Digital Communication and Signal Processing 2024

Department of Computer Science, University of Warwick

Seminar 7

The time domain representation of a second order ARMA filter is given by the difference equation

$$Y[n] = a_0 x[n] + a_1 x[n-1] + a_2 x[n-2] + b_1 y[n-1] + b_2 y[n-2]$$

This equation expresses the output sequence $y[n]$ in terms of the input sequence, $x[n]$, and a set of real coefficients $\{a_m\}$, and $\{b_m\}$. Suppose the input is given by a signal $s(t)$ corrupted by an additive sinusoidal disturbance, that is

$$x(t) = s(t) + cos(2\pi F_0 t)$$

Assume the input is sampled at $F_s = 44\ kHz$ and that the disturbance frequency is $F_0 = F_s/4$.

Your task is to design a second order ARMA filter which stops the disturbance and whose output is a close as possible to the original signal. In order to do this:

1. First, write down the transfer function of such filter, $H(z)$.
2. Derive the correspondent time domain representation, that is find the values of the coefficients $\{a_m\}$, $\{b_m\}$.
3. Sketch the block diagram representation of the filter.