Homework 2 (Due: 4/28)

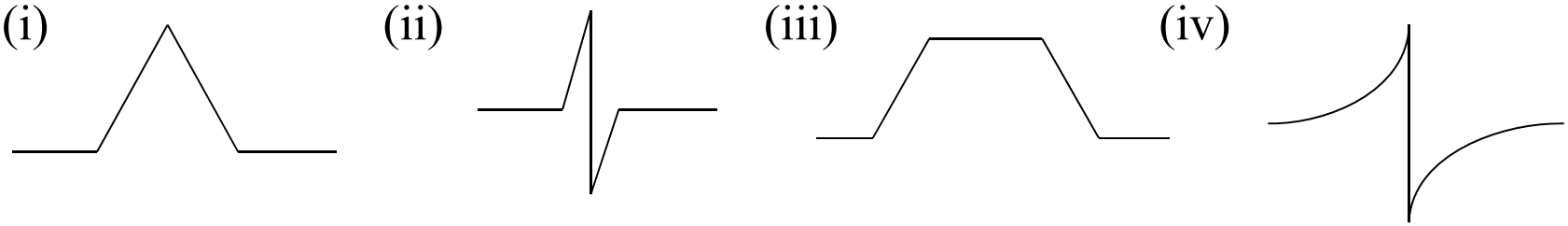
(1) If the z-transform of $h[n]$ is $H(z)=\dfrac{2z^3+5z^2+6z+2}{z^2-0.8z+0.15}$

(a) Determine the cepstrum of $h[n]$.

(b) Convert the IIR filter into the minimum phase filter. (20 scores)

(2) The following figures are the impulse responses of some filters. Which one is suitable for edge detection when (a) the SNR is high and (b) the SNR is low? Also illustrate the reasons. (10 scores)

(i) (ii) (iii) (iv)



(3) (a) Why the cepstrum is more suitable for dealing with the multipath problem than the equalizer?

(b) Why the Mel-frequency cepstrum is more suitable for dealing with the acoustic signal than the original cepstrum? (15 scores)

(4) What are the most important applications of (a) the matched filter and (b) the Kalman filter in signal processing? (10 scores)

(5) Suppose that the cepstrum of a signal $x[n]$ is

$$\hat{x}[2] = 0.6, \quad \hat{x}[n] = 0 \quad otherwise$$

Determine $x[n]$ using the Z transform and exp( ). (10 scores)

(6) What is the difference between the spectrums of a music signal and a speech signal? (10 scores)

(7) Write a Matlab program that uses the frequency sampling method to design a $(2k+1)$-point discrete differentiation filter $H(F) = j2\pi F$ (k is an input parameter and can be any integer). (25 scores)

The transition band can be assigned to reduce the error (unnecessary to optimize). The frequency response (DTFT of $r[n]$, see pages 103 and 104) and the impulse response of the designed filter should be shown. The Matlab code should be emailed to displab531@gmail.com