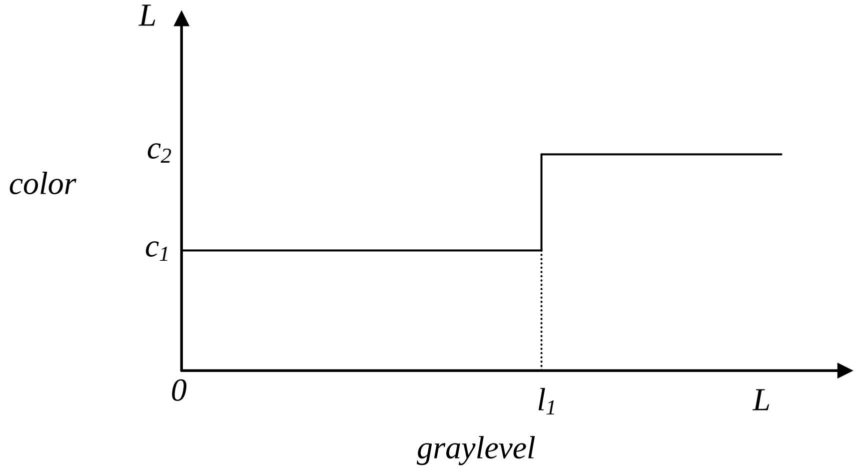
The technique of density (or intensity) slicing and color coding is one of the simplest examples of pseudo-color image processing. If an image is viewed as a two dimensional intensity function. The method can be interpreted as one of placing planes parallel to the coordinate plane of the image. Each plane then *"slices"* the function in the area of intersection.

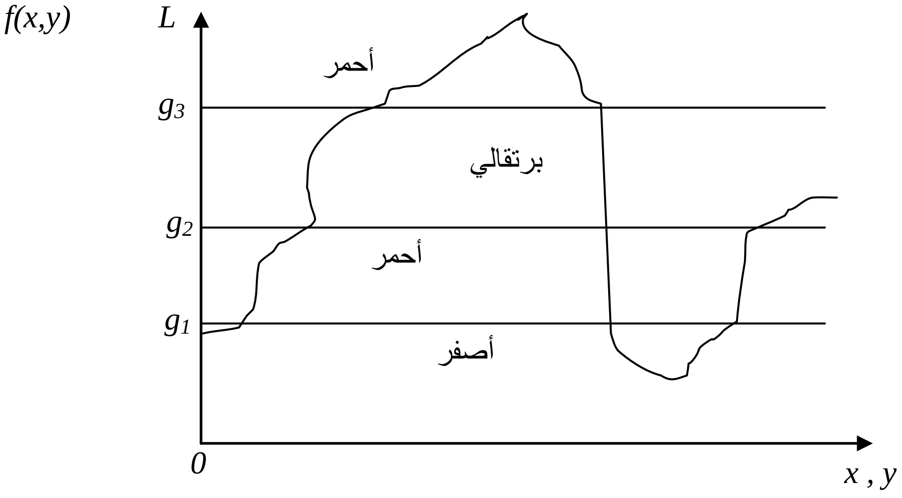
In general the technique may be summarized as follows. Suppose that M planes are defined at levels $l_1, l_2, \ldots\ldots, l_M$ and let l_0 represent black $[f(x,y)=0]$ and l_L represent white $[f(x,y)=L]$. Then assuming that $0<M<L$ the M planes partition the gray scale in to $M+1$ regions and color assignments are made according to the relation:

$$f(x,y) = c_k \qquad \text{if} \quad f(x,y) \in R_k$$

where c_k is the color associated with the k^{th} region R_k defined by the partitioning planes.

Any input gray level is assigned one of two colors depending on whether it is above or below the value of l_1 when more levels are used the mapping function assumes a staircase form.

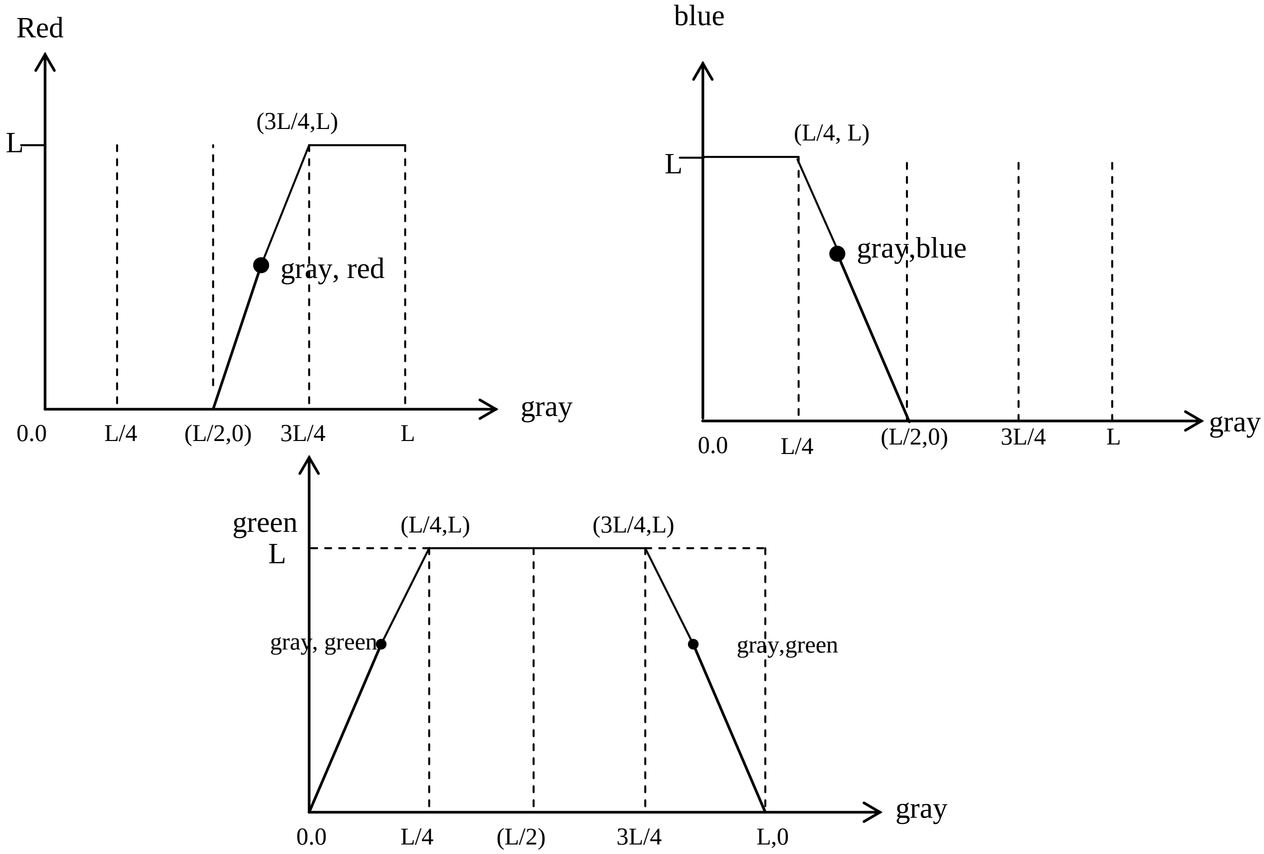




Gray level to Color transformation

This is a general method for color transformation and it is capable of achieving a wider range of pseudo color results. The idea of this approach is to perform three independent transformations on the gray levels of any input pixel. The three results are then fed separately to the red, green, blue parts of the palette registers. This procedure a composite image whose color contents in modulated by the nature of the transformation function.

f(x,y) { *Red transformation* ⟶ *Red part of palette*; *Green transformation* ⟶ *Green part of palette*; *Blue transformation* ⟶ *Blue part of palette* }



<u>*Solution:*</u>

$$\frac{y-y_1}{x-x_1}=\frac{y_2-y_1}{x_2-x_1}$$

<u>***for Red***</u>

$$\frac{red-0}{gray-L/2}=\frac{L-0}{3L/4-L/2}$$

$$\frac{red}{\frac{2gray-L}{2}}=\frac{L}{\frac{3L-2L}{4}}$$

$$\frac{red}{\frac{2gray-L}{2}}=\frac{L}{\frac{L}{4}}$$

$$red\left(L/4\right)=L\times\left(\frac{2gray-L}{2}\right)$$

$$red=L\times\left(\frac{2gray-L}{2}\right)\times\frac{4}{L}$$

$$red=\frac{8gray-4L}{2}$$

$$red=\frac{8gray}{2}-\frac{4L}{2}$$

$$red=4gray-2L$$

$$red=\begin{cases}0 & 0\le gray\le L/2\\ 4gray\text{-}2L & L/2\le gray\le 3L/4\\ L & 3L/4\le gray\le L\end{cases}$$

Blue

$$(x,y)\Rightarrow(gray,blue)\ ,\ p_1(x_1,y_1)\Rightarrow\left(\frac{L}{2},0\right),p_2(x_2,y_2)\Rightarrow\left(\frac{L}{4},L\right)\ ,\ \frac{y-y_1}{x-x_1}=\frac{y_2-y_1}{x_2-x_1}$$

$$\frac{blue-0}{gray-L/2}=\frac{L-0}{L/4-L/2}$$

$$\frac{blue}{\frac{(2gray-L)}{2}}=\frac{L}{\frac{(L-2L)}{4}}$$

$$\frac{blue}{(2gray-L)/2}=\frac{L}{-L/4}$$

$$blue(-L/4)=L(\frac{2gray-L}{2})$$

$$blue=L(\frac{2gray-L}{2})\times\frac{-4}{L}$$

$$blue=\frac{-8gray+4L}{2}$$

$$blue = \frac{-8gray}{2} + \frac{4L}{2}$$
$$blue = -4gray + 2L$$

$$blue = \begin{cases} L & 0 \le gray \le L/4 \\ 2L\text{-}4gray & L/4 \le gray \le L/2 \\ 0 & L/2 \le gray \le L \end{cases}$$

Green

$$(x, y) \Rightarrow (gray, green) \quad , \quad p_1(x_1, y_1) \Rightarrow (0,0), p_2(x_2, y_2) \Rightarrow \left(\frac{L}{4}, L\right)$$
$$\frac{green - 0}{gray - 0} = \frac{L - 0}{L/4 - 0}$$

$$\frac{green}{gray} = \frac{L}{L/4}$$

$$green\,(\frac{L}{4}) = L\,gray$$
$$green = L\,gray \times \frac{4}{L}$$
$$green = 4\,gray$$

$$p_1(x_1, y_1) \Rightarrow (L,0), p_2(x_2, y_2) \Rightarrow \left(\frac{3L}{4}, L\right)$$
$$\frac{green - 0}{gray - L} = \frac{L - 0}{3L/4 - L}$$

$$\frac{green}{gray - L} = \frac{L}{\frac{3L - 4L}{4}}$$
$$\frac{green}{gray - L} = \frac{L}{-L/4}$$

$$green(\frac{-L}{4}) = L \times (gray - L)$$
$$green = L \times (gray - L) \times \frac{-4}{L}$$

$$green = -4(gray - L)$$

$$green = -4gray + 4L$$

$$green = 4L - 4gray$$

$$green = \begin{cases} 4gray & 0 \le gray \le L/4 \\ L & L/4 \le gray \le 3L/4 \\ 4L\text{-}4gray & 3L/4 \le gray \le L \end{cases}$$