25/09/2012 - Lab experience n.1

1 Color space conversion

Read an image from a **.tiff** or **.bmp** file using command **imread** and then display separately the components R, G and B. Convert your image in YCbCr 4:4:4 format using the equations below and then separately display those components (to display only one of these components, set the other ones to their average value and then convert back the image to RGB)

$$\begin{pmatrix} Y \\ C_b \\ C_r \end{pmatrix} = \begin{pmatrix} 0.299 & 0.587 & 0.114 \\ -0.169 & -0.331 & 0.500 \\ 0.500 & -0.419 & -0.081 \end{pmatrix} \begin{pmatrix} R \\ G \\ B \end{pmatrix} + \begin{pmatrix} 0 \\ 128 \\ 128 \end{pmatrix}$$
$$\begin{pmatrix} R \\ G \\ B \end{pmatrix} = \begin{pmatrix} 1.000 & 0 & 1.4025 \\ 1.000 & -0.344 & -0.7142 \\ 1.000 & 1.773 & 0 \end{pmatrix} \begin{pmatrix} Y \\ C_b - 128 \\ C_r - 128 \end{pmatrix} \quad (1)$$

2 Subsampling of the chrominance components

Convert your image to format 4:2:2: and to 4:2:0 by subsampling the chrominance components (consider possible low pass filtering before subsampling). Write the resulting data to a binary **.yuv** file with **fwrite** and display them by appropriately interpolating the missing chrominance values and converting back to RGB.

3 Video formats

- Load the first 40 frames of a video sequence in YUV 4:2:0 CIF format (352×288) at 30 frames per second (fps). Extract the luminance component Y and write it to a **.y** file
- Low pass filter the Y component of the first frame with a mean filter of size 3×3, display the resulting filtered image and the difference with respect to the original (residual image).
- Convert your CIF sequence at 30 fps to a QCIF (176×144) 15 fps format, by subsampling all the components after a low pass filtering as described above