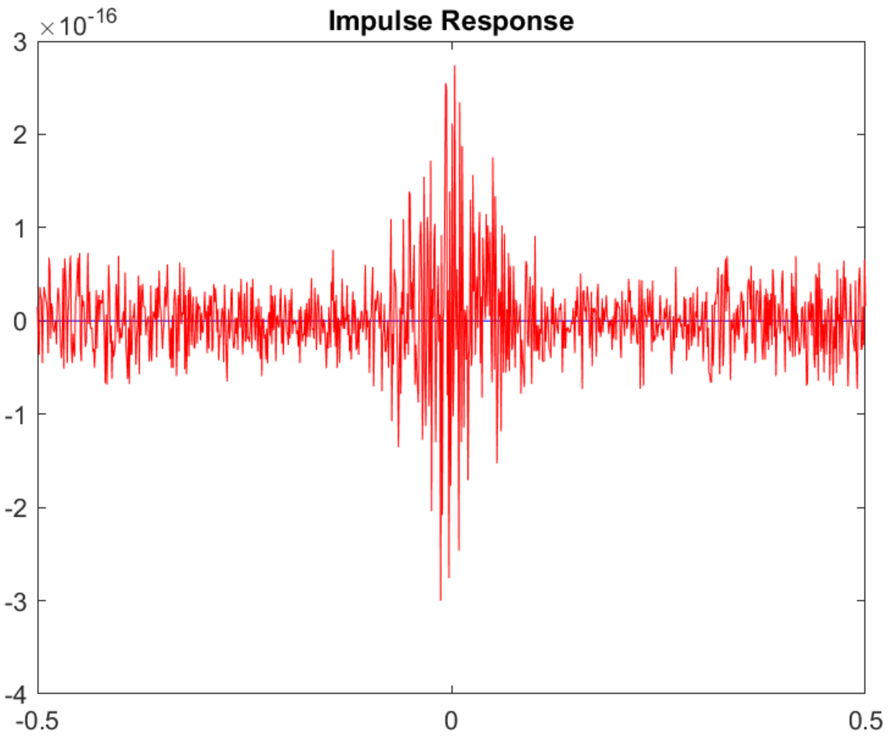
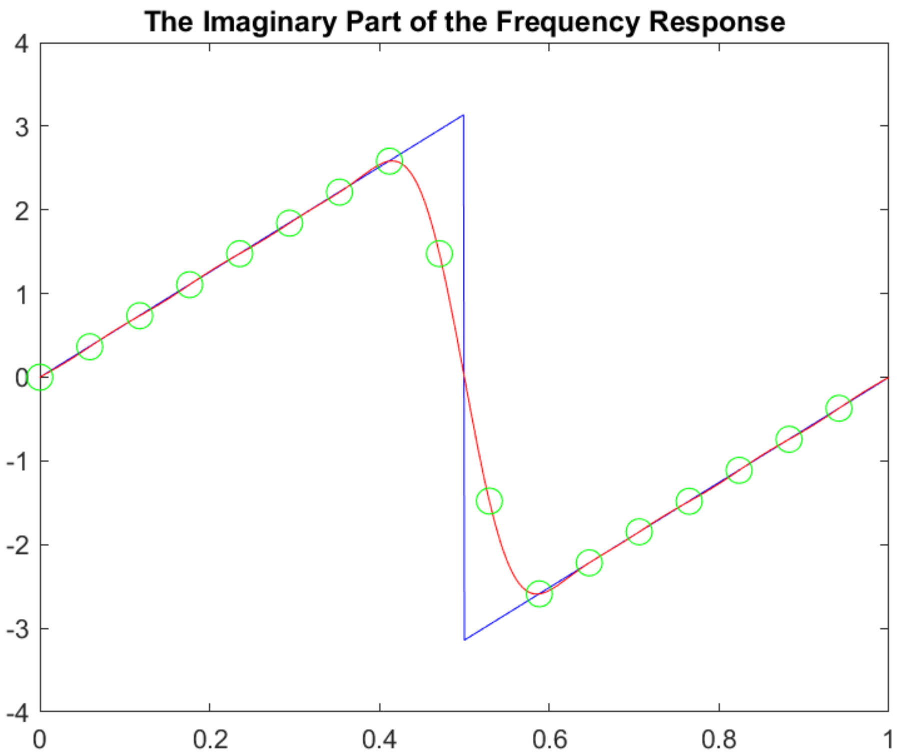
D11942011 林政均

1.

i.



ii.



2.

(a). Yes. MSE method is flexible. Even though the cosine function is not orthogonal if we apply transition band or weight function in the FIR filter designed, we are still able to use matrix operation to solve.

(b). Yes. We can still reduce the error with transition band. However, weight function can't be applied in the frequency sampling method.

3.

(a).

The smooth filter should satisfy

①. $h[n] = h[-n]$

②. $|h[n_1]| \leqq |h[n_2]|$ if $|n_1| > |n_2|$

③. $h[n] \geqq 0$, for all n

④. $\sum_\tau h[\tau] = 1$

$a \times (5\times2+1) + 0.023 \times (5\times2) = 1$

$a = 0.07$

(b).

Using recursive method

$y[n] = y[n-1] + \frac{1}{2L+1}(x[n+L] - x[n-1+L])$

4.

The smooth filter should be even function and decrease with $|n|$. Only (ii) and (iv) are satisfied.

(a).

(ii) Since the surrounding weights and filter size are smaller.

(b).

(iv) Since the surrounding weights and filter size are larger.

5.

(a).

$$H(z) = \frac{2z^4-2z^3+3z^2+z-2}{z^2+0.2z-0.24} = \frac{(z^2-z+2)(2z^2-1)}{(z+0.6)(z-0.4)}$$

$$= \frac{2[\left(\frac{1+\sqrt{7}j}{2}\right)-z][\left(\frac{1+\sqrt{7}j}{2}\right)+z](z-\sqrt{0.5})(z+\sqrt{0.5})}{(0.6+z)(-0.4+z)}$$

$$= \frac{2z\left(\frac{1+\sqrt{7}j}{2}\right)^2(1-\sqrt{0.5}z^{-1})[1-(-\sqrt{0.5}z^{-1})][1-\left(\frac{2}{1+\sqrt{7}j}\right)z][1-\left(-\frac{2}{1+\sqrt{7}j}\right)z]}{z^2[1-(-0.6z^{-1})](1-0.4z^{-1})}$$

$$= \frac{(-3+\sqrt{7}j)z^{-1}(1-\sqrt{0.5}z^{-1})[1-(-\sqrt{0.5}z^{-1})][1-\left(\frac{2}{1+\sqrt{7}j}\right)z][1-\left(-\frac{2}{1+\sqrt{7}j}\right)z]}{[1-(-0.6z^{-1})](1-0.4z^{-1})}$$

$$\hat{x}[n] = \begin{cases} \log\left(-3+\sqrt{7}j\right), n=0 \\ \frac{-(\sqrt{0.5})^n}{n} + \frac{(\sqrt{0.5})^n}{n} + \frac{-(-0.6)^n}{n} + \frac{(0.4)^n}{n}, n>0 \\ \frac{\left(\frac{2}{1+\sqrt{7}j}\right)^{-n}}{n} + \frac{-\left(-\frac{2}{1+\sqrt{7}j}\right)^{-n}}{n}, n<0 \end{cases}$$

(b).

$$H(z) = \frac{(z^2-z+2)(2z^2-1)}{(z+0.6)(z-0.4)}$$

$$= \frac{4z^4(1-0.5z^{-1}-0.5z^{-2})(1-0.5z^{-2})}{z^2(1+0.6z^{-1})(1-0.4z^{-1})}$$

$$= \frac{4z^2(1-0.5z^{-1}-0.5z^{-2})(1-0.5z^{-2})}{(1+0.6z^{-1})(1-0.4z^{-1})}$$

6.

$$\hat{x}[n] = \begin{cases} 0.7, n=2 \\ 0, otherwise \end{cases}$$

$$x[n] = e^{Z^{-1}\{\hat{x}[n]\}} = \sum_n \frac{0.7}{n!} z^{-n}$$

$$x[n] = \begin{cases} \frac{0.7}{n!}, n \geqq 0 \\ 0, n<0 \end{cases}$$

7.

(a).

①. The minimum phase filter is stable and causal.

②. The energy concentrating on the region near to n = 0

(b).

①. Analytic function

②. Edge detection

(c).

①. H(z) won't be unstable.

②. H(z) isn't a dynamic response.

Extra:

Q: What is the main use of the matched filter in signal processing?

A: The matched filter is usually used for demodulation, similarity measurement, and pattern recognition.