Tutorial #8
ELL-225: Control Engineering

Session: Semester-II (2022-23)

1. The linearized model for an HIV/AIDS patient treated with RTIs is as follows (refer to (1)):

$$P(s) = \frac{Y(s)}{U_1(s)} = \frac{-520s - 10.3844}{s^3 + 2.6817s^2 + 0.11s + 0.0126}$$

   (a) Consider this plant in the negative feedback configuration with $G(s) = P(s)$ and $H(s) = 1$. Obtain the Nyquist diagram. Evaluate the system for closed-loop stability.

   (b) Consider this plant in the negative feedback configuration with $G(s) = -P(s)$ and $H(s) = 1$. Obtain the Nyquist diagram. Evaluate the system for closed-loop stability.

2. A ship's roll can be stabilized with a control system. A voltage applied to the fins' actuators creates a roll torque that is applied to the ship. The ship, in response to the roll torque, yields a roll angle. Assuming the block diagram for the roll control system shown in Figure 1, for the system. Draw the Nyquist plot for $K = 5$ and comment on the stability of the system for $K = 5$.

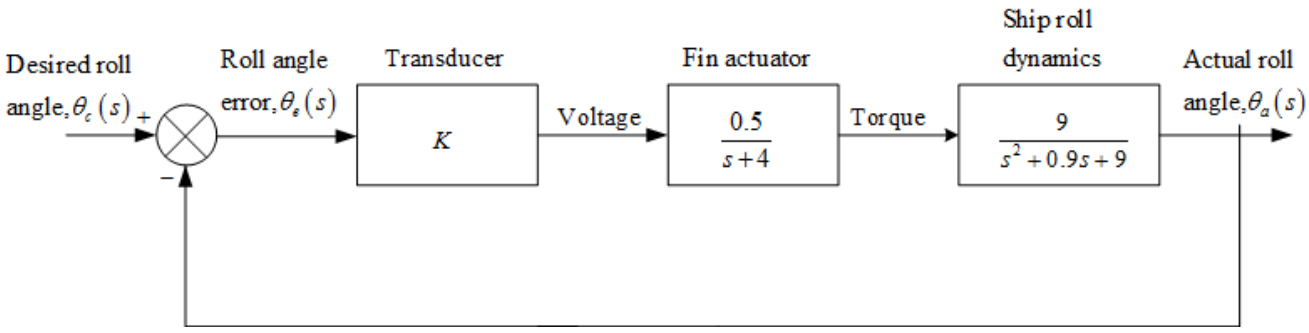

Figure 1: Block Diagram of a ship's roll-stabilizing System

3. The charge-coupled device (CCD) that is used in video movie cameras to convert images into electrical signals can be used as part of an automatic focusing system in cameras. Automatic focusing can be implemented by focusing the center of the image on a charge-coupled device array through two lenses. The separation of the two images on the CCD is related to the focus. The camera senses the separation, and a computer drives the lens and focuses the image. The automatic focus system is a position control, where the desired position of the lens is an input selected by pointing the camera at the subject. The output is the actual position of the lens. The camera in Figure 1(b) shows the automatic focusing feature represented as a position control system. assuming the simplified model shown in Figure 1(c), draw the Nyquist plot.

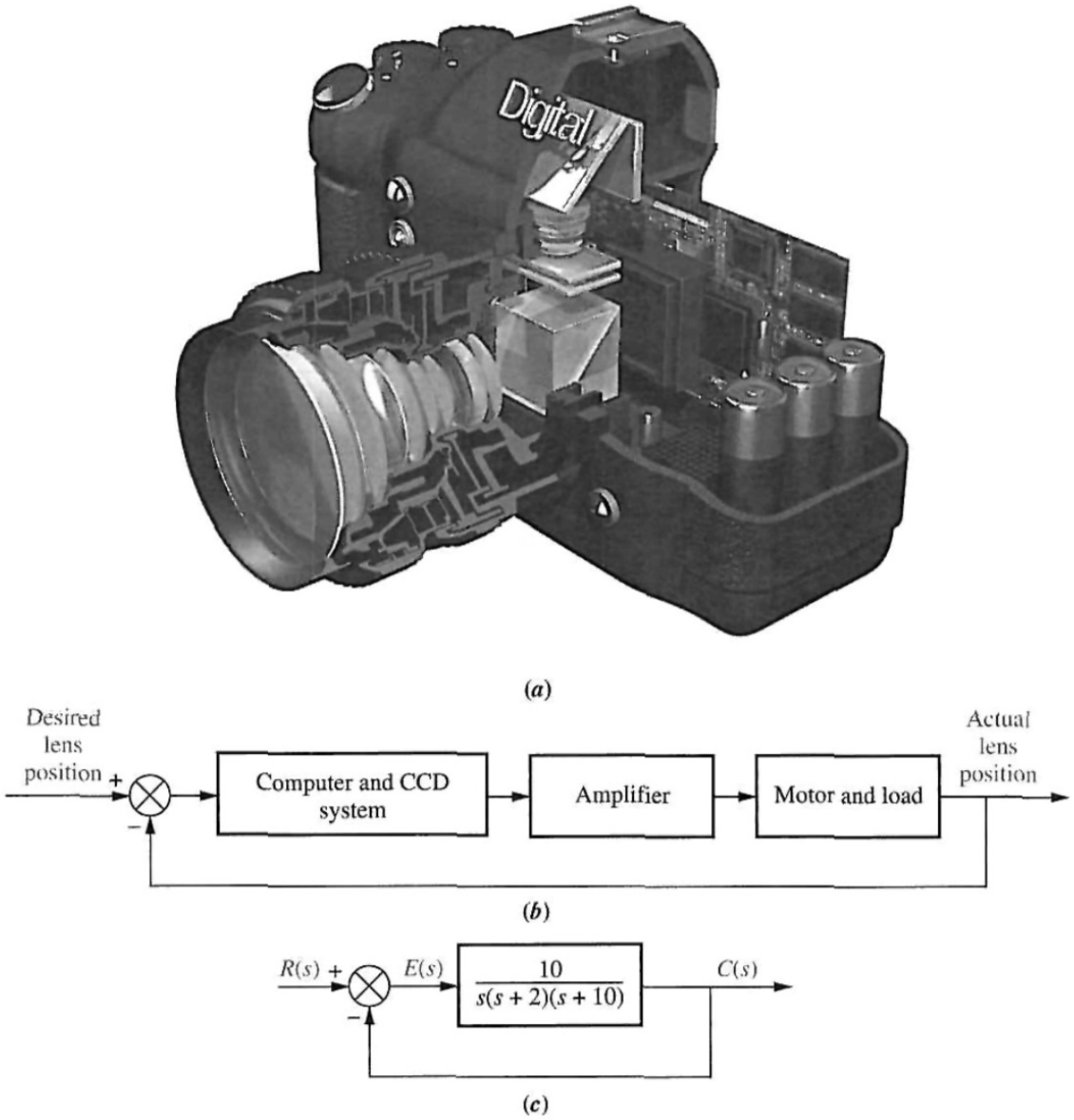

Figure 2: (a) A cutaway view of a digital camera showing parts of the CCD automatic focusing system (b) Functional block diagram (c) Block diagram

References

[1] I. Craig, X. Xia, and J. Venter, "Introducing hiv/aids education into the electrical engineering curriculum at the university of pretoria," *IEEE Transactions on Education*, vol. 47, no. 1, pp. 65–73, 2004.