ECE-320: Linear Control Systems
Homework 5

Due: Monday April 18 *at the beginning of class*

1) Consider the continuous-time plant with transfer function

$$G_p(s) = \frac{1}{s}$$

Determine the discrete-time equivalent to this plant, $G_p(z)$ by assuming a zero order hold is placed before the continuous-time plant to convert the discrete-time control signal to a continuous time control signal.

Answer: $G_p(z) = \frac{T}{z-1}$

2) Consider the continuous-time plant with transfer function

$$G_p(s) = \frac{1}{s+1}$$

Determine the discrete-time equivalent to this plant, $G_p(z)$ by assuming a zero order hold is placed before the continuous-time plant to convert the discrete-time control signal to a continuous time control signal.

Answer: $G_p(z) = \frac{1-e^{-T}}{z-e^{-T}}$

3) Consider the continuous-time plant with transfer function

$$G_p(s) = \frac{1}{(s+1)(s+2)}$$

We want to determine the discrete-time equivalent to this plant, $G_p(z)$, by assuming a zero order hold is placed before the continuous-time plant to convert the discrete-time control signal to a continuous time control signal.

Show that if we assume a sampling interval of T, the equivalent discrete-time plant is

$$G_p(z) = \frac{z(0.5 - e^{-T} + 0.5e^{-2T}) + (0.5e^{-T} - e^{-2T} + 0.5e^{-3T})}{(z-e^{-T})(z-e^{-2T})}$$

Note that we have poles were we expect them to be, but we have introduced a zero in going from the continuous time system to the discrete-time system.