Experiment 12

Transfer between digital states.

Background:

One of the advantages of digital systems (as we saw in our lecture course) is that with certain combos of design and inputs, the open ended analog design question of *dynamics settlement* over time can be replaced by a more desirable digital solution of *deadbeat dynamics* over counted number of steps.

Such performance in the digital domain requires a careful selection of *control design* as well as the *available inputs*, is not necessarily achievable, but may be possible in certain systems.

Objective:

In this experiment we consider a given three-variable digital system with parameters susceptible to arbitrariness of values (or for that matter, adjustable by the operator), and check out the scope and limits of possible deadbeat type performance.

Project:

The following three variable system has arbitrary values or settings possible for parameters *a* and *b*:

$$\begin{bmatrix} x_1(k+1) \\ x_2(k+1) \\ x3(k+1) \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ a & b & -a/b \end{bmatrix} \cdot \begin{bmatrix} x_1(k) \\ x_2(k) \\ x3(k) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} \cdot u(k)$$

1. With initial state $\mathbf{x}(0) = \begin{bmatrix} 1 & 1 & 1 \end{bmatrix}^T$, find out if $\mathbf{x}(3) = \mathbf{0}$ is achievable.
2. With initial state $\mathbf{x}(0) = \mathbf{0}$, find out if $\mathbf{x}(3) = \begin{bmatrix} 1 & 1 & 1 \end{bmatrix}^T$ is achievable.

For both requirements, the range of parameters and required input need to be found out.

For observations and discussions:

For cases where the performance is achievable, the solution will be a combo of the parameters (*a*, *b*) and a input signal that you should be able to define.

It is not necessary that the performance will be always achievable, but in either case, your solution must be accompanied by sound set of reasons, and substantiated by appropriate studies on MATLAB.