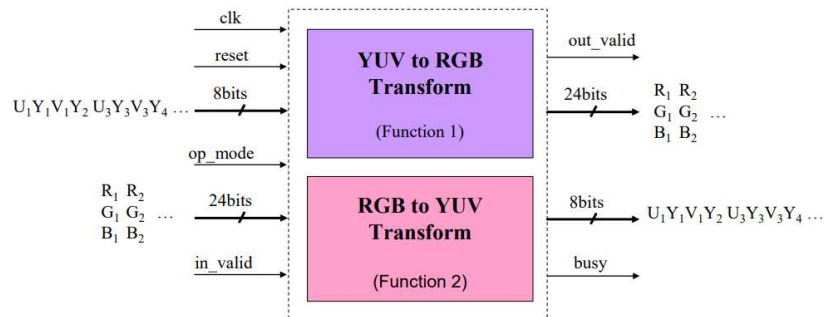


(9) Color Transform Engine

甲、摘要

設計一 Color Transform Engine 可將 YUV 訊號轉換成 RGB 訊號及 RGB 訊號轉換 YUV 訊號。



圖一、電路方塊圖

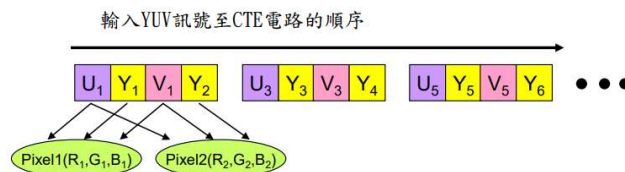
乙、想法

YUV→RGB:

將輸入進來的 YUV 透過矩陣運算輸出 RGB 訊號，而輸入與輸出格式如圖三、圖四所列，其中輸出結果若為正要四捨五入，而負的話要五捨六入。

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} 1 & 0 & 1.625 \\ 1 & -0.25 & -0.75 \\ 1 & 2 & 0 \end{bmatrix} \begin{bmatrix} Y \\ U \\ V \end{bmatrix}$$

圖二、YUV→RGB 轉換矩陣



圖三、YUV 輸入形式



圖四、RGB 輸出形式

RGB→YUV:

將輸入進來的 RGB 透過矩陣運算輸出 YUV 訊號，而輸入與輸出格式與圖三、圖四類似，方向相反而已。

$$\begin{bmatrix} Y \\ U \\ V \end{bmatrix} = \begin{bmatrix} 0.2909 & 0.6303 & 0.078 \\ -0.145 & -0.3151 & 0.4606 \\ 0.436 & -0.387 & -0.048 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

圖五、RGB→YUV 轉換矩陣

丙、結果

```
-----
Congratulations! All data have been generated successfully!
-----PASS-----
Simulation complete via $finish(1) at time 48121 NS + 0

ERROR at 723: Signal Y362 => output:88 v.s. expect:89 error(distance): 1
ERROR at 935: Signal Y468 => output:69 v.s. expect:6a error(distance): 1
-----

Square Distance of All YUV = 2.000000
Square of All YUV Signal = 23195754.000000
-----

So Your Error Ratio:
(Square Distance of YUV)/(Square of All YUV Signal) = 0.000000
-----

Your Score Level: A
Congratulations! CTE's Function2 Successfully!
-----PASS-----
Simulation complete via $finish(1) at time 48120 NS + 0

ERROR at 887: Signal Y444 => output:88 v.s. expect:89 error(distance): 1
-----

Square Distance of All YUV = 1.000000
Square of All YUV Signal = 22233632.000000
-----

So Your Error Ratio:
(Square Distance of YUV)/(Square of All YUV Signal) = 0.000000
-----

Your Score Level: A
Congratulations! CTE's Function2 Successfully!
-----PASS-----
Simulation complete via $finish(1) at time 48120 NS + 0

ERROR at 127: Signal Y 64 => output:d0 v.s. expect:d1 error(distance): 1
-----

Square Distance of All YUV = 1.000000
Square of All YUV Signal = 21561234.000000
-----

So Your Error Ratio:
(Square Distance of YUV)/(Square of All YUV Signal) = 0.000000
-----

Your Score Level: A
Congratulations! CTE's Function2 Successfully!
-----PASS-----
Simulation complete via $finish(1) at time 48120 NS + 0
./testfixture2.v:218 #(`CYCLE/2); $finish;
```

圖六七八九、四筆測試樣本皆通過且等級為 A