Heriot-Watt University Edinburgh

MOCKUP EXAM EXAMPLE

B39SE1 – Digital Signal Processing

(a) A DFT processor is to be used to estimate the frequency spectrum of a real signal. The system must be able to process any signal having frequencies up to 3500Hz. In addition, the interval between frequencies in the DFT must be less than or equal to 10Hz. Determine the minimum record length, the maximum time between samples and the minimum number of points in the record. Find the record length, the time between samples and the number of points in the record if the number of points is to be an integer power of 2.

(10)

(b) What conditions are necessary for linear and circular convolution to be equivalent? Why is the equivalence of interest? (5)

(c) What assumption is made of a signal being analysed using a DFT? What problems can this assumption cause and under what conditions do they occur? Use appropriate sketches to illustrate your answers. How can some of this problems been solved?

(10)

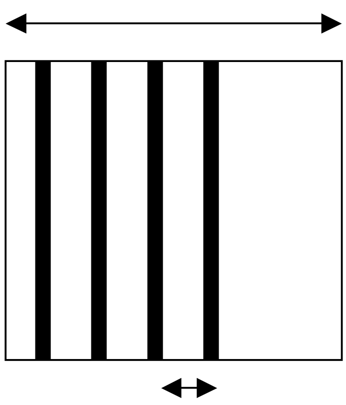
(d) An outdoor scene contains a fence consisting of fence posts 6cm across (width of each fence post), spaced 6cm apart (distance between fence post). A camera observing the scene captures a 30 m length of this fence within its field of view. The output of the camera is sampled to give an image of size 256x256 pixels

(i) What kind of artifacts might be seen in the image (Think of each line as a one dimensional signal). Perform some calculations to support your argument.

(ii) Determine the conditions under which these artifacts may not be present

(10)

Figure 1: Fence post in image



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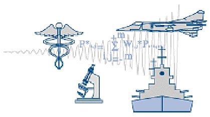

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(e) FIR Filters

(i) Derive the coefficients of a non-recursive filter which is to have a frequency response:

$$H(e^{j\theta}) = 1, \qquad 0 \le \theta \le \frac{\pi}{3}$$

$$H(e^{j\theta}) = 0, \qquad \text{elsewhere}$$

(ii) Calculate the first 5 coefficients from the expression derived in part (i)

(iii) What would the problem be using only a few coefficients? Can you think of ways to alleviate the problem?

(15)