

Abstract

Acquired Immune Deficiency Syndrome (AIDS) is a disease or continuum condition which is due to Human Immunodeficiency Virus (HIV) infection. One in five people are infected with HIV are not aware of the infection. Early detection of the infection helps the infected people to take medications to avoid future consequences and reduce the risk of transmitting the disease. Reverse transcriptase inhibitors (RTIs) were the first available drug and were considered a principal kind of medication available to treat HIV patients. These drugs are still successful, effective, and are considered to have imperative solutions for treating HIV when joined with different medications. Investigating effect of this branch of the drugs on HIV and model this interaction has a great of importance to control AIDS.

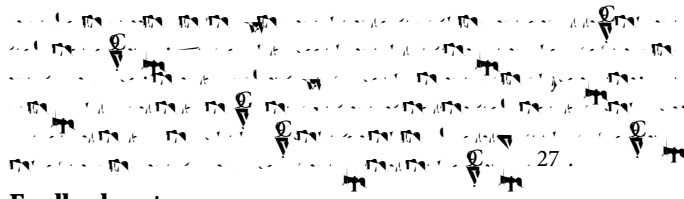
This need can be addressed by the control system engineering which uses control theory to estimate and design a system. Since Stability is the most significant requirement of the system, and a system of instability cannot be expected for a particular transient reaction or steady state error specification then objective which is needed to be achieved

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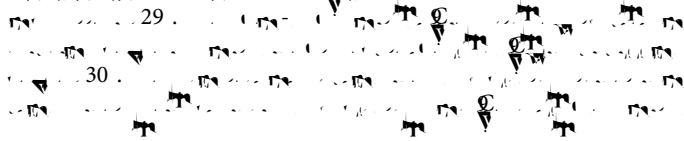
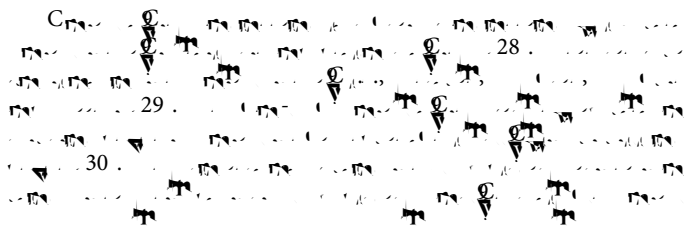
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Feedback system



$$\begin{pmatrix} \dot{x} \\ \dot{y} \end{pmatrix} = \begin{pmatrix} -\alpha & 0 \\ 0 & -\beta \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} 0 \\ \beta \end{pmatrix} + \begin{pmatrix} 0 \\ -\beta \end{pmatrix} \begin{pmatrix} 1 \\ 0 \end{pmatrix} \quad (3)$$

$$\begin{pmatrix} \dot{x} \\ \dot{y} \end{pmatrix} = \begin{pmatrix} -\alpha & 0 \\ 0 & -\beta \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} 0 \\ \beta \end{pmatrix} \quad (4)$$

State space representation

The state space representation of the system is given by the following equations:

$$\begin{aligned} \dot{x} &= -\alpha x \\ \dot{y} &= -\beta y + \beta \end{aligned}$$

where x and y are the state variables, α and β are the system parameters, and β is the input.

Routh-Hurwitz method

The characteristic equation of the system is given by:

$$s^2 + \alpha s + \beta = 0$$

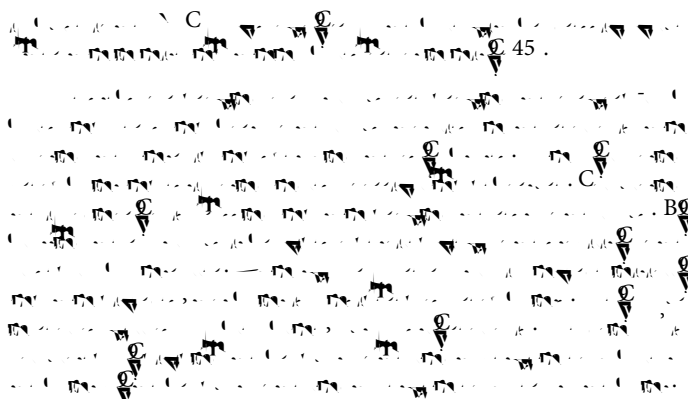
The Routh-Hurwitz stability criterion is used to determine the stability of the system. The Routh array is constructed as follows:

α	β
β	0

The system is stable if all the elements in the first column of the Routh array are positive. In this case, the system is stable if $\alpha > 0$ and $\beta > 0$.

Root locus

The root locus of the system is shown in Figure 1. The root locus is a line in the complex plane that represents the path of the poles of the system as the gain β varies from zero to infinity. The root locus is a line in the complex plane that represents the path of the poles of the system as the gain β varies from zero to infinity. The root locus is a line in the complex plane that represents the path of the poles of the system as the gain β varies from zero to infinity.



Results and Discussion

The results of the control design are shown in Figure 2. The plot shows the response of the system to a step change in the input. The system is stable and the response converges to the steady-state value. The root locus plot shows that the system is stable for all values of the gain β .

$$\frac{dy}{dt} = -\beta y \quad (5)$$

$$\frac{dx}{dt} = -\alpha x + \beta y \quad (6)$$

$$\begin{pmatrix} \dot{x} \\ \dot{y} \end{pmatrix} = \begin{pmatrix} -\alpha & 0 \\ 0 & -\beta \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} 0 \\ \beta \end{pmatrix} \quad (7)$$

$$\dot{x}_2 = (1 - \beta_1) \beta - \mu^* \quad (10)$$

$$\dot{x}_2 = (1 - \beta_1) \beta - \mu^* \quad (11)$$

$$\dot{x}_3 = (1 - \beta_2) \beta^* - \mu^* \quad (12)$$

$$\begin{bmatrix} \frac{\partial \dot{x}_1}{\partial x_1} & \frac{\partial \dot{x}_1}{\partial x_2} & \frac{\partial \dot{x}_1}{\partial x_3} \\ \frac{\partial \dot{x}_2}{\partial x_1} & \frac{\partial \dot{x}_2}{\partial x_2} & \frac{\partial \dot{x}_2}{\partial x_3} \\ \frac{\partial \dot{x}_3}{\partial x_1} & \frac{\partial \dot{x}_3}{\partial x_2} & \frac{\partial \dot{x}_3}{\partial x_3} \end{bmatrix} \Big| \begin{bmatrix} \frac{\partial \dot{x}_1}{\partial x_1} & \frac{\partial \dot{x}_1}{\partial x_2} \\ \frac{\partial \dot{x}_2}{\partial x_1} & \frac{\partial \dot{x}_2}{\partial x_2} \\ \frac{\partial \dot{x}_3}{\partial x_1} & \frac{\partial \dot{x}_3}{\partial x_2} \end{bmatrix}$$

8. Carrington