

System Biology Course: Homework --- reproducing figures in Tyson et al. 2003

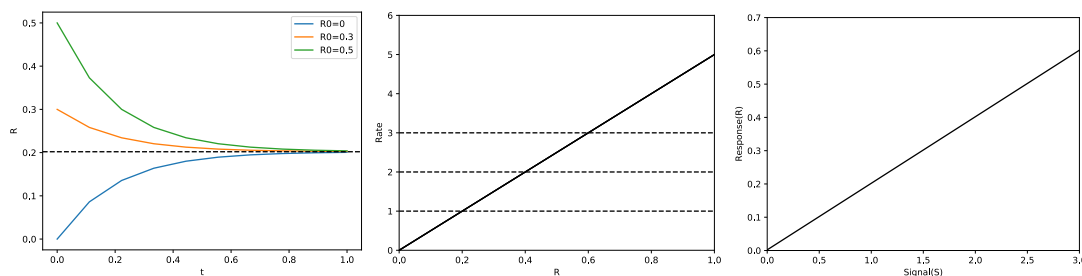
All the simulations were conducted through three python packages(functions), namely,

- [1] `scipy.integrate.odeint` function was used for simulating one component system
- [2] `scipy.optimize.fsolve` function was used for solving steady-state
- [3] Gekko package was used for simulating and solving steady-state for system which has more than one component

I will provide the code snippets for every figure I made.

Figure1a: Linear response curve

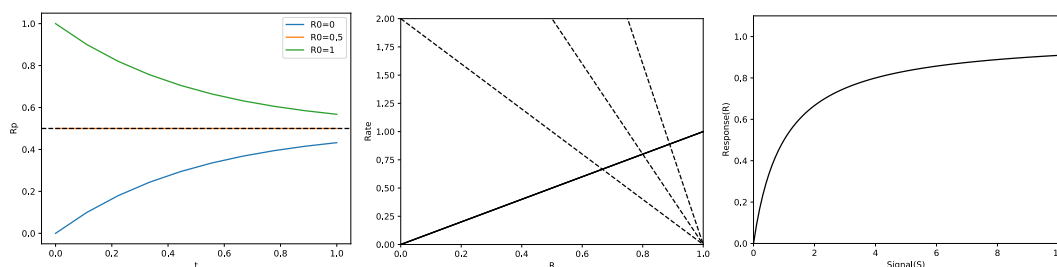
Code link: (https://github.com/frankligy/exercise_codes/blob/master/ODE/script.py/#L8-L69)



From left to right, they are solution curve (not required in the paper but I think it is important to generate), rate curve and signal-response curve.

Figure 1b: Hyperbolic response curve

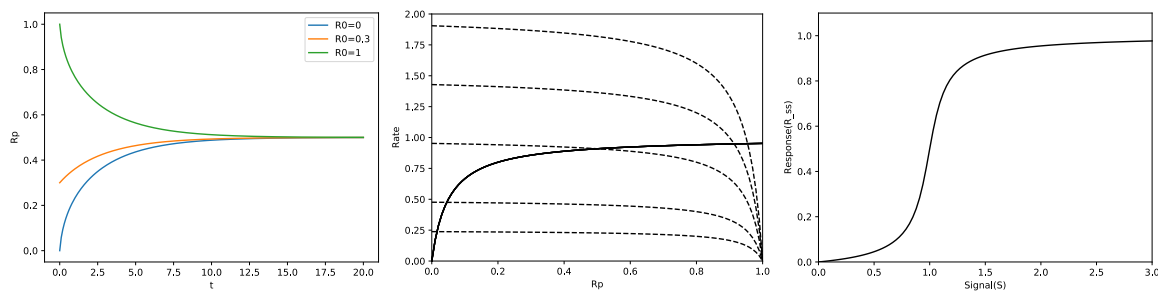
Code link: (https://github.com/frankligy/exercise_codes/blob/master/ODE/script.py/#L71-L133)



From left to right, solution curve, rate curve and signal-response curve

Figure 1c: sigmoidal response curve (buzzer)

Code link (https://github.com/frankligy/exercise_codes/blob/master/ODE/script.py/#L135-L208)

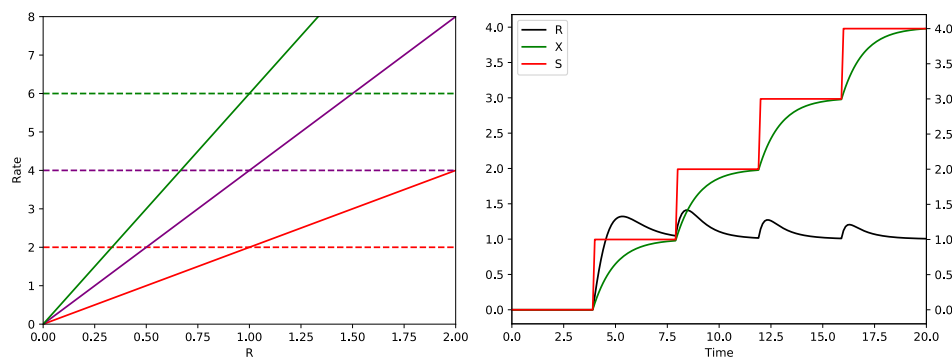


From left to right: solution curve, rate curve and signal-response curve

Typo report: equation (d) in the original paper, the second argument should be $k_2 \cdot S$ and ends up with 4 arguments in total instead of 5 arguments, which is paradoxical to the Goldbeter-Koshland function defined in the paper.

Figure1d: perfectly adapted (sniffer)

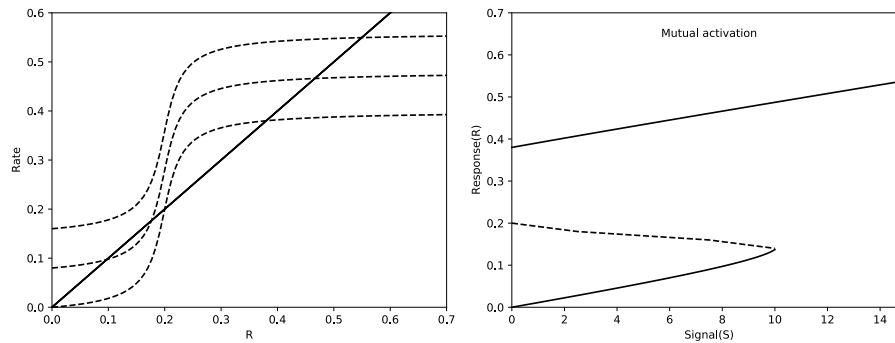
Code link: (https://github.com/frankligy/exercise_codes/blob/master/ODE/script.py/#L211-L259)



From left to right: rate curve and solution curve.

Figure1e: positive feedback, mutual activation

Code link: (https://github.com/frankligy/exercise_codes/blob/master/ODE/script.py/#L261-L330)

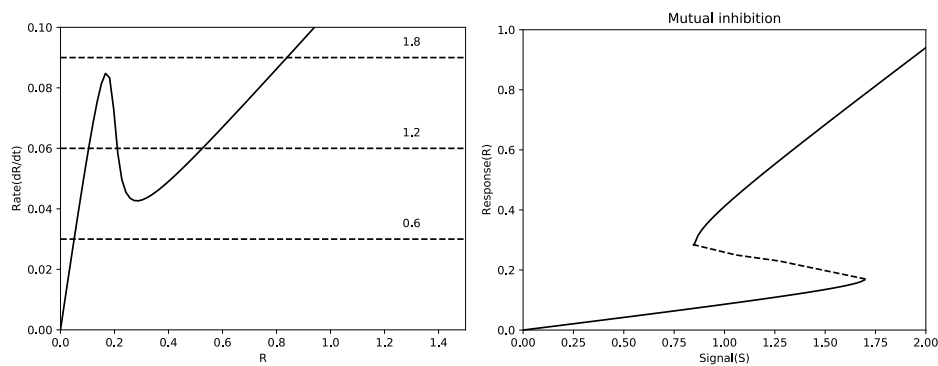


From left to right: rate curve and signal-response curve

Typo report: Box1 equation, dR/dt should be $k_2 \cdot R$ instead of $k_2 \cdot X \cdot R$

Figure 1f: positive feedback mutual inhibition (toggler)

Code link: (https://github.com/frankligy/exercise_codes/blob/master/ODE/script.py/#L333-L400)

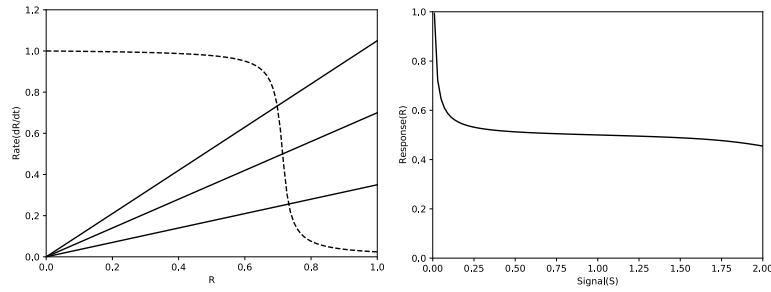


From left to right: rate curve and signal-response curve

Typo report: Box1 equation, $E(R)$ should be $G(k_4, k_3R, J_3, J_4)$

Figure1g: negative feedback, homeostasis

Code link: (https://github.com/frankligy/exercise_codes/blob/master/ODE/script.py/#L403-L446)



From left to right: rate curve and signal-response curve

Figure2a: negative feedback, oscillator (blinker)

Code link: (https://github.com/frankligy/exercise_codes/blob/master/ODE/script.py/#L448-L480)