Stability Analysis of A Model Using Non Standard Finite Difference Schemes

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In this paper, we developed a non standard numerical scheme for a model used by Perelson, Kirschner and Boer. This model is the interaction of HIV with $CD4^+T$. The model is given by the following system of differantial equations

$$\begin{aligned} \frac{dT}{dt} &= p - \alpha T + rT(1 - \frac{T+I}{T_{\max}}) - kVT, \\ \frac{dI}{dt} &= kVT - \beta I, \\ \frac{dV}{dt} &= N\beta I - \gamma V, \end{aligned} \tag{1}$$

with the initial conditions: $T(0) = r_1, I(0) = r_2, V(0) = r_3$. The concentration of $CD4^+T$ cells, the concentration of infected $CD4^+T$ cells by the HIV viruses and free HIV virus particles are denoted respectively by $T(t), I(t), V(t)$.

Nonstandard Finite Difference Schemes are a generalization of the usual discreate models of diferantial equations. They gives us more stable results than classical discretization by using denominator function. We will analyse stability of the model. If the differential equations have a constant solution with a particular stability property, the discrete model should also have this constant solution with exactly the same stability property. We will consider this rule and establish some criterions by choosing suitable denominator functions. By applying the Schur-Cohn criterion, we conclude if the model asymptotically stable or not.