

IPCV 2006 - Budapest  
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Practical Session on “Color Space transformations”

**Introduction**

In this session you will use the ColorSpace software (a freeware that you can download at <http://www.couleur.org>). Use the given instructions and answer to the question asked, in, case of problem see the notice of use of the ColoSpace software.

**Exercise : analysis of the color distribution of an image**

**Question 1.** For each image of Figure 1 among the following color spaces (RGB, L\*a\*b\*, HSV polar, YCbCr or I1I2I3) which is the most relevant to discriminate color clusters ? (click on *Color* ↗ *Color Space* (select a color space) ↗ *3D Visualization* ↗ *3D Color Space* ↗ *Visualization* ↗ *Get Image From Viewer*).

As example:

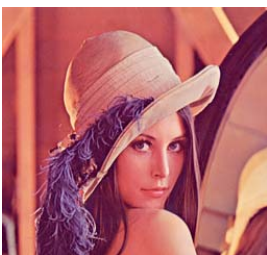
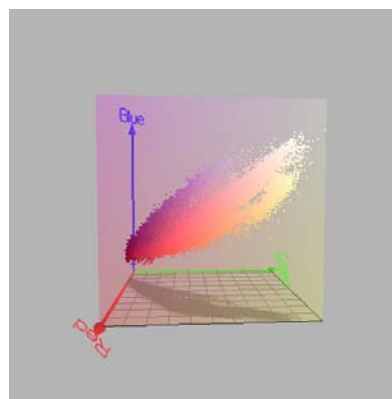
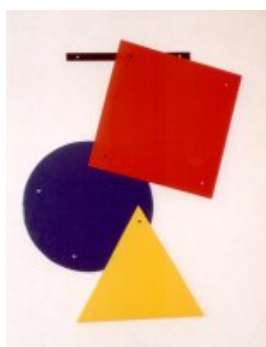


Image Lenna

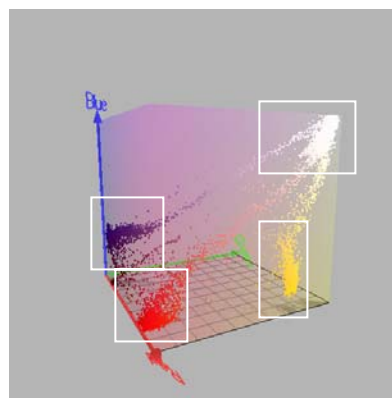
=>



projection in RGB

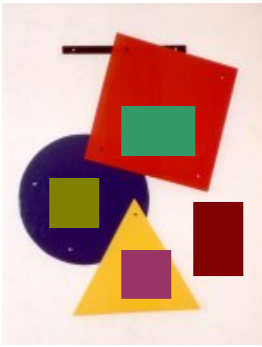


Kandinski's Color Shapes

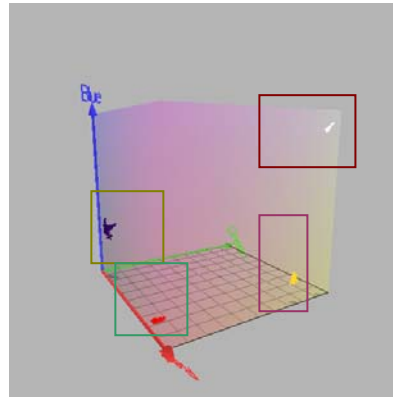


projection (of image) in RGB

Note that for this image there is four color clusters, each one corresponding to a color region in the original image. By doing a selection in the original image we obtain the following result (click on *Color* ↗ *Selection* ↗ *Rectangle* (do a selection manually in the image) ↗ *Selection Index* (select another color in the color palette, e.g. the green color) ) ↗ repeat ( ↗ *Rectangle* ↗ *selection Index*) until necessary ↗ *Color Space* ↗ *3D Visualization* ↗ *3D Color Space* ↗ *Visualization* ↗ *Get Selection From Viewer*):



Kandinski's Color Shapes



projection (of color selections) in RGB

**Question 2.** For each image of Figure 1: is there one or several color directions in the  $L^*a^*b^*$  color space more discriminating than other ones? (click on [Color](#)  $\&$  [Color Space](#) (select  $L^*a^*b^*$ )  $\&$  [3D Visualization](#)  $\&$  [3D Color Space](#)  $\&$  [Visualization](#)  $\&$  [Display PCA](#)). Note that the Principal Component Analysis (PCA) enables to find the main direction(s) of a cluster when this cluster is homogeneous

As example:

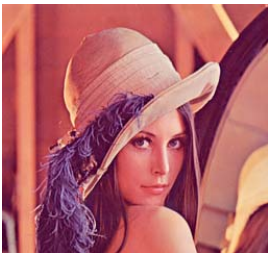
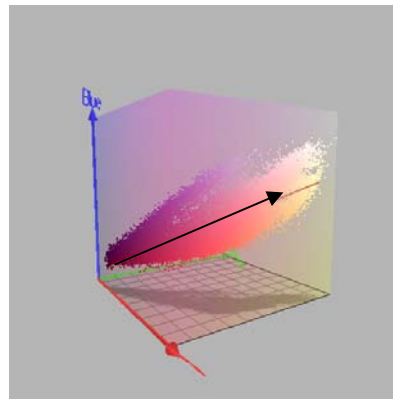


Image Lenna

=>

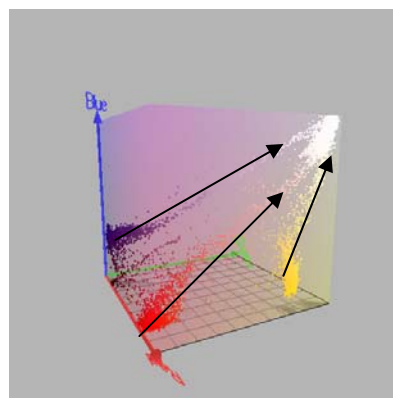


projection in RGB

Note that for this image there is only one direction. The power of discrimination (i.e. the inertia) of each axis is given by clicking on [Informations](#)  $\&$  [Color Information](#)



Kandinski's Color Shapes



projection (of image) in RGB

Note that for this image there is three directions, each one is oriented in the direction of the color of the background. Note that the Principal Component Analysis (PCA) can be used to find the main direction of each cluster (i.e. each selection) provided each selection was correctly done.

**Question 3.** For each image of Figure 1: is it possible to analysis the image studied as a 1-dimensional color image? (if the % of Inertia of the first component is upper than 90% yes) or as a 2-dimensional image ? (if the % of Inertia of the two first components is upper than 90% yes).

As example:

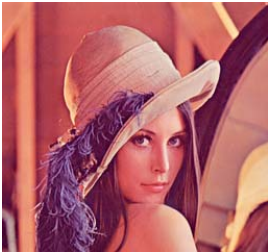
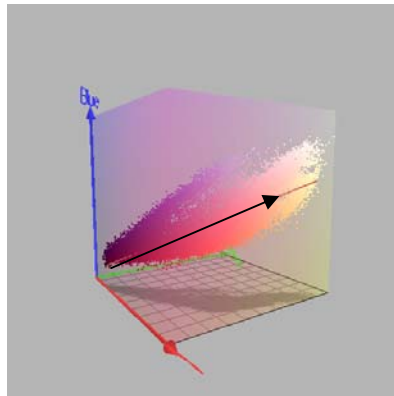


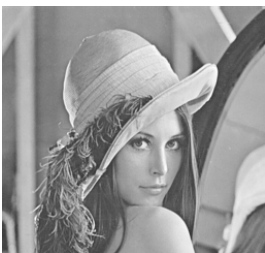
Image Lenna

=>



Inertia of the first component (computed in  $L^*a^*b^*$ ) = 90,19%

Note that this image can be seen as a “grey-level” image. The first component can be approximated by the first axis of I1I2I3 color space. Note that the I1 component is quite equivalent to the luminance component.



Lenna projected onto the I1 component.(click on Color ↗ Color Space (select I1I2I3) ↗ 2D Visualization ↗ 3D Color Space ↗ Image Visualization channel 0 (i.e. I1).



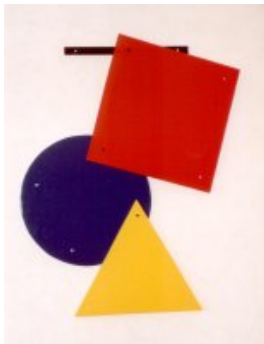
Lenna projected onto the  $L^*$  component.(click on Color ↗ Color Space (select  $L^*a^*b^*$ ) ↗ 2D Visualization ↗ 3D Color Space ↗ Image Visualization channel 0 (i.e.  $L^*$ ).

Note that all details that we can see on the  $L^*$  (grey-level) component are identical than those of the original (color) image. Consequently the Image Lenna can be segmented indifferently either from the  $L^*$  component or from the  $L^*a^*b^*$  components.

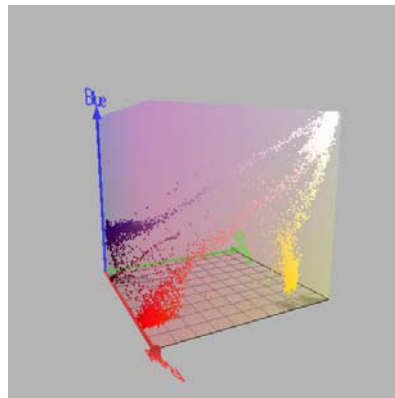
**Question 4.** For each image of Figure 1: (a) how many clusters can we define? (b) is there as many clusters as regions in the original image ? (c) can we segment directly each image in clustering its color space associated ?

In order to improve the quality of our results, we can quantize the image (i.e. we can subtract to the color space representation the colors of lower occurrence’s frequency). (click on Color ↗ Color Space ↗ 3D Visualization ↗ 3D Color Histogram ↗ Visualisation ↗ Get image from viewer ↗ Colors properties (adjust the Offset and the Scale) ).

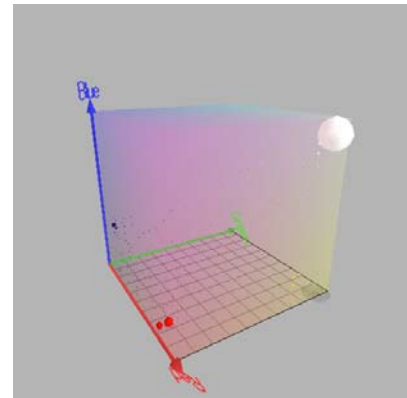
As example :



Kandinski's Color Shapes



3D color space projection (RGB)



3D histogram projection (RGB)  
with Scale = 55 and Offset = 0.3

Note that this tool avoids us to use the *selection* tools previously used.

**Question 5.** For each image of Figure 1 quantize the image from its 3D color histogram, next answer to the following questions. (a) How many clusters can we define? (b) is there as many clusters as regions in the original image ? (c) can we segment directly each image in clustering its color space associated ?

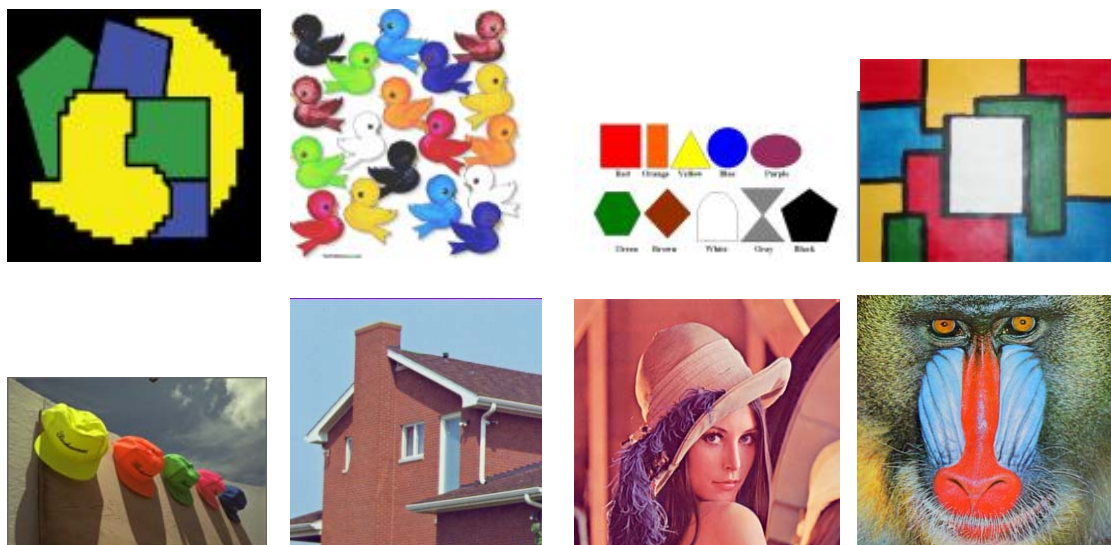


Figure 1 : Images (a) graphic, (b) birds, (c) shapes, (d) painting, (e) hats, (f) house, (g) lenna et (h).mandrill. Click on *Visualisation* *Zoom* to enhance the size of the studied image in order to better observe its quality.

Name of students :

Answers:

Images	Question 1	Question 2	Question 3	Question 4	Question 5
graphic	<input type="checkbox"/> RGB <input type="checkbox"/> L*a*b* <input type="checkbox"/> HSV polar <input type="checkbox"/> YCbCr <input type="checkbox"/> I1I2I3	<input type="checkbox"/> 1-D <input type="checkbox"/> 2-D <input type="checkbox"/> 3-D <input type="checkbox"/> 4-D <input type="checkbox"/> more	<input type="checkbox"/> 1-D <input type="checkbox"/> 2-D <input type="checkbox"/> 3-D	(a) ___ clusters (b) <input type="checkbox"/> Nb clusters = Nb regions <input type="checkbox"/> Nb clusters ≠ Nb regions (c) <input type="checkbox"/> clustering => segmentation <input type="checkbox"/> clustering ≠> segmentation	(a) ___ clusters (b) <input type="checkbox"/> Nb clusters = Nb regions <input type="checkbox"/> Nb clusters ≠ Nb regions (c) <input type="checkbox"/> clustering => segmentation <input type="checkbox"/> clustering ≠> segmentation
birds	<input type="checkbox"/> RGB <input type="checkbox"/> L*a*b* <input type="checkbox"/> HSV polar <input type="checkbox"/> YCbCr <input type="checkbox"/> I1I2I3	<input type="checkbox"/> 1-D <input type="checkbox"/> 2-D <input type="checkbox"/> 3-D <input type="checkbox"/> 4-D <input type="checkbox"/> more	<input type="checkbox"/> 1-D <input type="checkbox"/> 2-D <input type="checkbox"/> 3-D	(a) ___ clusters (b) <input type="checkbox"/> Nb clusters = Nb regions <input type="checkbox"/> Nb clusters ≠ Nb regions (c) <input type="checkbox"/> clustering => segmentation <input type="checkbox"/> clustering ≠> segmentation	(a) ___ clusters (b) <input type="checkbox"/> Nb clusters = Nb regions <input type="checkbox"/> Nb clusters ≠ Nb regions (c) <input type="checkbox"/> clustering => segmentation <input type="checkbox"/> clustering ≠> segmentation
shapes	<input type="checkbox"/> RGB <input type="checkbox"/> L*a*b* <input type="checkbox"/> HSV polar <input type="checkbox"/> YCbCr <input type="checkbox"/> I1I2I3	<input type="checkbox"/> 1-D <input type="checkbox"/> 2-D <input type="checkbox"/> 3-D <input type="checkbox"/> 4-D <input type="checkbox"/> more	<input type="checkbox"/> 1-D <input type="checkbox"/> 2-D <input type="checkbox"/> 3-D	(a) ___ clusters (b) <input type="checkbox"/> Nb clusters = Nb regions <input type="checkbox"/> Nb clusters ≠ Nb regions (c) <input type="checkbox"/> clustering => segmentation <input type="checkbox"/> clustering ≠> segmentation	(a) ___ clusters (b) <input type="checkbox"/> Nb clusters = Nb regions <input type="checkbox"/> Nb clusters ≠ Nb regions (c) <input type="checkbox"/> clustering => segmentation <input type="checkbox"/> clustering ≠> segmentation
painting	<input type="checkbox"/> RGB <input type="checkbox"/> L*a*b* <input type="checkbox"/> HSV polar <input type="checkbox"/> YCbCr <input type="checkbox"/> I1I2I3	<input type="checkbox"/> 1-D <input type="checkbox"/> 2-D <input type="checkbox"/> 3-D <input type="checkbox"/> 4-D <input type="checkbox"/> more	<input type="checkbox"/> 1-D <input type="checkbox"/> 2-D <input type="checkbox"/> 3-D	(a) ___ clusters (b) <input type="checkbox"/> Nb clusters = Nb regions <input type="checkbox"/> Nb clusters ≠ Nb regions (c) <input type="checkbox"/> clustering => segmentation <input type="checkbox"/> clustering ≠> segmentation	(a) ___ clusters (b) <input type="checkbox"/> Nb clusters = Nb regions <input type="checkbox"/> Nb clusters ≠ Nb regions (c) <input type="checkbox"/> clustering => segmentation <input type="checkbox"/> clustering ≠> segmentation
hats	<input type="checkbox"/> RGB <input type="checkbox"/> L*a*b* <input type="checkbox"/> HSV polar <input type="checkbox"/> YCbCr <input type="checkbox"/> I1I2I3	<input type="checkbox"/> 1-D <input type="checkbox"/> 2-D <input type="checkbox"/> 3-D <input type="checkbox"/> 4-D <input type="checkbox"/> more	<input type="checkbox"/> 1-D <input type="checkbox"/> 2-D <input type="checkbox"/> 3-D	(a) ___ clusters (b) <input type="checkbox"/> Nb clusters = Nb regions <input type="checkbox"/> Nb clusters ≠ Nb regions (c) <input type="checkbox"/> clustering => segmentation <input type="checkbox"/> clustering ≠> segmentation	(a) ___ clusters (b) <input type="checkbox"/> Nb clusters = Nb regions <input type="checkbox"/> Nb clusters ≠ Nb regions (c) <input type="checkbox"/> clustering => segmentation <input type="checkbox"/> clustering ≠> segmentation
house	<input type="checkbox"/> RGB <input type="checkbox"/> L*a*b* <input type="checkbox"/> HSV polar <input type="checkbox"/> YCbCr <input type="checkbox"/> I1I2I3	<input type="checkbox"/> 1-D <input type="checkbox"/> 2-D <input type="checkbox"/> 3-D <input type="checkbox"/> 4-D <input type="checkbox"/> more	<input type="checkbox"/> 1-D <input type="checkbox"/> 2-D <input type="checkbox"/> 3-D	(a) ___ clusters (b) <input type="checkbox"/> Nb clusters = Nb regions <input type="checkbox"/> Nb clusters ≠ Nb regions (c) <input type="checkbox"/> clustering => segmentation <input type="checkbox"/> clustering ≠> segmentation	(a) ___ clusters (b) <input type="checkbox"/> Nb clusters = Nb regions <input type="checkbox"/> Nb clusters ≠ Nb regions (c) <input type="checkbox"/> clustering => segmentation <input type="checkbox"/> clustering ≠> segmentation
lenna	<input type="checkbox"/> RGB <input type="checkbox"/> L*a*b* <input type="checkbox"/> HSV polar <input type="checkbox"/> YCbCr <input type="checkbox"/> I1I2I3	<input type="checkbox"/> 1-D <input type="checkbox"/> 2-D <input type="checkbox"/> 3-D <input type="checkbox"/> 4-D <input type="checkbox"/> more	<input type="checkbox"/> 1-D <input type="checkbox"/> 2-D <input type="checkbox"/> 3-D	(a) ___ clusters (b) <input type="checkbox"/> Nb clusters = Nb regions <input type="checkbox"/> Nb clusters ≠ Nb regions (c) <input type="checkbox"/> clustering => segmentation <input type="checkbox"/> clustering ≠> segmentation	(a) ___ clusters (b) <input type="checkbox"/> Nb clusters = Nb regions <input type="checkbox"/> Nb clusters ≠ Nb regions (c) <input type="checkbox"/> clustering => segmentation <input type="checkbox"/> clustering ≠> segmentation
mandrill	<input type="checkbox"/> RGB <input type="checkbox"/> L*a*b* <input type="checkbox"/> HSV polar <input type="checkbox"/> YCbCr <input type="checkbox"/> I1I2I3	<input type="checkbox"/> 1-D <input type="checkbox"/> 2-D <input type="checkbox"/> 3-D <input type="checkbox"/> 4-D <input type="checkbox"/> more	<input type="checkbox"/> 1-D <input type="checkbox"/> 2-D <input type="checkbox"/> 3-D	(a) ___ clusters (b) <input type="checkbox"/> Nb clusters = Nb regions <input type="checkbox"/> Nb clusters ≠ Nb regions (c) <input type="checkbox"/> clustering => segmentation <input type="checkbox"/> clustering ≠> segmentation	(a) ___ clusters (b) <input type="checkbox"/> Nb clusters = Nb regions <input type="checkbox"/> Nb clusters ≠ Nb regions (c) <input type="checkbox"/> clustering => segmentation <input type="checkbox"/> clustering ≠> segmentation