**SGN-12007 Introduction to Image and Video Processing**

**EXERCISE 11**

**04.12.2017-05.12.2017**

The tasks should be completed and presented to TA during the lab session. Questions about exercises should be addressed to the TA personally or via email: (firstname.surname@tut.fi).

## 1) YUV to RGB transformation

```
YuvToRgb = [1  0        1.402  ;
            1 -0.34413 -0.71414;
            1  1.772    0     ];
```

a) Load the file yuvdata.mat to the MATLAB workspace. Note the sizes of the variables and compare them to the given dimensions of the image (`rows*cols`). Is there a difference? Why/why not?
b) Reshape the components `yy`, `uu` and `vv` to the given image size (`reshape`), upsampling as necessary (`imresize`). Display the components in a 1x3 subplot to verify the result.
c) Center the `U` and `V` components around zero by subtracting 127 (note the data type).
d) Flatten and concatenate the components for conversion to RGB: `YUV=cat(2,Y(:),U(:),V(:))`.
e) Perform the transformation from YUV to RGB with the matrix given above: `RGB=YuvToRgb*YUV'`.
f) Reshape each component back to the image size and produce the RGB image. Show the result via `imshow`.

## 2) Chrominance subsampling

a) Load the RGB image *lena.tiff* and convert it to YCbCr colorspace (use built-in function `rgb2ycbcr`). Display `Y`, `Cb` and `Cr` in a 1x3 subplot.
b) Perform subsampling of the chrominance components, following each of the formats described in the lecture material: 4:2:2, 4:1:1, 4:2:0. Separately also perform subsampling on the luminance component, following the format 4:2:0. (Hint: you can use MATLAB indexing with a given step size to avoid for-loops.)
c) Upsample the same components back to the original resolution (`imresize`), recombine them and convert the images back to RGB (`ycbcr2rgb`). Show the five RGB images (the original and 4 subsampled ones) together on a subplot. Is there a perceptible difference?
d) Calculate the mean squared error values of the subsampled images with respect to the original (`immse`). Does the result support you previous conclusion?