Control Engineering II

Topic 5:
Discrete-Time PID Controllers

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Exercises

Problem 1
Given the regulator in continuous space that presents the following transfer function, discretize it by the residue method:

$$R(s) = \frac{2}{s+3}$$

Consider for this purpose that a zero-order hold is added to the input of the regulator so that it can operate in a discrete system. The resulting transform will be that of the holder-regulator set.
Use a sampling period T=0.5 s.

Problem 2
Calculate the discrete PID controller if the continuous PID controller has the following parameters $K = 2$, $T_d = 2.5$, $T_i = 40$ and sampling period $T = 1$ second. Use for this purpose forward rectangular integration and trapezoidal integration.

Problem 3
Calculate the simplest discrete regulator so that the following system simultaneously verifies: $e_p < 0.01$, $M_p \simeq 20$ and $t_s \simeq 2.1$

$$G(s) = \frac{5}{(s^2+9s+20)(s^2+3s+2)}$$

Calculate the appropriate continuous regulator and discretize it with a convenient sampling period using Euler's method.

Problem 4
Given a system with step input, unit feedback and open-loop transfer function:

$$G(z) = \frac{z}{(z-1)(z-2)}$$

Calculate from the root locus the simplest regulator so that the system presents zero position error.

Problem 5
Given a system with unit feedback and open-loop transfer function:

$$G(z) = \frac{1}{(z-0.7)(z-0.9)}$$

Calculate from the root locus the simplest possible discrete regulator so that the system meets the following specifications: $M_p \leq 20$, $n_s \leq 15$ samples and $e_p \leq 22$.