Creative Computing II

Device-Independent Colour Spaces

Wednesday 27th October 2010

This lab sheet explores sRGB, the device-independent colour space used in most digital displays.

1. This part of the lab demonstrates the ability to calculate the colour specification corresponding to a mixture of two other colours in the sRGB colour space.

   (a) If you have not already done so, do part 2 of last week's labsheet. Generate a table of colour mixtures and (by trial and error) the closest RGB colour to the mixture.

   (b) The reason why the mixture is not the simple average of the two colour components is, as discussed in the lecture, that sRGB is not a linear colour space. To calculate the effect of mixing two sRGB colours, they need to be converted into a linear colour space (e.g. the CIE XYZ space), averaged in that space, and then the average converted back into sRGB. Implement this as follows:

   - Define a class to represent sRGB colours, and a class to represent XYZ colours; implement suitable constructors for the sRGB class.
   - Implement the conversion from sRGB to CIE XYZ, remembering that the conversion in the lecture assumes that the sRGB colour is represented on a scale from 0 to 1 (not 0-255). Test your conversion by converting sRGB white – you should end up with XYZ values of around 1 each.
   - Implement the reverse conversion, from CIE XYZ to sRGB. Check that you can round-trip colours (converting an sRGB colour to XYZ and back should give the same values that you started with).
   - Implement two-colour averaging on CIE XYZ colours, by simply averaging each of the components of the two colours.

   If stuck, you may wish to start by reading and modifying the worked answer for part 1 of last week's lab.

   (c) Using your sketch, compute the sRGB values for the mixtures of colours you did last week or in part 1a. Check that the values given by your sketch are fairly close to the ones you generated by trial and error.

2. This part of the lab plots sRGB colours on the CIE xy chromaticity diagram.

   (a) Building on top of your sketches for part 1 of this labsheet, define and implement a representation of CIE xyY colours, and a conversion from CIE XYZ to CIE xyY.

   (b) Using your conversions, convert a number of sRGB colours to CIE xyY, and plot a dot of the sRGB colour at the (x, y) location corresponding to the xyY coordinates. You could plot the colours either systematically, iterating through possible red/green/blue values, or randomly (one random colour selected and plotted per frame).

Further Reading:

- Wikipedia page on sRGB at `http://en.wikipedia.org/wiki/SRGB` and links therefrom.

- Agoston, G.A., *Color Theory and its Application in Art and Design*, Springer (1979)