* Verification of time –delay system stability -- FOPTD system

1. Analytic solution :
   1. Routh : First approximation
   2. Pade approximation

Using Pade approximation first approximation,

* Routh Hurwitz

Hence

Implies

1.3 Nyquist

where is a solution to (1)

Now to (1) there are infinity solutions to this equation. There is no analytic solution.

In conclusion, given , the smallest value

Now to (1) there are infinity solutions to this equation. There is no analytic solution.

The first satisfies (1) is which yields to

1. Verification :

There are many approximated solutions for gain to insure the closed loop stability.

So I try these are simulate in Simulink. With the assumption , I check the stability

|  |  |  |
| --- | --- | --- |
|  | K |  |
| Routh Hurwitz |  |  |
| First approx.. | 0 < K < 1 | Too conservative |
| Pade | 0 < k < 3 | Not correct. |
| Nyquist |  |  |
| First approx.. | 0 < < 2.26 | Stable region   * Check if k> 2.26 |

1. In conclusion
2. If a model is assumed to be time delayed system, in order to check the stability, I recommend to use **Nyquist plot** and **Simulink**

* Convolution integral

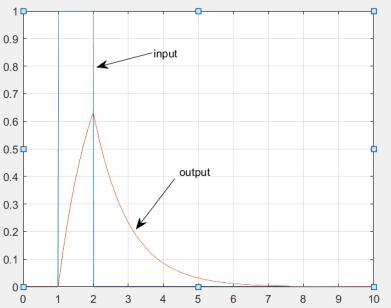
1. Calculate the output of the following system
2. Solution : remember the convolution integral, and in the Iden. Textbook, you may see this kind of output with pulse input.

Now look at the input.so

If

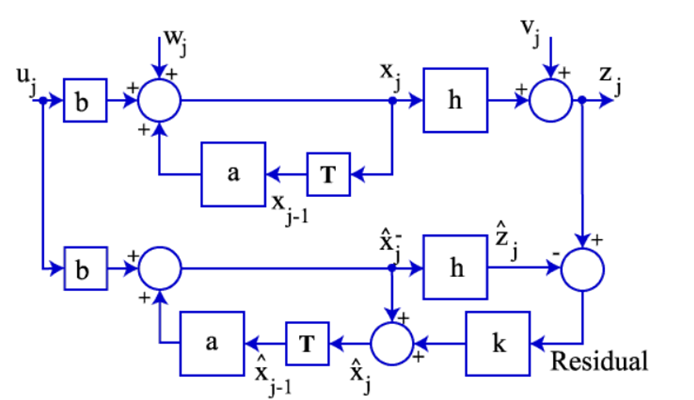
If

1. The graph



* Kalman filter

1. Block diagram for a Kalman filter



1. The kalman filter block

* It is implemented in the computer (almost all!!)
* What is the input of the kalman filter:

The measurement of the real plant, . What is the input of the real plant? Do you differentiate the differences?

What is the output of the kalman filter? if you want. Do you differentiate the differences?