大话成像之

数字成像系统 32讲

CSC/CSM

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staff image quality engineer

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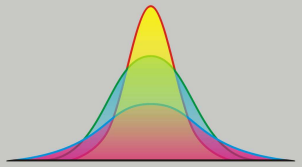
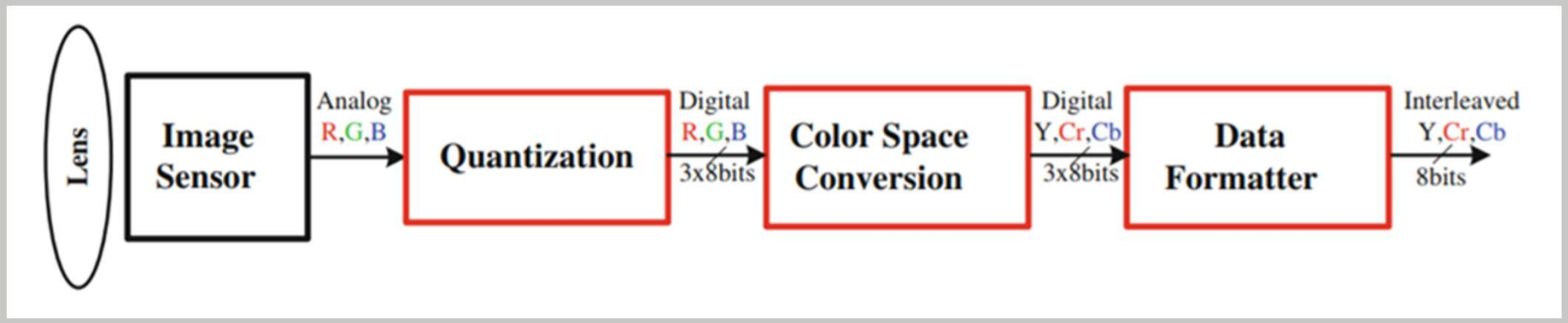
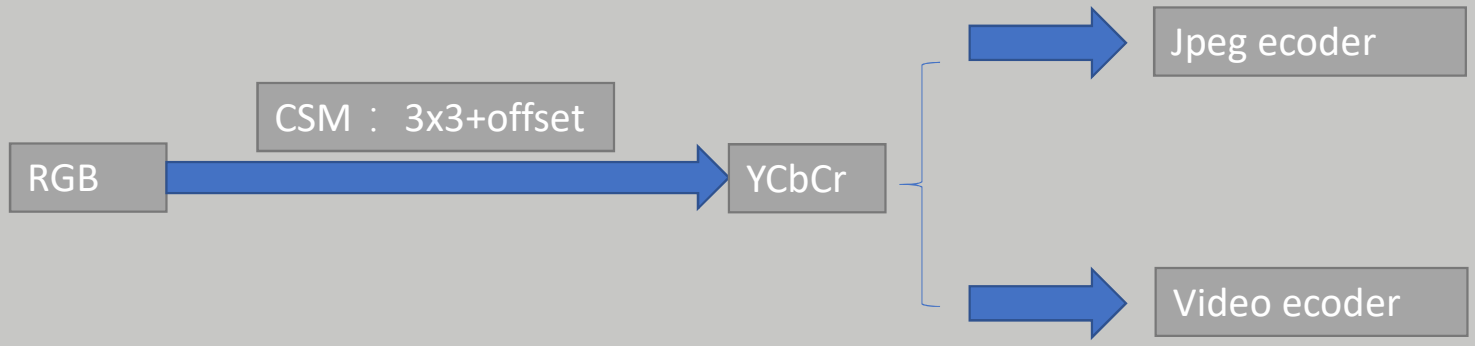
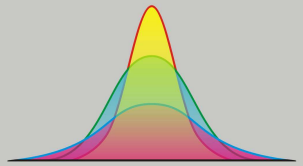


Color space conversion ： CSC
Color space matrix ： CSM

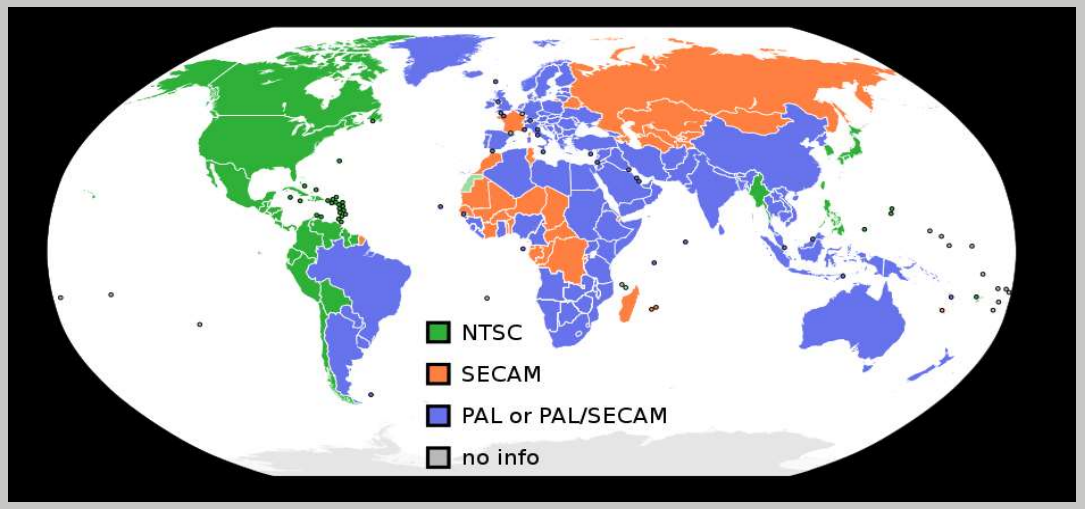


CSM在硬件ISP中的位置





YCbCr的来历



模拟黑白TV

Y = 亮度信号

模拟彩色TV

Y = 亮度信号
UV=色度信号

Pal 制：YPbPr
NTSC制：YIQ
SECAM: YDbDr

数字彩色TV

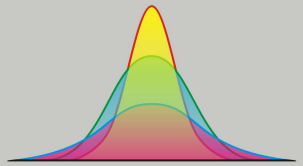
YCbCr → Jpeg / mpeg

标清SD

BT601

高清HD

BT709 →



2014
4K test broadcasting

2016
8K test satellite broadcasting

2018
8K Satellite broadcasting

2020
Tokyo Olympics

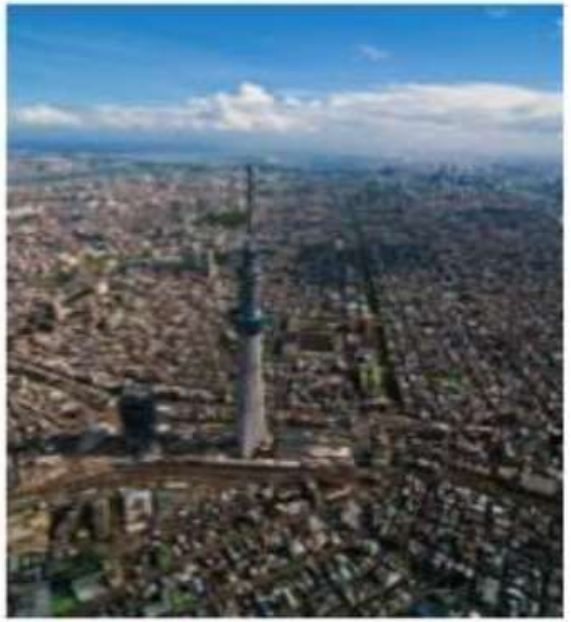
2012

London
8K Public Viewing

2016

Rio
8K Test Broadcasting

2020



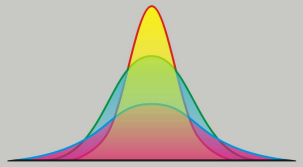
Tokyo
8K Broadcasting

Video parameters

- Specified in international standard (Rec. ITU-R BT.2020 and BT.2100)

Parameter	Values
Pixel count	7680 × 4320, 3840 × 2160
Frame frequency	120*, 100, 60*, 50, 30*, 24* Hz (Progressive)
Bit depth	12 & 10 bits
Colorimetry	Wide-gamut RGB
Dynamic Range	Standard-/High- DR

* 1/1.001 is also included



Jpeg 标准里的CSM

Conversion to and from RGB

Y, Cb, and Cr are converted from R, G, and B as defined in CCIR Recommendation 601 but are normalized so as to occupy the full 256 levels of a 8-bit binary encoding. More precisely:

$$Y = 256 * E'_y$$
$$Cb = 256 * [E'_{Cb}] + 128$$
$$Cr = 256 * [E'_{Cr}] + 128$$

where the E'_y, E'_{Cb} and E'_{Cb} are defined as in CCIR 601. Since values of E'_y have a range of 0 to 1.0 and those for E'_{Cb} and E'_{Cr} have a range of -0.5 to +0.5, Y, Cb, and Cr must be clamped to 255 when they are maximum value.

RGB to YCbCr Conversion

YCbCr (256 levels) can be computed directly from 8-bit RGB as follows:

$$Y = 0.299\,R + 0.587\,G + 0.114\,B$$
$$Cb = -0.1687\,R - 0.3313\,G + 0.5\,B + 128$$
$$Cr = 0.5\,R - 0.4187\,G - 0.0813\,B + 128$$

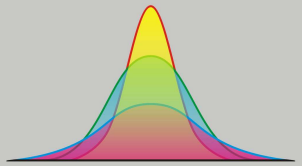
NOTE - Not all image file formats store image samples in the order R_0, G_0, B_0, ... R_n, G_n, B_n. Be sure to verify the sample order before converting an RGB file to JFIF.

YCbCr to RGB Conversion

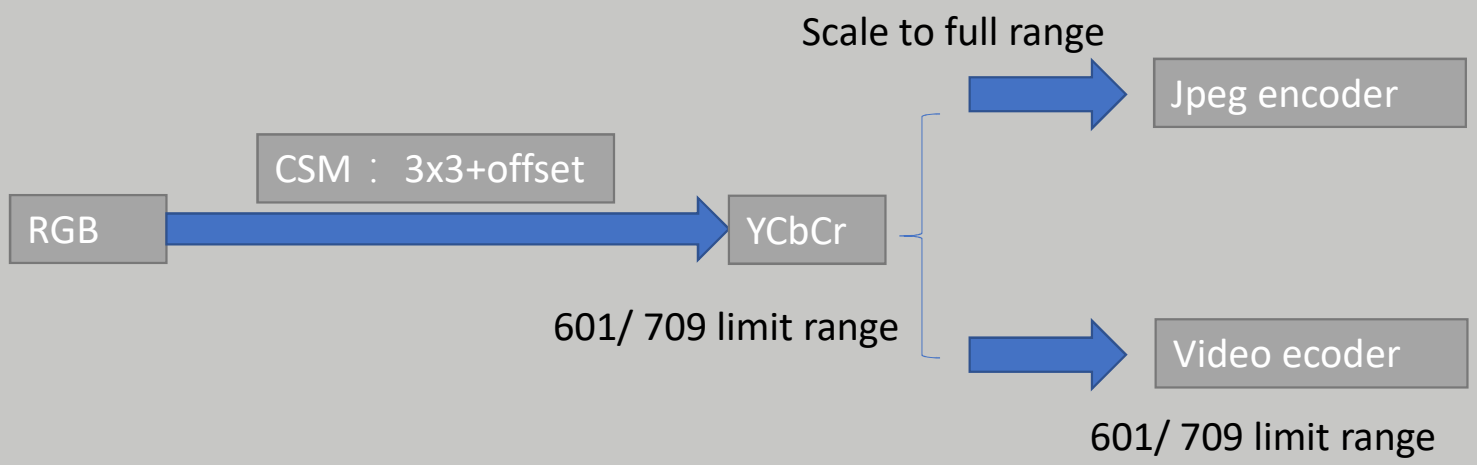
RGB can be computed directly from YCbCr (256 levels) as follows:

$$R = Y + 1.402\,(Cr-128)$$
$$G = Y - 0.34414\,(Cb-128) - 0.71414\,(Cr-128)$$
$$B = Y + 1.772\,(Cb-128)$$

(This conversion is used in JPEG, which allows the input to be in the full [0...255] range, where the output is in range Y=[0...255]; Cb=[0.5...255.5];Cr=[0.5...255.5])

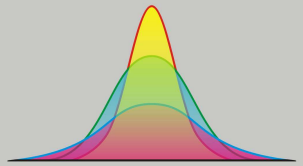


典型配置


Scale to full range
Jpeg encoder
CSM： 3x3+offset
RGB
YCbCr
601/ 709 limit range
Video ecoder
601/ 709 limit range

THANKS

本课程由 Maver Jiang提供



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