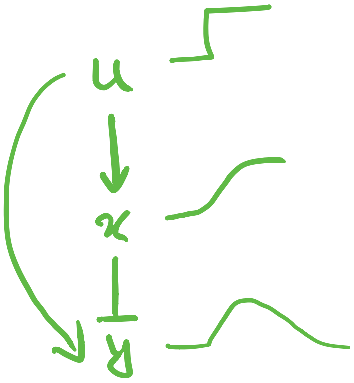
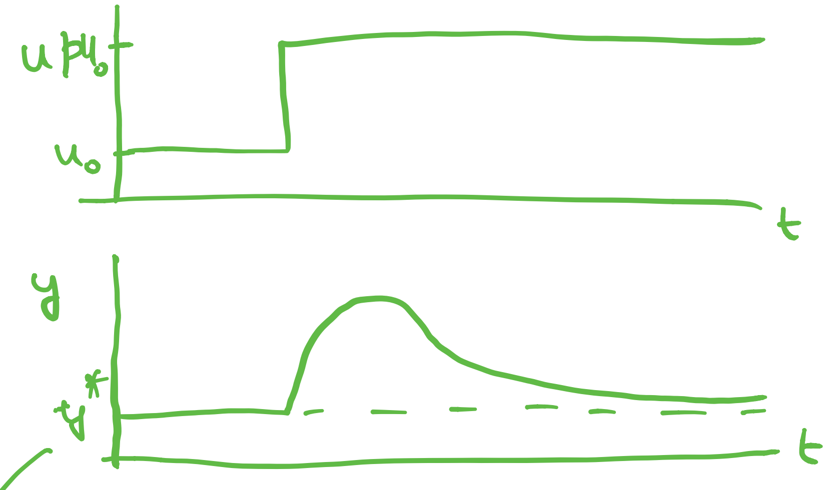
02.03.2020

ELL707





$$y(t) = \frac{\alpha_y}{\alpha_x} K + \frac{\alpha_y}{\alpha_x} K \frac{p-1}{p} e^{-rt} \ln(1-p+pe^{rt})$$

[for same degradation, $r_x = r = r_y$]

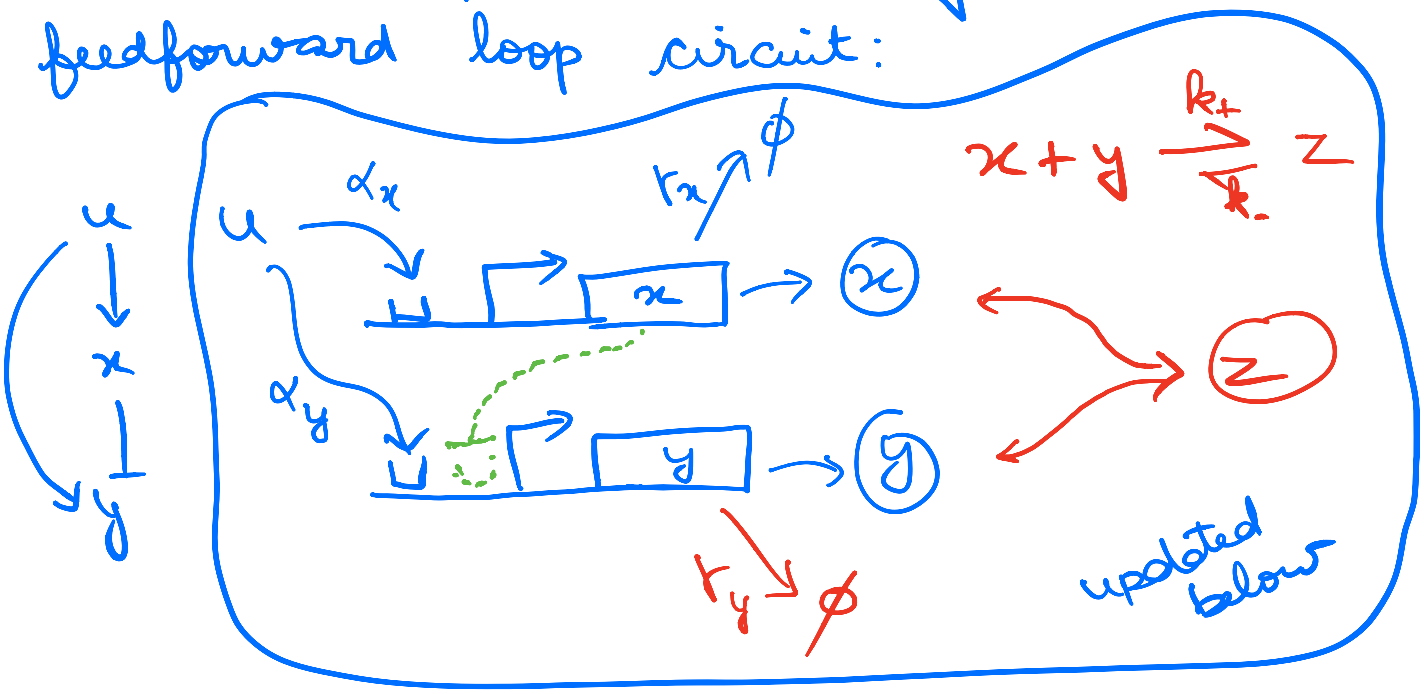
What features of this response are interesting from functional/biological/mathematical point of view?

- The steady-state value of y is independent of input u.

- Transient response has maximum i.e shows pulse dynamics.

- ...

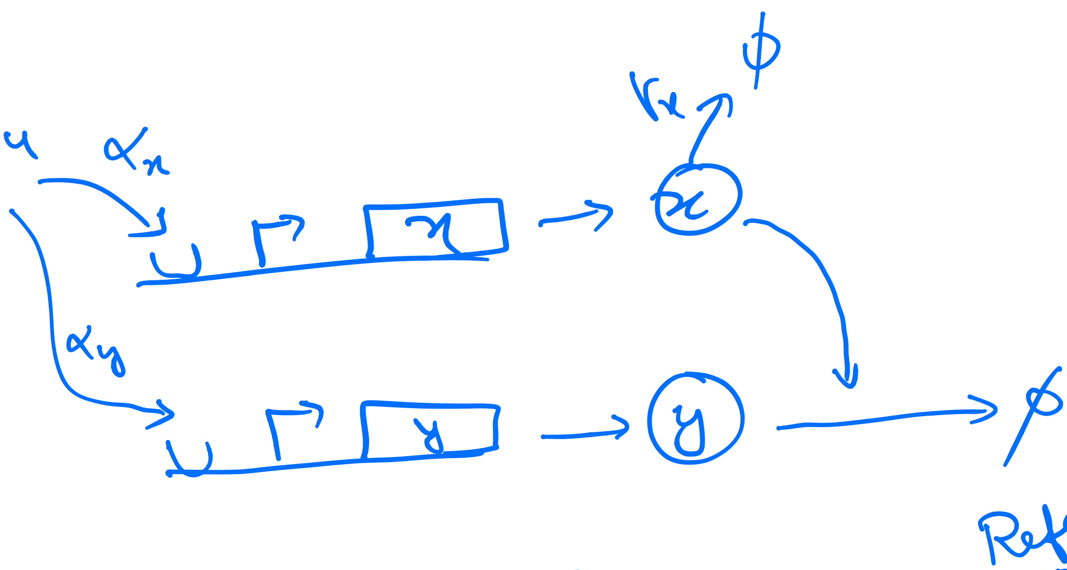
Another implementation of this feedforward loop circuit:



$$\frac{dx}{dt} = \alpha_x u - r_x x$$

$$\frac{dy}{dt} = \alpha_y u - k x y$$

this is how $x \dashv y$



$$x + y \rightleftharpoons [x \cdot y] \rightarrow x$$

usually neglected

Refer DM 2.4 for more details on this

$$\frac{dx}{dt} = \alpha_x u - r_x x$$

$$\frac{dy}{dt} = \alpha_y u - k x y$$

- Steady-state: independence of u?
- its stability?
- exact solution?

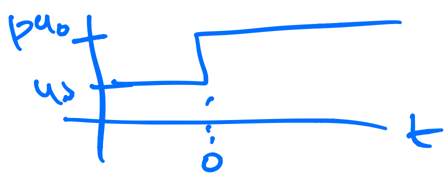
- Steady-state: $x^* = \frac{\alpha_x u}{r_x}$, $y^* = \frac{\alpha_y}{\alpha_x} \frac{r_x}{k}$

independent of u

- Stability: calculate linearization

$$J = \begin{bmatrix} -r_x & 0 \\ -k y^* & -k x^* \end{bmatrix}$$ (Try!!)

$\Rightarrow$ stable?



- exact solution!

$$u = \begin{cases} u_0, & t < 0 \\ p u_0, & t \geq 0 \end{cases}$$

$$x(0) = \frac{\alpha_x u_0}{r_x}$$

$$y(0) = \frac{\alpha_y}{\alpha_x} \frac{r_x}{k}$$

$$\Rightarrow x(t) = x(0) e^{-r_x t} + p.x(0)\left(1 - e^{-r_x t}\right)$$

$$\frac{dy}{dt} = \alpha_y . p . u_0 - k x y$$

How to solve?