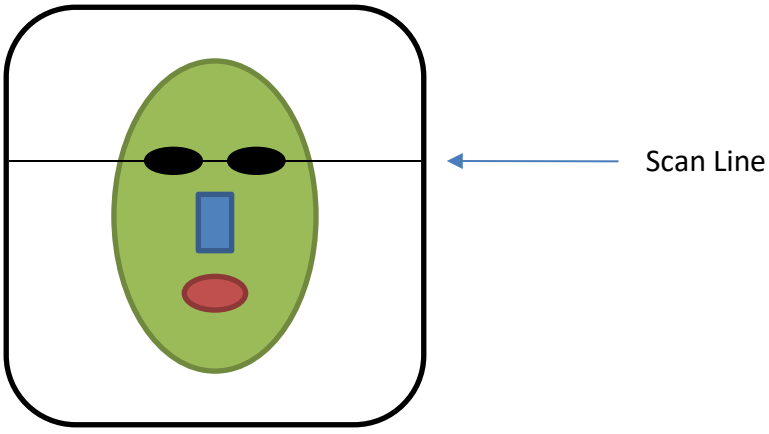
COMP70110 Computer Vision

Tutorial 2 – Fourier Methods

1. Process the image below (or any image you want) directly in the frequency domain as follows:
   - Create a smoothed image
   - Detect edges

2. A face recognition system is based on taking the Fourier transform of individual scan lines of a face image as shown schematically in the diagram.

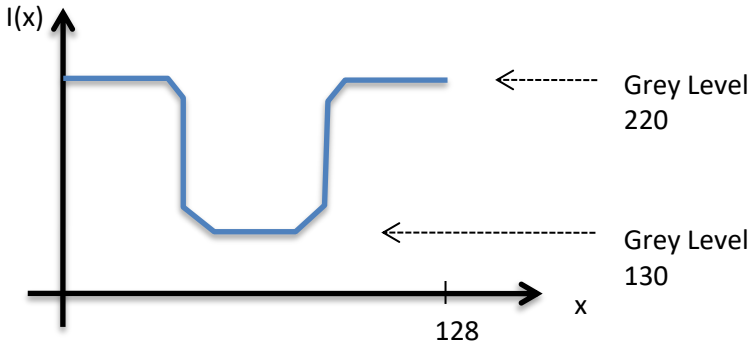


The transformation is from the intensities of the pixels along the scan line $l(x)$ to the coefficients of the harmonic components a_i and b_i given by the equation:

$$I(x) = a_0 + a_1 \cos(\alpha x) + b_1 \sin(\alpha x) + a_2 \cos(2\alpha x) + b_2 \sin(2\alpha x) + \cdots$$

a) Assuming that the image has a resolution of 128 by 128 pixels, calculate the value of α.

b) At a fairly featureless place in the face, the intensity profile along a scan line looks like this:



Estimate roughly the coefficients a_0, a_1 and b_1 in the transform of the line.

c) In another image, the face has been displaced from the centre. The transform is taken and the component values are found to be:

$$a_0 = 110, a_1 = 80, b_1 = 20$$

Calculate the displacement of the image from the centre in pixels.

Hint: Consider that the fundamental has the form $m_1 \cos(\alpha x + \phi)$ and expand to find the value of ϕ.

d) Discuss (with your neighbour) the significance of the magnitude and phase of the harmonics for a typical scan line such as the one shown above.