

System Simulation HW

Problem #2

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$$H(s) = \frac{x_s(s)}{w_{sp}(s)} = \frac{50e^{-0.015s}}{s+2+50e^{-0.02s}}$$

$$H(s) = \frac{50(-s^2 + 33.3333s + 13333.3)}{s^3 + 185.333s^2 + 12133.3s + 643333}$$

$$H(s) = \frac{50\left(-\frac{1}{s} + \frac{33.3333}{s^2} + \frac{13333.3}{s^3}\right)}{1 + \frac{185.333}{s} + \frac{12133.3}{s^2} + \frac{643333}{s^3}}$$

$$H(z) = \frac{50\left(\frac{-T}{z-1} + \frac{33.3333T^2z}{(z-1)^2} + \frac{13333.3T^3(z^2+z)}{2(z-1)^3}\right)}{\left(1 + \frac{185.333T}{z-1} + \frac{12133.3T^2z}{(z-1)^2} + \frac{643333T^3(z^2+z)}{2(z-1)^3}\right)}$$

$$\frac{Y}{X} = H(z) = \frac{50\left(-T(z-1)^2 + 33.3333T^2z(z-1) + \frac{13333.3T^3(z^2+z)}{2}\right)}{\left((z-1)^3 + 185.333T(z-1)^2 + 12133.3T^2z(z-1) + \frac{643333T^3(z^2+z)}{2}\right)}$$

must keep fractions in code

$$H(z) = \frac{50\left(-T(z^2-2z+1) + 33.3333T^2(z^2-z) + 666.65T^3(z^2+z)\right)}{(z^3-3z^2+3z-1) + 185.333T(z^2-2z+1) + 12133.3T^2(z^2-z) + 34666.5T^3(z^2+z)}$$

must keep fractions in code

$$H(z) = \frac{50\left(z^2(666.65T^3 + 33.3333T^2 - T) + z(666.65T^3 - 33.3333T^2 + 2T) - T\right)}{z^3 + z^2(34666.5T^3 + 12133.3T^2 + 185.333T - 3) + z(34666.5T^3 - 12133.3T^2 - 370.67T + 3) + (185.333T - 1)}$$

$$H(z) = \frac{50(z^2(A) + z(B) + C)}{z^3 + z^2(D) + z(E) + F} = \frac{50\left(\frac{1}{z}(A) + \frac{1}{z^2}(B) + \frac{1}{z^3}(C)\right)}{1 + \frac{1}{z}(D) + \frac{1}{z^2}(E) + \frac{1}{z^3}(F)}$$

$$Y[n] + Y[n-1](D) + Y[n-2](E) + Y[n-3](F) = 50(X[n-1](A) + X[n-2](B) + X[n-3](C))$$

$$Y[n] = 50(X[n-1](A) + X[n-2](B) + X[n-3](C)) - Y[n-3](F) - Y[n-2](E) - Y[n-1](D)$$

~~Final code~~