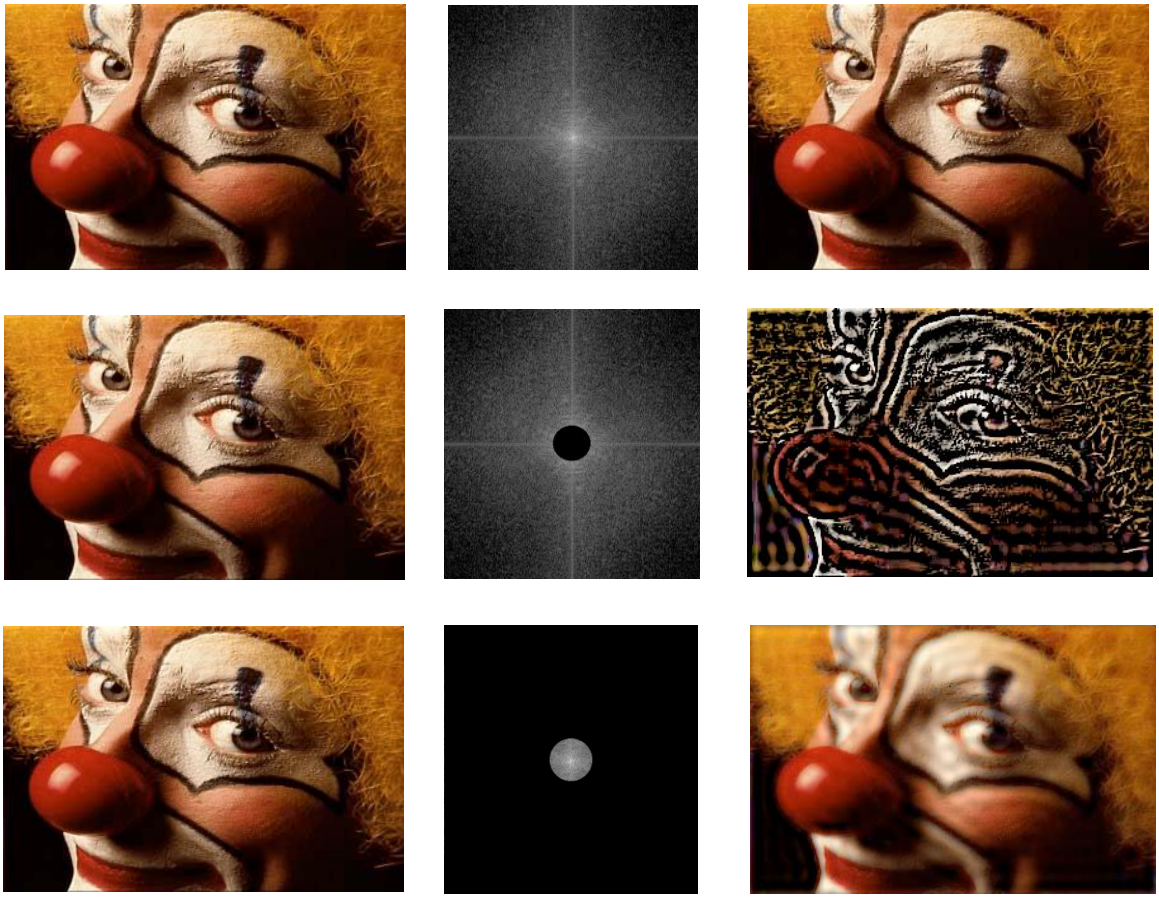
COMP70110 Computer Vision

Tutorial 2 – Fourier Methods

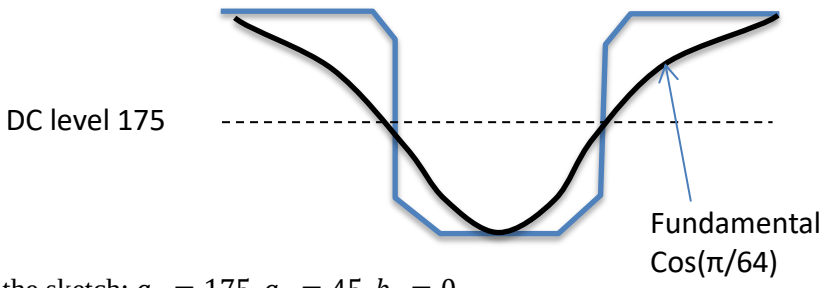
1. Process the image below (or any image you want) directly in the frequency domain as follows:
   - Create a smoothed image
   - Detect edges



2.

a) For the fundamental, 128 pixels will correspond to an angle of 2π. Hence we have that: $128\alpha = 2\pi$ giving $\alpha = \pi/64$.

b)



From the sketch: $a_0 = 175, a_1 = 45, b_1 = 0$

c) $m_1 \cos(\alpha x + \phi) = m_1 \cos\phi \cos\alpha x - m_1 \sin\phi \sin\alpha x$
Thus $m_1 \cos\phi = 80$ and $m_1 \sin\phi = -20$
Eliminating m_1 we get that $\tan\phi = -20/80 = -1/4$
Hence $\phi = -0.25$ (small angle approximation $\tan\phi = \phi$)

Now since 128 pixels corresponds to an angle of 2π radians, and the phase angle is -0.25 radians, the displacement in pixels is given by $-0.25 * 128/2\pi$. That is, $-16/\pi$ or approximately 5 pixels.

d) From the above we see that the fundamental magnitude is most strongly determined by the contrast between the face and the background and its phase is determined by the position of the face in the image. The next harmonic could well be determined by the contrast of the secondary features (eyes or nose) to the face and background, and their phase to the relative positions, that is the broad layout of the face such as the separation of the eyes. The higher frequencies will be required to represent details at the sharp changes, for example where the fundamental in the example above is a poor match to the abrupt change between the background and the face. The phase of the higher harmonics is difficult to interpret.