Chap9.z-transform. Hands-on: 1. Pre-Lab

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1.6.1 FIR filter with PeZ

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자동 생성된 설명

FIR filter with PeZ, H(z) = 1 – z^(-1) + z^(-2), impulse response h[n] values are equal to the polynomial coefficients of H(z), h[n] = [1 -1 1]. The frequency response has nulls because the zeros of H(z) lie exactly on the unit circle.

* + 1. FIR filter with many zeros

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Roots function to get zeros coefficients = [1 1 1 1 1 1], zeros = roots(coefficients). Pole zero cancellation at z = 1. PeZ figure is shown above. Nulled Frequency is the same as the position of the zeros. We can calculate the frequency with the zero location in the figure above. The nulling frequency are -2\*pi/3, -pi/3, pi/3, 2\*pi/3, pi.

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New Filter with hc[n]=[1 2 2 2 2 2 1] can be made using weighted, shifted impulses. Num = [1 0 0 0 0 0 -1] and zeros = roots (Num) is shown in the PeZ figure above. The new filter above is called Comb filter because the impulse response looks like a comb. The nulls are located at the same position as above -2\*pi/3, -pi/3, pi/3, 2\*pi/3, pi.

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One of the zeros are at z = -1. Moving it to z = +1 makes a system function’s coefficients = [1 -2 2 -2 2 -2 1]. The frequency of the new filter created from moving the zeros is an HPF.

* 1. Real Poles

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Define the passband as the region where the magnitude response is greater than 90% of the maximum (about pi/1.1) and the stopband as the region where the magnitude response is less than 10% of the maximum (about pi/3). The coefficients of H(z) denominator become close to the [1 2 1] as the pole moves to -0.999 and denominator becomes close to [1 0 0] when close to the origin. When the pole goes out of the circle the denominator increases [1 2++ 1++] and the system is not stable. In general, where should poles be placed to guarantee system stability? In the left complex plane within the unit circle.

1.7.1 Create a First-order IIR filter with PeZ

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When moving the pole to 0 and +0.9 the denominator move to [1 0] then to [1 -0.9] and the filter becomes an HPF.