

Control of HIV/AIDS Infection System with Reverse Transcriptase Inhibitors Dosages Design via Robust Feedback Controller

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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 by working on this research is to design a stabilized model of a patient having AIDS. In this research feedback controllers, Root locus technique and Routh Hurwitz method have been adopted to design such an advanced transformative controller which robustly regulates RTIs infusion dosages considering the amount of HIV viruses in infected human body.

Keywords: A, D, C, ...

Methodology

Introduction

A, D, C, ...

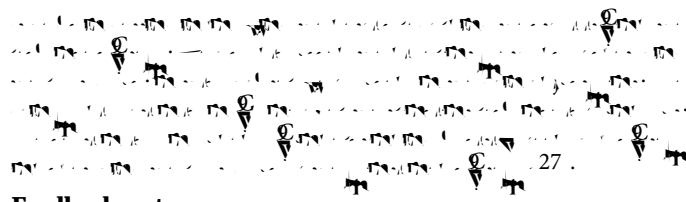
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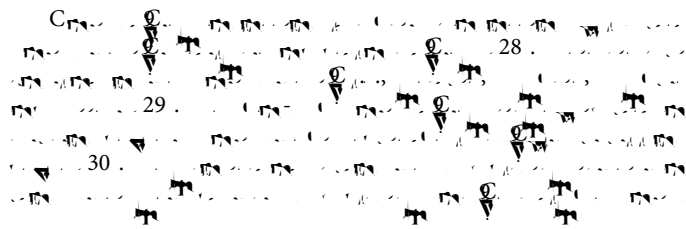
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Feedback system



$$X(s) = (sI - A)^{-1} x(0) + (sI - A)^{-1} BU(s) \quad (3)$$

$$Y(s) = CX(s) + DU(s) \quad (4)$$

State space representation

The state space representation of the HIV/AIDS infection system is given by the following equations:

$$\dot{x} = Ax + Bu$$

$$y = Cx + Du$$

where x is the state vector, u is the input vector, y is the output vector, A , B , C , and D are the system matrices.

Routh-Hurwitz method

The Routh-Hurwitz method is used to determine the stability of the system. The characteristic equation is given by:

$$\det(sI - A) = 0$$

The Routh-Hurwitz stability criterion is applied to the characteristic equation to determine the stability of the system.

Root locus

The root locus is a plot in the complex plane showing the poles and zeros of the transfer function. The root locus is used to determine the stability of the system for different values of the gain K .

The root locus is plotted in the complex plane. The poles are marked with 'x' and the zeros are marked with 'o'. The root locus is shown for different values of the gain K .

Results and Discussion

The results of the control design are shown in the following plots. The plots show the response of the system for different values of the gain K . The plots show that the system is stable for all values of K .

$$\frac{dT}{dt} = s - dT - \beta T v \quad (5)$$

$$\frac{dT^*}{dt} = \beta T v - \mu T^* \quad (6)$$

$$\frac{dT}{dt} = \frac{dT^*}{dt} = \frac{dv}{dt} = 0 \quad (7)$$

$$f_2 = (1 - u_1)\beta T v - \mu T^* \quad (10)$$

$$f_2 = (1 - u_1)\beta T v - \mu T^* \quad (11)$$

$$f_3 = (1 - u_2)k T^* - cv \quad (12)$$

$$\begin{bmatrix} \frac{\partial}{\partial} & \frac{\partial}{\partial^*} & \frac{\partial}{\partial} \\ \frac{\partial}{\partial} & \frac{\partial}{\partial^*} & \frac{\partial}{\partial} \\ \frac{\partial}{\partial} & \frac{\partial}{\partial^*} & \frac{\partial}{\partial} \end{bmatrix} \quad \left| \begin{bmatrix} \frac{\partial}{\partial} & \frac{\partial}{\partial} \\ \frac{\partial}{\partial} & \frac{\partial}{\partial} \\ \frac{\partial}{\partial} & \frac{\partial}{\partial} \end{bmatrix} \right.$$

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8. Carrington