Exercise Realization 1

Consider the 5th order 0.5 dB Chebyshev lowpass filter

$$H(z) = \frac{0.06654\,z^5 + 0.3327\,z^4 + 0.6654\,z^3 + 0.6654\,z^2 + 0.3327\,z + 0.06654}{z^5 + 0.1825\,z^4 + 1.001\,z^3 - 0.2126\,z^2 + 0.268\,z - 0.1098}$$

for a sampling frequency at 100Hz.

1. Rewrite the above transfer function to a cascade structure using first- and second-order transfer functions.
2. Rewrite the above transfer function to a parallel structure using first- and second-order transfer functions.
3. Draw the above cascade realization and parallel structure using Simulink. Check if they give you the same result with a 20Hz sinusoidal input.

Exercise Realization 2

Consider the following transfer function:

$$H(z) = \frac{0.0876z^{-1} + 0.0676z^{-2}}{1 - 1.874z^{-1} + 1.489z^{-2} - 0.4601z^{-3}}$$

for a sampling frequency at 8 kHz.

1. Draw a direct type I realization structure for $H(z)$ and determine how many delay elements are needed.
2. Determine the poles and zeros of $H(z)$, and estimate whether $H(z)$ is stable.
3. Draw a cascade realization for $H(z)$ using first- and second-order transfer functions.
4. Determine a parallel realization for $H(z)$ using first- and second-order transfer functions.
5. Identify the filter type (low pass, high pass, band pass or band stop) of $H(z)$ by plotting a Bode plot in MATLAB.
6. Use Matlab Simulink for the above realization. Check your drawing with input sinusoidal signals at different frequencies.