PE Course: Digital Filter Design

MM4: Synthesis of FIR discrete-time filters Using Window Method

1 Reading

Page 291-311 and 465-478 of Alan V. Oppenheim, Ronald W. Schafer, and John R. Buck: "*Discrete-Time Signal Processing (Second Edition)*", Prentice Hall, 1999.

2 Content

- Generalized linear phase systems
- Pole-Zero Diagram of linear phase systems
- Windowing method for FIR filter design

3 Exercise

1. The parameters of a FIR filter are listed as

$$\begin{aligned} h_0 &= -0.0750 \\ h_1 &= -0.1592 \\ h_2 &= -0.2251 \\ h_3 &= 0.7500 \\ h_4 &= -0.2251 \\ h_5 &= -0.1592 \\ h_6 &= -0.0750 \end{aligned}$$

   (a) What is this filter's order M?

   (b) Sketch out the impulse response sequence $h(n)$ of this filter.

   (c) Calculate the system function $H(z)$ of this filter.

   (d) Determine whether this filter is linear phase or not, and explain why.

   (e) Make a Matlab program to determine what kind of filter (lowpass, highpass, bandpass, bandstop) it is.
   (Hint: use the function **freqz(num,den)**)

2. Design a lowpass FIR filter using the Kaiser window method, where this designed filter should satisfy
   - DC gain: 0 dB
   - Gain at 750Hz: minimum -1.0dB
   - Gain at 1500Hz: maximum -10.0dB
   - Sampling frequency: 8000Hz

3. Use the **Filter Design Toolbox** in Matlab to finish above design task.
   (Hint: type **fdatool** after you enter Matlab workspace)