# 原 最简单的基于FFmpeg的libswscale的示例（YUV转RGB）



=====================================================

最简单的基于FFmpeg的libswscale的示例系列文章列表：

最简单的基于FFmpeg的libswscale的示例（YUV转RGB）

最简单的基于FFmpeg的libswscale的示例附件：测试图片生成工具

=====================================================

本文记录一个基于FFmpeg的libswscale的示例。Libswscale里面实现了各种图像像素格式的转换，例如YUV与RGB之间的转换；以及图像大小缩放（例如640x360拉伸为1280x720）功能。而且libswscale还做了相应指令集的优化，因此它的转换效率比自己写的C语言的转换效率高很多。

本文记录的程序将像素格式为YUV420P，分辨率为480x272的视频转换为像素格式为RGB24，分辨率为1280x720的视频。

## 流程

### 简单的初始化方法

Libswscale使用起来很方便，最主要的函数只有3个：
（1） sws_getContext()：使用参数初始化SwsContext结构体。
（2） sws_scale()：转换一帧图像。
（3） sws_freeContext()：释放SwsContext结构体。
其中sws_getContext()也可以用另一个接口函数sws_getCachedContext()取代。

### 复杂但是更灵活的初始化方法

初始化SwsContext除了调用sws_getContext()之外还有另一种方法，更加灵活，可以配置更多的参数。该方法调用的函数如下所示。
（1） sws_alloc_context()：为SwsContext结构体分配内存。
（2） av_opt_set_XXX()：通过av_opt_set_int()，av_opt_set()…等等一系列方法设置SwsContext结构体的值。在这里需要注意，SwsContext结构体的定义看不到，所以不能对其中的成员变量直接进行赋值，必须通过av_opt_set()这类的API才能对其进行赋值。
（3） sws_init_context()：初始化SwsContext结构体。
这种复杂的方法可以配置一些sws_getContext()配置不了的参数。比如说设置图像的YUV像素的取值范围是JPEG标准（Y、U、V取值范围都是0-255）还是MPEG标准（Y取值范围是16-235，U、V的取值范围是16-240）。

## 几个知识点

下文记录几个图像像素数据处理过程中的几个知识点：像素格式，图像拉伸，YUV像素取值范围，色域。

### 像素格式

像素格式的知识此前已经记录过，不再重复。在这里记录一下FFmpeg支持的像素格式。有几点注意事项：
（1） 所有的像素格式的名称都是以"AV_PIX_FMT_"开头
（2） 像素格式名称后面有"P"的，代表是planar格式，否则就是packed格式。Planar格式不同的分量分别存储在不同的数组中，例如AV_PIX_FMT_YUV420P存储方式如下：

data[0]: Y1, Y2, Y3, Y4, Y5, Y6, Y7, Y8……
data[1]: U1, U2, U3, U4……
data[2]: V1, V2, V3, V4……

Packed格式的数据都存储在同一个数组中，例如AV_PIX_FMT_RGB24存储方式如下：

data[0]: R1, G1, B1, R2, G2, B2, R3, G3, B3, R4, G4, B4……

（3） 像素格式名称后面有"BE"的，代表是Big Endian格式；名称后面有"LE"的，代表是Little Endian格式。

FFmpeg支持的像素格式的定义位于libavutil\pixfmt.h，是一个名称为AVPixelFormat的枚举类型，如下所示。

[cpp]

```cpp
/**
 * Pixel format.
 *
 * @note
 * AV_PIX_FMT_RGB32 is handled in an endian-specific manner. An RGBA
 * color is put together as:
 *  (A << 24) | (R << 16) | (G << 8) | B
 * This is stored as BGRA on little-endian CPU architectures and ARGB on
```

```
 * big-endian CPUs.
 *
 * @par
 * When the pixel format is palettized RGB (AV_PIX_FMT_PAL8), the palettized
 * image data is stored in AVFrame.data[0]. The palette is transported in
 * AVFrame.data[1], is 1024 bytes long (256 4-byte entries) and is
 * formatted the same as in AV_PIX_FMT_RGB32 described above (i.e., it is
 * also endian-specific). Note also that the individual RGB palette
 * components stored in AVFrame.data[1] should be in the range 0..255.
 * This is important as many custom PAL8 video codecs that were designed
 * to run on the IBM VGA graphics adapter use 6-bit palette components.
 *
 * @par
 * For all the 8bit per pixel formats, an RGB32 palette is in data[1] like
 * for pal8. This palette is filled in automatically by the function
 * allocating the picture.
 *
 * @note
 * Make sure that all newly added big-endian formats have (pix_fmt & 1) == 1
 * and that all newly added little-endian formats have (pix_fmt & 1) == 0.
 * This allows simpler detection of big vs little-endian.
 */
enum AVPixelFormat {
    AV_PIX_FMT_NONE = -1,
    AV_PIX_FMT_YUV420P,   ///< planar YUV 4:2:0, 12bpp, (1 Cr & Cb sample per 2x2 Y samples)
    AV_PIX_FMT_YUYV422,   ///< packed YUV 4:2:2, 16bpp, Y0 Cb Y1 Cr
    AV_PIX_FMT_RGB24,     ///< packed RGB 8:8:8, 24bpp, RGBRGB...
    AV_PIX_FMT_BGR24,     ///< packed RGB 8:8:8, 24bpp, BGRBGR...
    AV_PIX_FMT_YUV422P,   ///< planar YUV 4:2:2, 16bpp, (1 Cr & Cb sample per 2x1 Y samples)
    AV_PIX_FMT_YUV444P,   ///< planar YUV 4:4:4, 24bpp, (1 Cr & Cb sample per 1x1 Y samples)
    AV_PIX_FMT_YUV410P,   ///< planar YUV 4:1:0,  9bpp, (1 Cr & Cb sample per 4x4 Y samples)
    AV_PIX_FMT_YUV411P,   ///< planar YUV 4:1:1, 12bpp, (1 Cr & Cb sample per 4x1 Y samples)
    AV_PIX_FMT_GRAY8,     ///<        Y        ,  8bpp
    AV_PIX_FMT_MONOWHITE, ///<        Y        ,  1bpp, 0 is white, 1 is black, in each byte pixels are ordered from the msb to the l

    AV_PIX_FMT_MONOBLACK, ///<        Y        ,  1bpp, 0 is black, 1 is white, in each byte pixels are ordered from the msb to the l

    AV_PIX_FMT_PAL8,      ///< 8 bit with PIX_FMT_RGB32 palette
    AV_PIX_FMT_YUVJ420P,  ///< planar YUV 4:2:0, 12bpp, full scale (JPEG), deprecated in favor of PIX_FMT_YUV420P and setting color_r
ge
    AV_PIX_FMT_YUVJ422P,  ///< planar YUV 4:2:2, 16bpp, full scale (JPEG), deprecated in favor of PIX_FMT_YUV422P and setting color_r
ge
    AV_PIX_FMT_YUVJ444P,  ///< planar YUV 4:4:4, 24bpp, full scale (JPEG), deprecated in favor of PIX_FMT_YUV444P and setting color_r
ge
#if FF_API_XVMC
    AV_PIX_FMT_XVMC_MPEG2_MC,///< XVideo Motion Acceleration via common packet passing
    AV_PIX_FMT_XVMC_MPEG2_IDCT,
#define AV_PIX_FMT_XVMC AV_PIX_FMT_XVMC_MPEG2_IDCT
#endif /* FF_API_XVMC */
    AV_PIX_FMT_UYVY422,   ///< packed YUV 4:2:2, 16bpp, Cb Y0 Cr Y1
    AV_PIX_FMT_UYYVYY411, ///< packed YUV 4:1:1, 12bpp, Cb Y0 Y1 Cr Y2 Y3
    AV_PIX_FMT_BGR8,      ///< packed RGB 3:3:2,  8bpp, (msb)2B 3G 3R(lsb)
    AV_PIX_FMT_BGR4,      ///< packed RGB 1:2:1 bitstream,  4bpp, (msb)1B 2G 1R(lsb), a byte contains two pixels, the first pixel in
e byte is the one composed by the 4 msb bits
    AV_PIX_FMT_BGR4_BYTE, ///< packed RGB 1:2:1,  8bpp, (msb)1B 2G 1R(lsb)
    AV_PIX_FMT_RGB8,      ///< packed RGB 3:3:2,  8bpp, (msb)2R 3G 3B(lsb)
    AV_PIX_FMT_RGB4,      ///< packed RGB 1:2:1 bitstream,  4bpp, (msb)1R 2G 1B(lsb), a byte contains two pixels, the first pixel in
e byte is the one composed by the 4 msb bits
    AV_PIX_FMT_RGB4_BYTE, ///< packed RGB 1:2:1,  8bpp, (msb)1R 2G 1B(lsb)
    AV_PIX_FMT_NV12,      ///< planar YUV 4:2:0, 12bpp, 1 plane for Y and 1 plane for the UV components, which are interleaved (first
yte U and the following byte V)
    AV_PIX_FMT_NV21,      ///< as above, but U and V bytes are swapped

    AV_PIX_FMT_ARGB,      ///< packed ARGB 8:8:8:8, 32bpp, ARGBARGB...
    AV_PIX_FMT_RGBA,      ///< packed RGBA 8:8:8:8, 32bpp, RGBARGBA...
    AV_PIX_FMT_ABGR,      ///< packed ABGR 8:8:8:8, 32bpp, ABGRABGR...
    AV_PIX_FMT_BGRA,      ///< packed BGRA 8:8:8:8, 32bpp, BGRABGRA...

    AV_PIX_FMT_GRAY16BE,  ///<        Y        , 16bpp, big-endian
    AV_PIX_FMT_GRAY16LE,  ///<        Y        , 16bpp, little-endian
    AV_PIX_FMT_YUV440P,   ///< planar YUV 4:4:0 (1 Cr & Cb sample per 1x2 Y samples)
    AV_PIX_FMT_YUVJ440P,  ///< planar YUV 4:4:0 full scale (JPEG), deprecated in favor of PIX_FMT_YUV440P and setting color_range
    AV_PIX_FMT_YUVA420P,  ///< planar YUV 4:2:0, 20bpp, (1 Cr & Cb sample per 2x2 Y & A samples)
#if FF_API_VDPAU
    AV_PIX_FMT_VDPAU_H264,///< H.264 HW decoding with VDPAU, data[0] contains a vdpau_render_state struct which contains the bitstrea
of the slices as well as various fields extracted from headers
    AV_PIX_FMT_VDPAU_MPEG1,///< MPEG-
1 HW decoding with VDPAU, data[0] contains a vdpau_render_state struct which contains the bitstream of the slices as well as various
lds extracted from headers
    AV_PIX_FMT_VDPAU_MPEG2,///< MPEG-
2 HW decoding with VDPAU, data[0] contains a vdpau_render_state struct which contains the bitstream of the slices as well as various
lds extracted from headers
    AV_PIX_FMT_VDPAU_WMV3,///< WMV3 HW decoding with VDPAU, data[0] contains a vdpau_render_state struct which contains the bitstream
f the slices as well as various fields extracted from headers
    AV_PIX_FMT_VDPAU_VC1, ///< VC-
1 HW decoding with VDPAU, data[0] contains a vdpau_render_state struct which contains the bitstream of the slices as well as various
lds extracted from headers
#endif
    AV_PIX_FMT_RGB48BE,   ///< packed RGB 16:16:16, 48bpp, 16R, 16G, 16B, the 2-
byte value for each R/G/B component is stored as big-endian
    AV_PIX_FMT_RGB48LE,   ///< packed RGB 16:16:16, 48bpp, 16R, 16G, 16B, the 2-
byte value for each R/G/B component is stored as little-endian
```

```
byte value for each R/G/B component is stored as little-endian

    AV_PIX_FMT_RGB565BE,  ///< packed RGB 5:6:5, 16bpp, (msb)   5R 6G 5B(lsb), big-endian
    AV_PIX_FMT_RGB565LE,  ///< packed RGB 5:6:5, 16bpp, (msb)   5R 6G 5B(lsb), little-endian
    AV_PIX_FMT_RGB555BE,  ///< packed RGB 5:5:5, 16bpp, (msb)1A 5R 5G 5B(lsb), big-endian, most significant bit to 0
    AV_PIX_FMT_RGB555LE,  ///< packed RGB 5:5:5, 16bpp, (msb)1A 5R 5G 5B(lsb), little-endian, most significant bit to 0

    AV_PIX_FMT_BGR565BE,  ///< packed BGR 5:6:5, 16bpp, (msb)   5B 6G 5R(lsb), big-endian
    AV_PIX_FMT_BGR565LE,  ///< packed BGR 5:6:5, 16bpp, (msb)   5B 6G 5R(lsb), little-endian
    AV_PIX_FMT_BGR555BE,  ///< packed BGR 5:5:5, 16bpp, (msb)1A 5B 5G 5R(lsb), big-endian, most significant bit to 1
    AV_PIX_FMT_BGR555LE,  ///< packed BGR 5:5:5, 16bpp, (msb)1A 5B 5G 5R(lsb), little-endian, most significant bit to 1

    AV_PIX_FMT_VAAPI_MOCO, ///< HW acceleration through VA API at motion compensation entry-
point, Picture.data[3] contains a vaapi_render_state struct which contains macroblocks as well as various fields extracted from heade

    AV_PIX_FMT_VAAPI_IDCT, ///< HW acceleration through VA API at IDCT entry-
point, Picture.data[3] contains a vaapi_render_state struct which contains fields extracted from headers
    AV_PIX_FMT_VAAPI_VLD,  ///< HW decoding through VA API, Picture.data[3] contains a vaapi_render_state struct which contains the b
stream of the slices as well as various fields extracted from headers

    AV_PIX_FMT_YUV420P16LE,  ///< planar YUV 4:2:0, 24bpp, (1 Cr & Cb sample per 2x2 Y samples), little-endian
    AV_PIX_FMT_YUV420P16BE,  ///< planar YUV 4:2:0, 24bpp, (1 Cr & Cb sample per 2x2 Y samples), big-endian
    AV_PIX_FMT_YUV422P16LE,  ///< planar YUV 4:2:2, 32bpp, (1 Cr & Cb sample per 2x1 Y samples), little-endian
    AV_PIX_FMT_YUV422P16BE,  ///< planar YUV 4:2:2, 32bpp, (1 Cr & Cb sample per 2x1 Y samples), big-endian
    AV_PIX_FMT_YUV444P16LE,  ///< planar YUV 4:4:4, 48bpp, (1 Cr & Cb sample per 1x1 Y samples), little-endian
    AV_PIX_FMT_YUV444P16BE,  ///< planar YUV 4:4:4, 48bpp, (1 Cr & Cb sample per 1x1 Y samples), big-endian
#if FF_API_VDPAU
    AV_PIX_FMT_VDPAU_MPEG4,  ///< MPEG4 HW decoding with VDPAU, data[0] contains a vdpau_render_state struct which contains the bitst
am of the slices as well as various fields extracted from headers
#endif
    AV_PIX_FMT_DXVA2_VLD,    ///< HW decoding through DXVA2, Picture.data[3] contains a LPDIRECT3DSURFACE9 pointer

    AV_PIX_FMT_RGB444LE,  ///< packed RGB 4:4:4, 16bpp, (msb)4A 4R 4G 4B(lsb), little-endian, most significant bits to 0
    AV_PIX_FMT_RGB444BE,  ///< packed RGB 4:4:4, 16bpp, (msb)4A 4R 4G 4B(lsb), big-endian, most significant bits to 0
    AV_PIX_FMT_BGR444LE,  ///< packed BGR 4:4:4, 16bpp, (msb)4A 4B 4G 4R(lsb), little-endian, most significant bits to 1
    AV_PIX_FMT_BGR444BE,  ///< packed BGR 4:4:4, 16bpp, (msb)4A 4B 4G 4R(lsb), big-endian, most significant bits to 1
    AV_PIX_FMT_GRAY8A,    ///< 8bit gray, 8bit alpha
    AV_PIX_FMT_BGR48BE,   ///< packed RGB 16:16:16, 48bpp, 16B, 16G, 16R, the 2-
byte value for each R/G/B component is stored as big-endian
    AV_PIX_FMT_BGR48LE,   ///< packed RGB 16:16:16, 48bpp, 16B, 16G, 16R, the 2-
byte value for each R/G/B component is stored as little-endian

    /**
     * The following 12 formats have the disadvantage of needing 1 format for each bit depth.
     * Notice that each 9/10 bits sample is stored in 16 bits with extra padding.
     * If you want to support multiple bit depths, then using AV_PIX_FMT_YUV420P16* with the bpp stored separately is better.
     */
    AV_PIX_FMT_YUV420P9BE, ///< planar YUV 4:2:0, 13.5bpp, (1 Cr & Cb sample per 2x2 Y samples), big-endian
    AV_PIX_FMT_YUV420P9LE, ///< planar YUV 4:2:0, 13.5bpp, (1 Cr & Cb sample per 2x2 Y samples), little-endian
    AV_PIX_FMT_YUV420P10BE,///< planar YUV 4:2:0, 15bpp, (1 Cr & Cb sample per 2x2 Y samples), big-endian
    AV_PIX_FMT_YUV420P10LE,///< planar YUV 4:2:0, 15bpp, (1 Cr & Cb sample per 2x2 Y samples), little-endian
    AV_PIX_FMT_YUV422P10BE,///< planar YUV 4:2:2, 20bpp, (1 Cr & Cb sample per 2x1 Y samples), big-endian
    AV_PIX_FMT_YUV422P10LE,///< planar YUV 4:2:2, 20bpp, (1 Cr & Cb sample per 2x1 Y samples), little-endian
    AV_PIX_FMT_YUV444P9BE, ///< planar YUV 4:4:4, 27bpp, (1 Cr & Cb sample per 1x1 Y samples), big-endian
    AV_PIX_FMT_YUV444P9LE, ///< planar YUV 4:4:4, 27bpp, (1 Cr & Cb sample per 1x1 Y samples), little-endian
    AV_PIX_FMT_YUV444P10BE,///< planar YUV 4:4:4, 30bpp, (1 Cr & Cb sample per 1x1 Y samples), big-endian
    AV_PIX_FMT_YUV444P10LE,///< planar YUV 4:4:4, 30bpp, (1 Cr & Cb sample per 1x1 Y samples), little-endian
    AV_PIX_FMT_YUV422P9BE, ///< planar YUV 4:2:2, 18bpp, (1 Cr & Cb sample per 2x1 Y samples), big-endian
    AV_PIX_FMT_YUV422P9LE, ///< planar YUV 4:2:2, 18bpp, (1 Cr & Cb sample per 2x1 Y samples), little-endian
    AV_PIX_FMT_VDA_VLD,    ///< hardware decoding through VDA

#ifdef AV_PIX_FMT_ABI_GIT_MASTER
    AV_PIX_FMT_RGBA64BE,  ///< packed RGBA 16:16:16:16, 64bpp, 16R, 16G, 16B, 16A, the 2-
byte value for each R/G/B/A component is stored as big-endian
    AV_PIX_FMT_RGBA64LE,  ///< packed RGBA 16:16:16:16, 64bpp, 16R, 16G, 16B, 16A, the 2-
byte value for each R/G/B/A component is stored as little-endian
    AV_PIX_FMT_BGRA64BE,  ///< packed RGBA 16:16:16:16, 64bpp, 16B, 16G, 16R, 16A, the 2-
byte value for each R/G/B/A component is stored as big-endian
    AV_PIX_FMT_BGRA64LE,  ///< packed RGBA 16:16:16:16, 64bpp, 16B, 16G, 16R, 16A, the 2-
byte value for each R/G/B/A component is stored as little-endian
#endif
    AV_PIX_FMT_GBRP,      ///< planar GBR 4:4:4 24bpp
    AV_PIX_FMT_GBRP9BE,   ///< planar GBR 4:4:4 27bpp, big-endian
    AV_PIX_FMT_GBRP9LE,   ///< planar GBR 4:4:4 27bpp, little-endian
    AV_PIX_FMT_GBRP10BE,  ///< planar GBR 4:4:4 30bpp, big-endian
    AV_PIX_FMT_GBRP10LE,  ///< planar GBR 4:4:4 30bpp, little-endian
    AV_PIX_FMT_GBRP16BE,  ///< planar GBR 4:4:4 48bpp, big-endian
    AV_PIX_FMT_GBRP16LE,  ///< planar GBR 4:4:4 48bpp, little-endian

    /**
     * duplicated pixel formats for compatibility with libav.
     * FFmpeg supports these formats since May 8 2012 and Jan 28 2012 (commits f9ca1ac7 and 143a5c55)
     * Libav added them Oct 12 2012 with incompatible values (commit 6d5600e85)
     */
    AV_PIX_FMT_YUVA422P_LIBAV,  ///< planar YUV 4:2:2 24bpp, (1 Cr & Cb sample per 2x1 Y & A samples)
    AV_PIX_FMT_YUVA444P_LIBAV,  ///< planar YUV 4:4:4 32bpp, (1 Cr & Cb sample per 1x1 Y & A samples)

    AV_PIX_FMT_YUVA420P9BE,  ///< planar YUV 4:2:0 22.5bpp, (1 Cr & Cb sample per 2x2 Y & A samples), big-endian
    AV_PIX_FMT_YUVA420P9LE,  ///< planar YUV 4:2:0 22.5bpp, (1 Cr & Cb sample per 2x2 Y & A samples), little-endian
    AV_PIX_FMT_YUVA422P9BE,  ///< planar YUV 4:2:2 27bpp, (1 Cr & Cb sample per 2x1 Y & A samples), big-endian
    AV_PIX_FMT_YUVA422P9LE,  ///< planar YUV 4:2:2 27bpp, (1 Cr & Cb sample per 2x1 Y & A samples), little-endian
    AV_PIX_FMT_YUVA444P9BE,  ///< planar YUV 4:4:4 36bpp, (1 Cr & Cb sample per 1x1 Y & A samples), big-endian
```

```
    AV_PIX_FMT_YUVA444P9LE,  ///< planar YUV 4:4:4 36bpp, (1 Cr & Cb sample per 1x1 Y & A samples), little-endian
    AV_PIX_FMT_YUVA420P10BE, ///< planar YUV 4:2:0 25bpp, (1 Cr & Cb sample per 2x2 Y & A samples, big-endian)
    AV_PIX_FMT_YUVA420P10LE, ///< planar YUV 4:2:0 25bpp, (1 Cr & Cb sample per 2x2 Y & A samples, little-endian)
    AV_PIX_FMT_YUVA422P10BE, ///< planar YUV 4:2:2 30bpp, (1 Cr & Cb sample per 2x1 Y & A samples, big-endian)
    AV_PIX_FMT_YUVA422P10LE, ///< planar YUV 4:2:2 30bpp, (1 Cr & Cb sample per 2x1 Y & A samples, little-endian)
    AV_PIX_FMT_YUVA444P10BE, ///< planar YUV 4:4:4 40bpp, (1 Cr & Cb sample per 1x1 Y & A samples, big-endian)
    AV_PIX_FMT_YUVA444P10LE, ///< planar YUV 4:4:4 40bpp, (1 Cr & Cb sample per 1x1 Y & A samples, little-endian)
    AV_PIX_FMT_YUVA420P16BE, ///< planar YUV 4:2:0 40bpp, (1 Cr & Cb sample per 2x2 Y & A samples, big-endian)
    AV_PIX_FMT_YUVA420P16LE, ///< planar YUV 4:2:0 40bpp, (1 Cr & Cb sample per 2x2 Y & A samples, little-endian)
    AV_PIX_FMT_YUVA422P16BE, ///< planar YUV 4:2:2 48bpp, (1 Cr & Cb sample per 2x1 Y & A samples, big-endian)
    AV_PIX_FMT_YUVA422P16LE, ///< planar YUV 4:2:2 48bpp, (1 Cr & Cb sample per 2x1 Y & A samples, little-endian)
    AV_PIX_FMT_YUVA444P16BE, ///< planar YUV 4:4:4 64bpp, (1 Cr & Cb sample per 1x1 Y & A samples, big-endian)
    AV_PIX_FMT_YUVA444P16LE, ///< planar YUV 4:4:4 64bpp, (1 Cr & Cb sample per 1x1 Y & A samples, little-endian)

    AV_PIX_FMT_VDPAU,     ///< HW acceleration through VDPAU, Picture.data[3] contains a VdpVideoSurface

    AV_PIX_FMT_XYZ12LE,      ///< packed XYZ 4:4:4, 36 bpp, (msb) 12X, 12Y, 12Z (lsb), the 2-byte value for each X/Y/Z is stored as little-endian, the 4 lower bits are set to 0
    AV_PIX_FMT_XYZ12BE,      ///< packed XYZ 4:4:4, 36 bpp, (msb) 12X, 12Y, 12Z (lsb), the 2-byte value for each X/Y/Z is stored as big-endian, the 4 lower bits are set to 0
    AV_PIX_FMT_NV16,         ///< interleaved chroma YUV 4:2:2, 16bpp, (1 Cr & Cb sample per 2x1 Y samples)
    AV_PIX_FMT_NV20LE,       ///< interleaved chroma YUV 4:2:2, 20bpp, (1 Cr & Cb sample per 2x1 Y samples), little-endian
    AV_PIX_FMT_NV20BE,       ///< interleaved chroma YUV 4:2:2, 20bpp, (1 Cr & Cb sample per 2x1 Y samples), big-endian

    /**
     * duplicated pixel formats for compatibility with libav.
     * FFmpeg supports these formats since Sat Sep 24 06:01:45 2011 +0200 (commits 9569a3c9f41387a8c7d1ce97d8693520477a66c3)
     * also see Fri Nov 25 01:38:21 2011 +0100 92afb431621c79155fcb7171d26f137eb1bee028
     * Libav added them Sun Mar 16 23:05:47 2014 +0100 with incompatible values (commit 1481d24c3a0abf81e1d7a514547bd5305232be30)
     */
    AV_PIX_FMT_RGBA64BE_LIBAV,     ///< packed RGBA 16:16:16:16, 64bpp, 16R, 16G, 16B, 16A, the 2-byte value for each R/G/B/A component is stored as big-endian
    AV_PIX_FMT_RGBA64LE_LIBAV,     ///< packed RGBA 16:16:16:16, 64bpp, 16R, 16G, 16B, 16A, the 2-byte value for each R/G/B/A component is stored as little-endian
    AV_PIX_FMT_BGRA64BE_LIBAV,     ///< packed RGBA 16:16:16:16, 64bpp, 16B, 16G, 16R, 16A, the 2-byte value for each R/G/B/A component is stored as big-endian
    AV_PIX_FMT_BGRA64LE_LIBAV,     ///< packed RGBA 16:16:16:16, 64bpp, 16B, 16G, 16R, 16A, the 2-byte value for each R/G/B/A component is stored as little-endian

    AV_PIX_FMT_YVYU422,   ///< packed YUV 4:2:2, 16bpp, Y0 Cr Y1 Cb

#ifndef AV_PIX_FMT_ABI_GIT_MASTER
    AV_PIX_FMT_RGBA64BE=0x123,  ///< packed RGBA 16:16:16:16, 64bpp, 16R, 16G, 16B, 16A, the 2-byte value for each R/G/B/A component is stored as big-endian
    AV_PIX_FMT_RGBA64LE,  ///< packed RGBA 16:16:16:16, 64bpp, 16R, 16G, 16B, 16A, the 2-byte value for each R/G/B/A component is stored as little-endian
    AV_PIX_FMT_BGRA64BE,  ///< packed RGBA 16:16:16:16, 64bpp, 16B, 16G, 16R, 16A, the 2-byte value for each R/G/B/A component is stored as big-endian
    AV_PIX_FMT_BGRA64LE,  ///< packed RGBA 16:16:16:16, 64bpp, 16B, 16G, 16R, 16A, the 2-byte value for each R/G/B/A component is stored as little-endian
#endif
    AV_PIX_FMT_0RGB=0x123+4,      ///< packed RGB 8:8:8, 32bpp, 0RGB0RGB...
    AV_PIX_FMT_RGB0,      ///< packed RGB 8:8:8, 32bpp, RGB0RGB0...
    AV_PIX_FMT_0BGR,      ///< packed BGR 8:8:8, 32bpp, 0BGR0BGR...
    AV_PIX_FMT_BGR0,      ///< packed BGR 8:8:8, 32bpp, BGR0BGR0...
    AV_PIX_FMT_YUVA444P,  ///< planar YUV 4:4:4 32bpp, (1 Cr & Cb sample per 1x1 Y & A samples)
    AV_PIX_FMT_YUVA422P,  ///< planar YUV 4:2:2 24bpp, (1 Cr & Cb sample per 2x1 Y & A samples)

    AV_PIX_FMT_YUV420P12BE, ///< planar YUV 4:2:0,18bpp, (1 Cr & Cb sample per 2x2 Y samples), big-endian
    AV_PIX_FMT_YUV420P12LE, ///< planar YUV 4:2:0,18bpp, (1 Cr & Cb sample per 2x2 Y samples), little-endian
    AV_PIX_FMT_YUV420P14BE, ///< planar YUV 4:2:0,21bpp, (1 Cr & Cb sample per 2x2 Y samples), big-endian
    AV_PIX_FMT_YUV420P14LE, ///< planar YUV 4:2:0,21bpp, (1 Cr & Cb sample per 2x2 Y samples), little-endian
    AV_PIX_FMT_YUV422P12BE, ///< planar YUV 4:2:2,24bpp, (1 Cr & Cb sample per 2x1 Y samples), big-endian
    AV_PIX_FMT_YUV422P12LE, ///< planar YUV 4:2:2,24bpp, (1 Cr & Cb sample per 2x1 Y samples), little-endian
    AV_PIX_FMT_YUV422P14BE, ///< planar YUV 4:2:2,28bpp, (1 Cr & Cb sample per 2x1 Y samples), big-endian
    AV_PIX_FMT_YUV422P14LE, ///< planar YUV 4:2:2,28bpp, (1 Cr & Cb sample per 2x1 Y samples), little-endian
    AV_PIX_FMT_YUV444P12BE, ///< planar YUV 4:4:4,36bpp, (1 Cr & Cb sample per 1x1 Y samples), big-endian
    AV_PIX_FMT_YUV444P12LE, ///< planar YUV 4:4:4,36bpp, (1 Cr & Cb sample per 1x1 Y samples), little-endian
    AV_PIX_FMT_YUV444P14BE, ///< planar YUV 4:4:4,42bpp, (1 Cr & Cb sample per 1x1 Y samples), big-endian
    AV_PIX_FMT_YUV444P14LE, ///< planar YUV 4:4:4,42bpp, (1 Cr & Cb sample per 1x1 Y samples), little-endian
    AV_PIX_FMT_GBRP12BE,    ///< planar GBR 4:4:4 36bpp, big-endian
    AV_PIX_FMT_GBRP12LE,    ///< planar GBR 4:4:4 36bpp, little-endian
    AV_PIX_FMT_GBRP14BE,    ///< planar GBR 4:4:4 42bpp, big-endian
    AV_PIX_FMT_GBRP14LE,    ///< planar GBR 4:4:4 42bpp, little-endian
    AV_PIX_FMT_GBRAP,       ///< planar GBRA 4:4:4:4 32bpp
    AV_PIX_FMT_GBRAP16BE,   ///< planar GBRA 4:4:4:4 64bpp, big-endian
    AV_PIX_FMT_GBRAP16LE,   ///< planar GBRA 4:4:4:4 64bpp, little-endian
    AV_PIX_FMT_YUVJ411P,    ///< planar YUV 4:1:1, 12bpp, (1 Cr & Cb sample per 4x1 Y samples) full scale (JPEG), deprecated in favor f PIX_FMT_YUV411P and setting color_range

    AV_PIX_FMT_BAYER_BGGR8,    ///< bayer, BGBG..(odd line), GRGR..(even line), 8-bit samples */
    AV_PIX_FMT_BAYER_RGGB8,    ///< bayer, RGRG..(odd line), GBGB..(even line), 8-bit samples */
    AV_PIX_FMT_BAYER_GBRG8,    ///< bayer, GBGB..(odd line), RGRG..(even line), 8-bit samples */
    AV_PIX_FMT_BAYER_GRBG8,    ///< bayer, GRGR..(odd line), BGBG..(even line), 8-bit samples */
    AV_PIX_FMT_BAYER_BGGR16LE, ///< bayer, BGBG..(odd line), GRGR..(even line), 16-bit samples, little-endian */
    AV_PIX_FMT_BAYER_BGGR16BE, ///< bayer, BGBG..(odd line), GRGR..(even line), 16-bit samples, big-endian */
    AV_PIX_FMT_BAYER_RGGB16LE, ///< bayer, RGRG..(odd line), GBGB..(even line), 16-bit samples, little-endian */
    AV_PIX_FMT_BAYER_RGGB16BE, ///< bayer, RGRG..(odd line), GBGB..(even line), 16-bit samples, big-endian */
    AV_PIX_FMT_BAYER_GBRG16LE, ///< bayer, GBGB..(odd line), RGRG..(even line), 16-bit samples, little-endian */
    AV_PIX_FMT_BAYER_GBRG16BE, ///< bayer, GBGB..(odd line), RGRG..(even line), 16-bit samples, big-endian */
    AV_PIX_FMT_BAYER_GRBG16LE, ///< bayer, GRGR..(odd line), BGBG..(even line), 16-bit samples, little-endian */
```

```
    AV_PIX_FMT_BAYER_GRBG16BE, ///< bayer, GRGR..(odd line), BGBG..(even line), 16-bit samples, big-endian */
#if !FF_API_XVMC
    AV_PIX_FMT_XVMC,///< XVideo Motion Acceleration via common packet passing
#endif /* !FF_API_XVMC */

    AV_PIX_FMT_NB,        ///< number of pixel formats, DO NOT USE THIS if you want to link with shared libav* because the number of
rmats might differ between versions

#if FF_API_PIX_FMT
#include "old_pix_fmts.h"
#endif
};
```

FFmpeg有一个专门用于描述像素格式的结构体AVPixFmtDescriptor。该结构体的定义位于libavutil\pixdesc.h，如下所示。

```cpp
/**
 * Descriptor that unambiguously describes how the bits of a pixel are
 * stored in the up to 4 data planes of an image. It also stores the
 * subsampling factors and number of components.
 *
 * @note This is separate of the colorspace (RGB, YCbCr, YPbPr, JPEG-style YUV
 *       and all the YUV variants) AVPixFmtDescriptor just stores how values
 *       are stored not what these values represent.
 */
typedef struct AVPixFmtDescriptor{
    const char *name;
    uint8_t nb_components;      ///< The number of components each pixel has, (1-4)

    /**
     * Amount to shift the luma width right to find the chroma width.
     * For YV12 this is 1 for example.
     * chroma_width = -((-luma_width) >> log2_chroma_w)
     * The note above is needed to ensure rounding up.
     * This value only refers to the chroma components.
     */
    uint8_t log2_chroma_w;      ///< chroma_width = -((-luma_width )>>log2_chroma_w)

    /**
     * Amount to shift the luma height right to find the chroma height.
     * For YV12 this is 1 for example.
     * chroma_height= -((-luma_height) >> log2_chroma_h)
     * The note above is needed to ensure rounding up.
     * This value only refers to the chroma components.
     */
    uint8_t log2_chroma_h;
    uint8_t flags;

    /**
     * Parameters that describe how pixels are packed.
     * If the format has 2 or 4 components, then alpha is last.
     * If the format has 1 or 2 components, then luma is 0.
     * If the format has 3 or 4 components,
     * if the RGB flag is set then 0 is red, 1 is green and 2 is blue;
     * otherwise 0 is luma, 1 is chroma-U and 2 is chroma-V.
     */
    AVComponentDescriptor comp[4];
}AVPixFmtDescriptor;
```

关于AVPixFmtDescriptor这个结构体不再做过多解释。它的定义比较简单，看注释就可以理解。通过av_pix_fmt_desc_get()可以获得指定像素格式的AVPixFmtDescriptor结构体。

```cpp
/**
 * @return a pixel format descriptor for provided pixel format or NULL if
 * this pixel format is unknown.
 */
const AVPixFmtDescriptor *av_pix_fmt_desc_get(enum AVPixelFormat pix_fmt);
```

通过AVPixFmtDescriptor结构体可以获得不同像素格式的一些信息。例如下文中用到了av_get_bits_per_pixel()，通过该函数可以获得指定像素格式每个像素占用的比特数（Bit Per Pixel）。

```cpp
/**
 * Return the number of bits per pixel used by the pixel format
 * described by pixdesc. Note that this is not the same as the number
 * of bits per sample.
 *
 * The returned number of bits refers to the number of bits actually
 * used for storing the pixel information, that is padding bits are
 * not counted.
 */
int av_get_bits_per_pixel(const AVPixFmtDescriptor *pixdesc);
```

其他的API在这里不做过多记录。

## 图像拉伸

FFmpeg支持多种像素拉伸的方式。这些方式的定义位于libswscale\swscale.h中，如下所示。

```cpp
#define SWS_FAST_BILINEAR     1
#define SWS_BILINEAR          2
#define SWS_BICUBIC           4
#define SWS_X                 8
#define SWS_POINT          0x10
#define SWS_AREA           0x20
#define SWS_BICUBLIN       0x40
#define SWS_GAUSS          0x80
#define SWS_SINC          0x100
#define SWS_LANCZOS       0x200
#define SWS_SPLINE        0x400
```

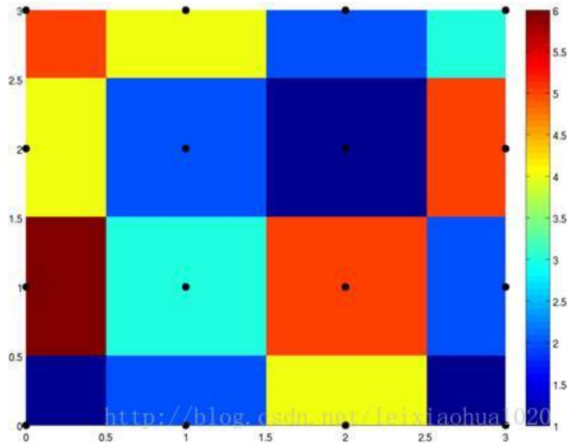
其中SWS_BICUBIC性能比较好；SWS_FAST_BILINEAR在性能和速度之间有一个比好好的平衡，
而SWS_POINT的效果比较差。
有关这些方法的评测可以参考文章：

《ffmpeg中的sws_scale算法性能测试》

简单解释一下SWS_BICUBIC、SWS_BILINEAR和SWS_POINT的原理。

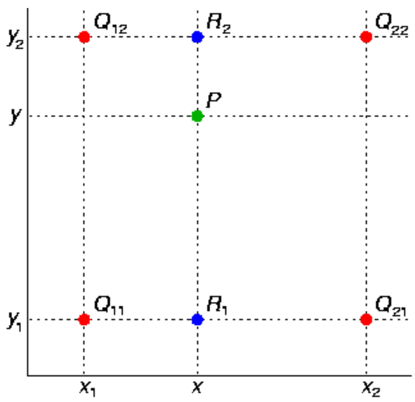
### SWS_POINT（Nearest-neighbor interpolation， 邻域插值）

领域插值可以简单说成“1个点确定插值的点”。例如当图像放大后，新的样点根据距离它最近的样点的值取得自己的值。换句话说就是简单拷贝附近距离它最近的样点的值。领域插值是一种最基础的插值方法，速度最快，插值效果最不好，一般情况下不推荐使用。一般情况下使用邻域插值之后，画面会产生很多的“锯齿”。下图显示了4x4=16个彩色样点经过邻域插值后形成的图形。




### SWS_BILINEAR（Bilinear interpolation， 双线性插值）

双线性插值可以简单说成“4个点确定插值的点”。它的计算过程可以简单用下图表示。图中绿色的P点是需要插值的点。首先通过Q11，Q21求得R1；Q12，Q22求得R2。然后根据R1，R2求得P。



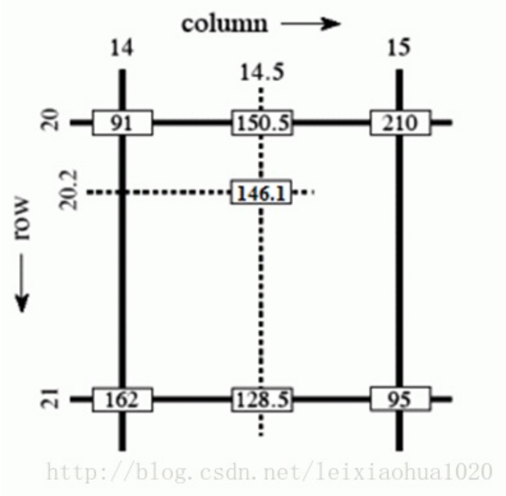

其中求值的过程是一个简单的加权计算的过程。
设定Q11 = (x1, y1)，Q12 = (x1, y2)，Q21 = (x2, y1)，Q22 = (x2, y2)则各点的计算公式如下。

$$f(R_1) \approx \frac{x_2 - x}{x_2 - x_1} f(Q_{11}) + \frac{x - x_1}{x_2 - x_1} f(Q_{21})$$

$$f(R_2) \approx \frac{x_2 - x}{x_2 - x_1} f(Q_{12}) + \frac{x - x_1}{x_2 - x_1} f(Q_{22})$$

$$f(P) \approx \frac{y_2 - y}{y_2 - y_1} f(R_1) + \frac{y - y_1}{y_2 - y_1} f(R_2).$$

可以看出距离插值的点近一些的样点权值会大一些，远一些的样点权值要小一些。
下面看一个维基百科上的双线性插值的实例。该例子根据坐标为(20, 14)， (20, 15)， (21, 14)，(21, 15)的4个样点计算坐标为（20.2, 14.5）的插值点的值。




$$\begin{aligned} I_{20,14.5} &= \tfrac{15-14.5}{15-14} \cdot 91 &+ \tfrac{14.5-14}{15-14} \cdot 210 &= 150.5 \\ I_{21,14.5} &= \tfrac{15-14.5}{15-14} \cdot 162 &+ \tfrac{14.5-14}{15-14} \cdot 95 &= 128.5 \end{aligned}$$

$$I_{20.2,14.5} = \tfrac{21-20.2}{21-20} \cdot 150.5 + \tfrac{20.2-20}{21-20} \cdot 128.5 = 146.1$$

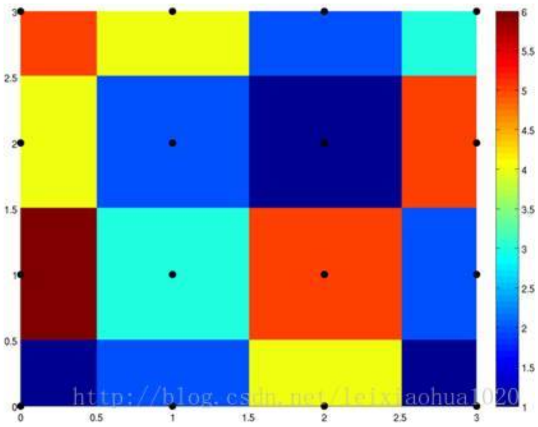
### SWS_BICUBIC（Bicubic interpolation， 双三次插值）

双三次插值可以简单说成“16个点确定插值的点”。该插值算法比前两种算法复杂很多，插值后图像的质量也是最好的。有关它的插值方式比较复杂不再做过多记录。它的差值方法可以简单表述为下述公式。

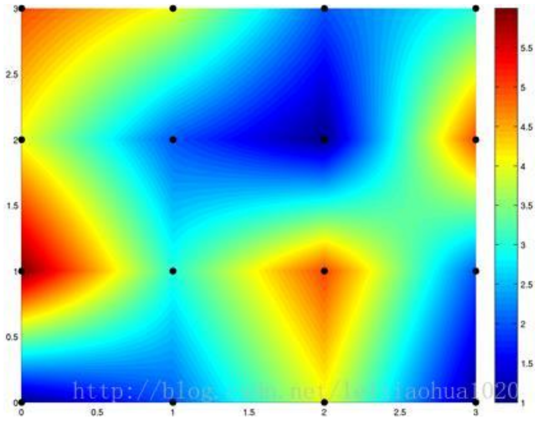
$$\sum_{i=0}^{3} \sum_{j=0}^{3} a_{ij} x^i y^j$$

其中aij的过程依赖于插值数据的特性。

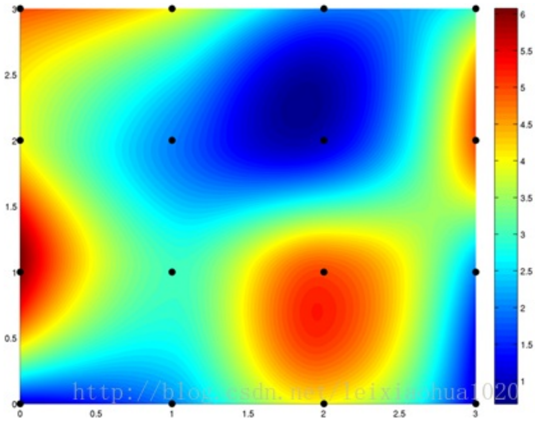
维基百科上使用同样的样点进行邻域插值，双线性插值，双三次插值对比如下图所示。




Nearest-neighbor interpolation，邻域插值



Bilinear interpolation，双线性插值



Bicubic interpolation，双三次插值

## YUV像素取值范围

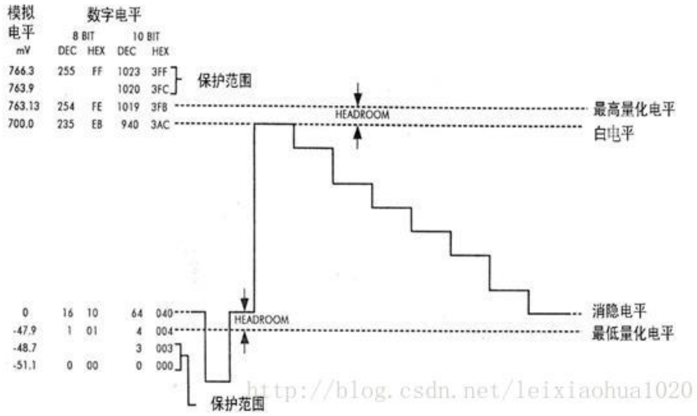
FFmpeg中可以通过使用av_opt_set()设置“src_range”和“dst_range”来设置输入和输出的YUV的取值范围。如果“dst_range”字段设置为“1”的话，则代表输出的YUV的取值范围遵循“jpeg”标准；如果“dst_range”字段设置为“0”的话，则代表输出的YUV的取值范围遵循“mpeg”标准。下面记录一下YUV的取值范围的概念。

与RGB每个像素点的每个分量取值范围为0-255不同（每个分量占8bit），YUV取值范围有两种：

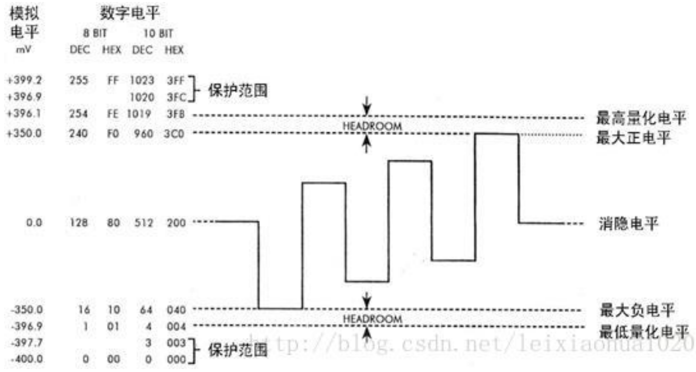
（1）　以Rec.601为代表（还包括BT.709 / BT.2020）的广播电视标准中，Y的取值范围是16-235，U、V的取值范围是16-240。FFmpeg中称之为“mpeg”范围。
（2）　以JPEG为代表的标准中，Y、U、V的取值范围都是0-255。FFmpeg中称之为“jpeg” 范围。

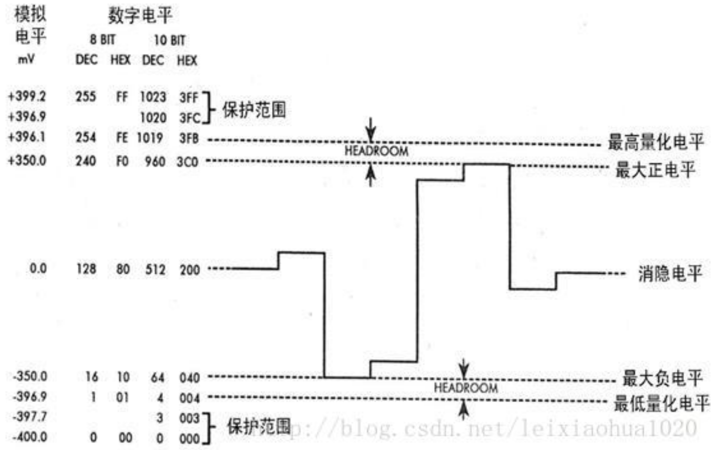
实际中最常见的是第1种取值范围的YUV（可以自己观察一下YUV的数据，会发现其中亮度分量没有取值为0、255这样的数值）。很多人在这个地方会有疑惑，为什么会去掉“两边”的取值呢？

在广播电视系统中不传输很低和很高的数值，实际上是为了防止信号变动造成过载，因而把这“两边”的数值作为“保护带”。下面这张图是数字电视中亮度信号量化后的电平分配图。从图中可以看出，对于8bit量化来说，信号的白电平为235，对应模拟电平为700mV；黑电平为16，对应模拟电平为0mV。信号上方的“保护带”取值范围是236至254，而信号下方的“保护带”取值范围是1-15。最边缘的0和255两个电平是保护电平，是不允许出现在数据流中的。与之类似，10bit量化的时候，白电平是235*4=940，黑电平是16*4=64。




下面两张图是数字电视中色度信号量化后的电平分配图。可以看出，色度最大正电平为240，对应模拟电平为+350mV；色度最大负电平为16，对应模拟电平为-350mV。需要注意的是，色度信号数字电平128对应的模拟电平是0mV。




## 色域

Libswscale支持色域的转换。有关色域的转换我目前还没有做太多的研究，仅记录一下目前最常见的三个标准中的色域：BT.601，BT.709，BT.2020。这三个标准中的色域逐渐增大。

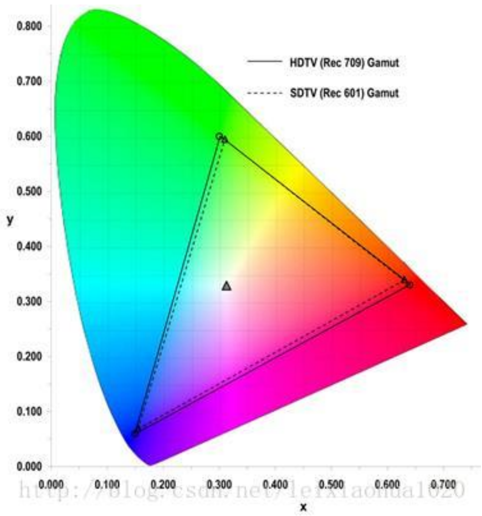
在这里先简单解释一下CIE 1931颜色空间。这个空间围绕的区域像一个“舌头”，其中包含了自然界所有的颜色。CIE 1931颜色空间中的横坐标是x，纵坐标是y，x、y、z满足如下关系：

$$x + y + z = 1$$

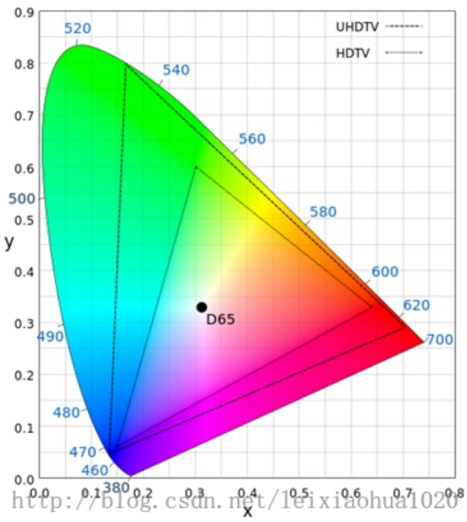
“舌头”的边缘叫做“舌形曲线”，代表着饱和度为100%的光谱色。“舌头”的中心点（1/3，1/3）对应着白色，饱和度为0。

受显示器件性能的限制，电视屏幕是无法重现所有的颜色的，尤其是位于“舌形曲线”上的100% 饱和度的光谱色一般情况下是无法显示出来的。因此电视屏幕只能根据其具体的荧光粉的配方，有选择性的显示一部分的颜色，这部分可以显示的颜色称为色域。下文分别比较标清电视、高清电视和超高清电视标准中规定的色域。可以看出随着技术的进步，色域的范围正变得越来越大。

**标清电视（SDTV）色域的规定源自于BT.601。高清电视（HDTV）色域的规定源自于BT.709。** 他们两个标准中的色域在CIE 1931颜色空间中的对比如下图所示。从图中可以看出，BT.709和BT.601色域差别不大，BT.709的色域要略微大于BT.601。

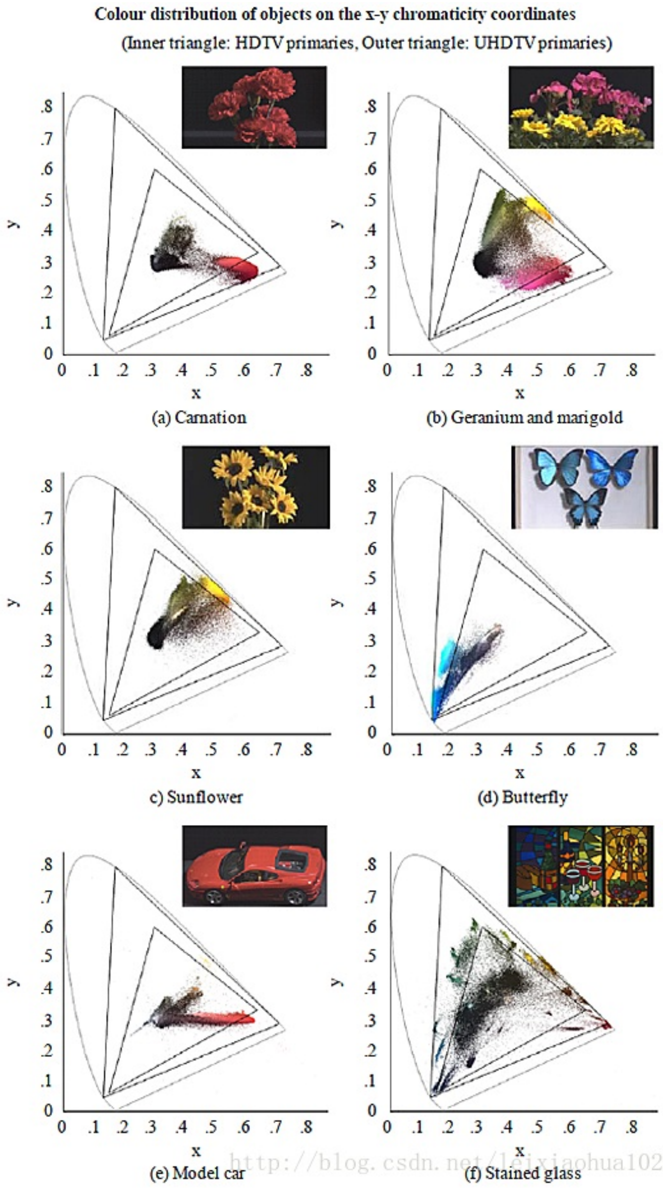



**超高清电视（UHDTV）色域的规定源自于BT.2020。** BT.2020和BT.709的色域在CIE 1931 颜色空间中的对比如下图所示。从图中可以看出，BT.2020的色域要远远大于BT.709。




从上面的对比也可以看出，对超高清电视（UHDTV）的显示器件的性能的要求更高了。这样超高清电视可以还原出一个更“真实”的世界。

下面这张图则使用实际的例子反映出色域范围大的重要性。图中的两个黑色三角形分别标识出了BT.709（小三角形）和BT.2020（大三角形）标准中的色域。从图中可以看出，如果使用色域较小的显示设备显示图片的话，将会损失掉很多的颜色。




## 源代码

本示例程序包含一个输入和一个输出，实现了从输入图像格式（YUV420P）到输出图像格式（RGB24）之间的转换；同时将输入视频的分辨率从480x272拉伸为1280x720。

[cpp]

```cpp
/**
 * 最简单的基于FFmpeg的Swscale示例
 * Simplest FFmpeg Swscale
 *
 * 雷霄骅 Lei Xiaohua
 * leixiaohua1020@126.com
 * 中国传媒大学/数字电视技术
 * Communication University of China / Digital TV Technology
 * http://blog.csdn.net/leixiaohua1020
 *
 * 本程序使用libswscale对像素数据进行缩放转换等处理。
 * 它中实现了YUV420P格式转换为RGB24格式，
 * 同时将分辨率从480x272拉伸为1280x720
 * 它是最简单的libswscale的教程。
 *
 * This software uses libswscale to scale / convert pixels.
 * It convert YUV420P format to RGB24 format,
 * and changes resolution from 480x272 to 1280x720.
 * It's the simplest tutorial about libswscale.
 */

#include <stdio.h>

#define __STDC_CONSTANT_MACROS

#ifdef _WIN32
//Windows
extern "C"
{
#include "libswscale/swscale.h"
#include "libavutil/opt.h"
#include "libavutil/imgutils.h"
};
#else
//Linux...
#ifdef __cplusplus
extern "C"
{
#endif
#include <libswscale/swscale.h>
#include <libavutil/opt.h>
#include <libavutil/imgutils.h>
#ifdef __cplusplus
};
#endif
#endif


int main(int argc, char* argv[])
{
    //Parameters
    FILE *src_file =fopen("sintel_480x272_yuv420p.yuv", "rb");
    const int src_w=480,src_h=272;
    AVPixelFormat src_pixfmt=AV_PIX_FMT_YUV420P;

    int src_bpp=av_get_bits_per_pixel(av_pix_fmt_desc_get(src_pixfmt));

    FILE *dst_file = fopen("sintel_1280x720_rgb24.rgb", "wb");
    const int dst_w=1280,dst_h=720;
    AVPixelFormat dst_pixfmt=AV_PIX_FMT_RGB24;
    int dst_bpp=av_get_bits_per_pixel(av_pix_fmt_desc_get(dst_pixfmt));

    //Structures
    uint8_t *src_data[4];
    int src_linesize[4];

    uint8_t *dst_data[4];
    int dst_linesize[4];

    int rescale_method=SWS_BICUBIC;
    struct SwsContext *img_convert_ctx;
    uint8_t *temp_buffer=(uint8_t *)malloc(src_w*src_h*src_bpp/8);

    int frame_idx=0;
    int ret=0;
    ret= av_image_alloc(src_data, src_linesize,src_w, src_h, src_pixfmt, 1);
    if (ret< 0) {
        printf( "Could not allocate source image\n");
        return -1;
    }
    ret = av_image_alloc(dst_data, dst_linesize,dst_w, dst_h, dst_pixfmt, 1);
    if (ret< 0) {
        printf( "Could not allocate destination image\n");
        return -1;
    }
    //-----------------------------
    //Init Method 1
    img_convert_ctx =sws_alloc_context();
    //Show AVOption
    av_opt_show2(img_convert_ctx,stdout,AV_OPT_FLAG_VIDEO_PARAM,0);
```

```
    av_opt_show2(img_convert_ctx,stdout,AV_OPT_FLAG_VIDEO_PARAM,0);
    //Set Value
    av_opt_set_int(img_convert_ctx,"sws_flags",SWS_BICUBIC|SWS_PRINT_INFO,0);
    av_opt_set_int(img_convert_ctx,"srcw",src_w,0);
    av_opt_set_int(img_convert_ctx,"srch",src_h,0);
    av_opt_set_int(img_convert_ctx,"src_format",src_pixfmt,0);
    //'0' for MPEG (Y:0-235);'1' for JPEG (Y:0-255)
    av_opt_set_int(img_convert_ctx,"src_range",1,0);
    av_opt_set_int(img_convert_ctx,"dstw",dst_w,0);
    av_opt_set_int(img_convert_ctx,"dsth",dst_h,0);
    av_opt_set_int(img_convert_ctx,"dst_format",dst_pixfmt,0);
    av_opt_set_int(img_convert_ctx,"dst_range",1,0);
    sws_init_context(img_convert_ctx,NULL,NULL);

    //Init Method 2
    //img_convert_ctx = sws_getContext(src_w, src_h,src_pixfmt, dst_w, dst_h, dst_pixfmt,
    //  rescale_method, NULL, NULL, NULL);
    //-----------------------------
    /*
    //Colorspace
    ret=sws_setColorspaceDetails(img_convert_ctx,sws_getCoefficients(SWS_CS_ITU601),0,
        sws_getCoefficients(SWS_CS_ITU709),0,
         0, 1 << 16, 1 << 16);
    if (ret==-1) {
        printf( "Colorspace not support.\n");
        return -1;
    }
    */
    while(1)
    {
        if (fread(temp_buffer, 1, src_w*src_h*src_bpp/8, src_file) != src_w*src_h*src_bpp/8){
            break;
        }

        switch(src_pixfmt){
        case AV_PIX_FMT_GRAY8:{
            memcpy(src_data[0],temp_buffer,src_w*src_h);
            break;
                              }
        case AV_PIX_FMT_YUV420P:{
            memcpy(src_data[0],temp_buffer,src_w*src_h);                    //Y
            memcpy(src_data[1],temp_buffer+src_w*src_h,src_w*src_h/4);      //U
            memcpy(src_data[2],temp_buffer+src_w*src_h*5/4,src_w*src_h/4);  //V
            break;
                                }
        case AV_PIX_FMT_YUV422P:{
            memcpy(src_data[0],temp_buffer,src_w*src_h);                    //Y
            memcpy(src_data[1],temp_buffer+src_w*src_h,src_w*src_h/2);      //U
            memcpy(src_data[2],temp_buffer+src_w*src_h*3/2,src_w*src_h/2);  //V
            break;
                                }
        case AV_PIX_FMT_YUV444P:{
            memcpy(src_data[0],temp_buffer,src_w*src_h);                    //Y
            memcpy(src_data[1],temp_buffer+src_w*src_h,src_w*src_h);        //U
            memcpy(src_data[2],temp_buffer+src_w*src_h*2,src_w*src_h);      //V
            break;
                                }
        case AV_PIX_FMT_YUYV422:{
            memcpy(src_data[0],temp_buffer,src_w*src_h*2);                  //Packed
            break;
                                }
        case AV_PIX_FMT_RGB24:{
            memcpy(src_data[0],temp_buffer,src_w*src_h*3);                  //Packed
            break;
                                }
        default:{
            printf("Not Support Input Pixel Format.\n");
            break;
                              }
        }

        sws_scale(img_convert_ctx, src_data, src_linesize, 0, src_h, dst_data, dst_linesize);
        printf("Finish process frame %5d\n",frame_idx);
        frame_idx++;

        switch(dst_pixfmt){
        case AV_PIX_FMT_GRAY8:{
            fwrite(dst_data[0],1,dst_w*dst_h,dst_file);
            break;
                              }
        case AV_PIX_FMT_YUV420P:{
            fwrite(dst_data[0],1,dst_w*dst_h,dst_file);                 //Y
            fwrite(dst_data[1],1,dst_w*dst_h/4,dst_file);               //U
            fwrite(dst_data[2],1,dst_w*dst_h/4,dst_file);               //V
            break;
                                }
        case AV_PIX_FMT_YUV422P:{
            fwrite(dst_data[0],1,dst_w*dst_h,dst_file);                 //Y
            fwrite(dst_data[1],1,dst_w*dst_h/2,dst_file);               //U
            fwrite(dst_data[2],1,dst_w*dst_h/2,dst_file);               //V
            break;
                                }
```

```
        case AV_PIX_FMT_YUV444P:{
            fwrite(dst_data[0],1,dst_w*dst_h,dst_file);                 //Y
            fwrite(dst_data[1],1,dst_w*dst_h,dst_file);                 //U
            fwrite(dst_data[2],1,dst_w*dst_h,dst_file);                 //V
            break;
                                }
        case AV_PIX_FMT_YUYV422:{
            fwrite(dst_data[0],1,dst_w*dst_h*2,dst_file);               //Packed
            break;
                                }
        case AV_PIX_FMT_RGB24:{
            fwrite(dst_data[0],1,dst_w*dst_h*3,dst_file);               //Packed
            break;
                              }
        default:{
            printf("Not Support Output Pixel Format.\n");
            break;
                            }
        }
    }

    sws_freeContext(img_convert_ctx);

    free(temp_buffer);
    fclose(dst_file);
    av_freep(&src_data[0]);
    av_freep(&dst_data[0]);

    return 0;
}
```

## 运行结果

程序的输入为一个名称为“sintel_480x272_yuv420p.yuv”的视频。该视频像素格式是YUV420P，分辨率为480x272。


程序的输出为一个名称为“sintel_1280x720_rgb24.rgb”的视频。该视频像素格式是RGB24，分辨率为1280x720。


## 下载

**Simplest FFmpeg Swscale**

**项目主页**

SourceForge： https://sourceforge.net/projects/simplestffmpegswscale/

Github： https://github.com/leixiaohua1020/simplest_ffmpeg_swscale

开源中国： http://git.oschina.net/leixiaohua1020/simplest_ffmpeg_swscale

CDSN下载地址： http://download.csdn.net/detail/leixiaohua1020/8292175

本教程是最简单的基于FFmpeg的libswscale进行像素处理的教程。它包含了两个工程：
simplest_ffmpeg_swscale: 最简单的libswscale的教程。
simplest_pic_gen: 生成各种测试图片的工具。

**更新-1.1 (2015.2.13)=========================================**

这次考虑到了跨平台的要求，调整了源代码。经过这次调整之后，源代码可以在以下平台编译通过：

*VC++：打开sln文件即可编译，无需配置。*

*cl.exe：打开compile_cl.bat即可命令行下使用cl.exe进行编译，注意可能需要按照VC的安装路径调整脚本里面的参数。编译命令如下。*

[plain]

```
::VS2010 Environment
call "D:\Program Files\Microsoft Visual Studio 10.0\VC\vcvarsall.bat"
::include
@set INCLUDE=include;%INCLUDE%
::lib
@set LIB=lib;%LIB%
::compile and link
cl simplest_ffmpeg_swscale.cpp /link swscale.lib avutil.lib /OPT:NOREF
```

*MinGW：MinGW命令行下运行compile_mingw.sh即可使用MinGW的g++进行编译。编译命令如下。*

[plain]

```
g++ simplest_ffmpeg_swscale.cpp -g -o simplest_ffmpeg_swscale.exe \
-I /usr/local/include -L /usr/local/lib -lswscale -lavutil
```

*GCC：Linux或者MacOS命令行下运行compile_gcc.sh即可使用GCC进行编译。编译命令如下。*

[plain]

```
gcc simplest_ffmpeg_swscale.cpp -g -o simplest_ffmpeg_swscale.out  -I /usr/local/include -L /usr/local/lib \
-lswscale -lavutil
```

PS：相关的编译命令已经保存到了工程文件夹中

CSDN下载地址： http://download.csdn.net/detail/leixiaohua1020/8445671

SourceForge上已经更新。



文章标签： libswscale 拉伸 yuv ffmpeg 色域

个人分类： FFMPEG 我的开源项目

所属专栏： FFmpeg