Coding Exercise - Colour Uniformity

Background

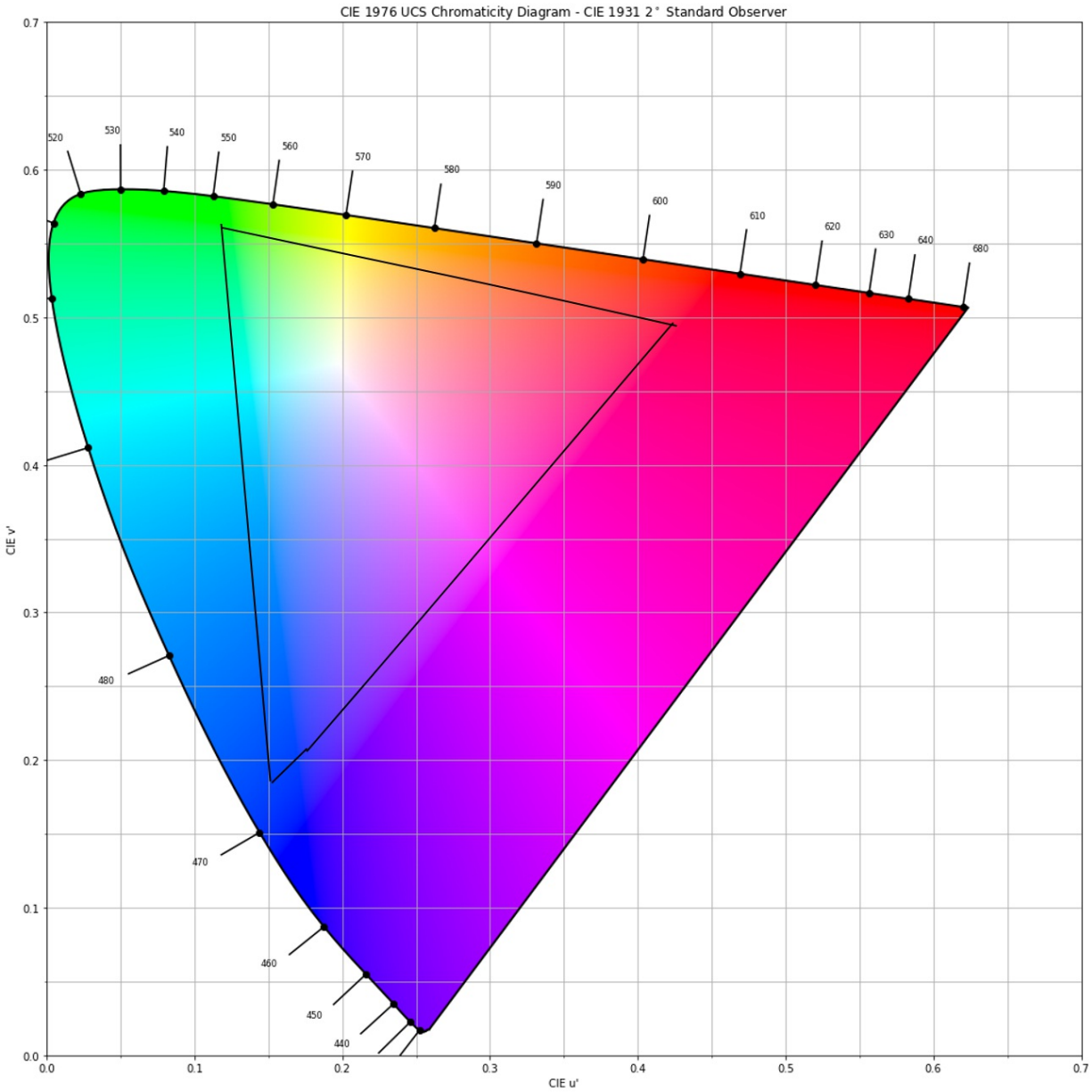
An important metric for display systems is Colour Uniformity. Broadly speaking, this is a measure of both (a) the ability of the display to produce desired colours, and (b) the "evenness" or variability in colour reproduction. Obviously there are many possible ways to measure these qualities.

Colour may be measured in a suitable colour coordinate space such as CIE 1976 Lu'v' (https://en.wikipedia.org/wiki/CIELUV). This is a 3-dimensional space, where one dimension is a measure of Luminance (brightness), and other other 2 dimensions describe Colour.

The diagram below shows the (u', v') colour space, which has the following properties:

1. The horseshoe-shaped locus represents monochromatic light across the visible spectrum.
2. The perceived colour of a mixture of 2 wavelengths lies on the straight line between the corresponding points on the locus
3. Equal distances between any 2 pairs of point represent approximately perceptually equal colour differences

Real-world displays usually use 3 primary colours, Red Green and Blue. These are usually a mixture of wavelengths, and so lie inside the locus. The range of colours the display can render (its gamut) is contained in the triangle formed by its 3 primaries. An example display gamut is shown on the diagram.



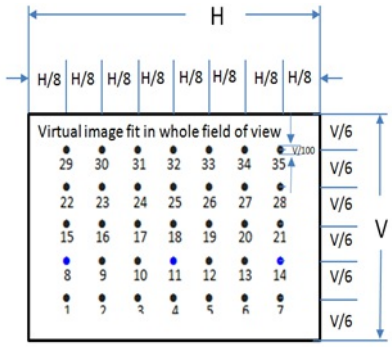
The Measurement

1. The display is set to a uniform colour (usually white)
2. The displayed image is captured using a scientific camera

3. The pixels of the captured image are transformed into the desired colour space (Lu'v')
4. Samples are taken at a number of points in the image, on a grid. At each grid point, a pair of colour coordinates is calculated, by averaging the (u', v') coordinates of pixels contained in a circle of diameter V/100 (where V is the vertical field of view of the image).
5. The colour difference between any pair of points (m,n) may be calculated as the Cartesian distance between them:

△u'v'[m,n] = sqrt(〈u[m]-u[n]〉2+〈v[m]-v[n]^2), where m, n range from 1..35

1. Two metrics are calculated from the 35 pairs of colour coordinates: A: max colour difference between any 2 points B: max colour difference between any 2 horizontally or vertically adjacent points



The exercise

Two displays SAMPLE1 and SAMPLE2 have been measured. Each display has been measured with a full screen image consisting of all pixels set to the same colour - Red, Green, Blue and White.

An excel spreadsheet contains the measurement data. This consists of 4 tables of 35 pairs of colour coordinates (u',v'), for each of the 2 displays.

Your task is to calculate the A and B metrics above for each of the 8 tables.

Please use Python 3.6, and any libraries you wish.