Simulation of an exclusive genetic switch

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Simulation part of Homework 2.3

set parameters

I used the default parameter set as in Figure 3, but leave alpha0 flexible (the value depends on k).

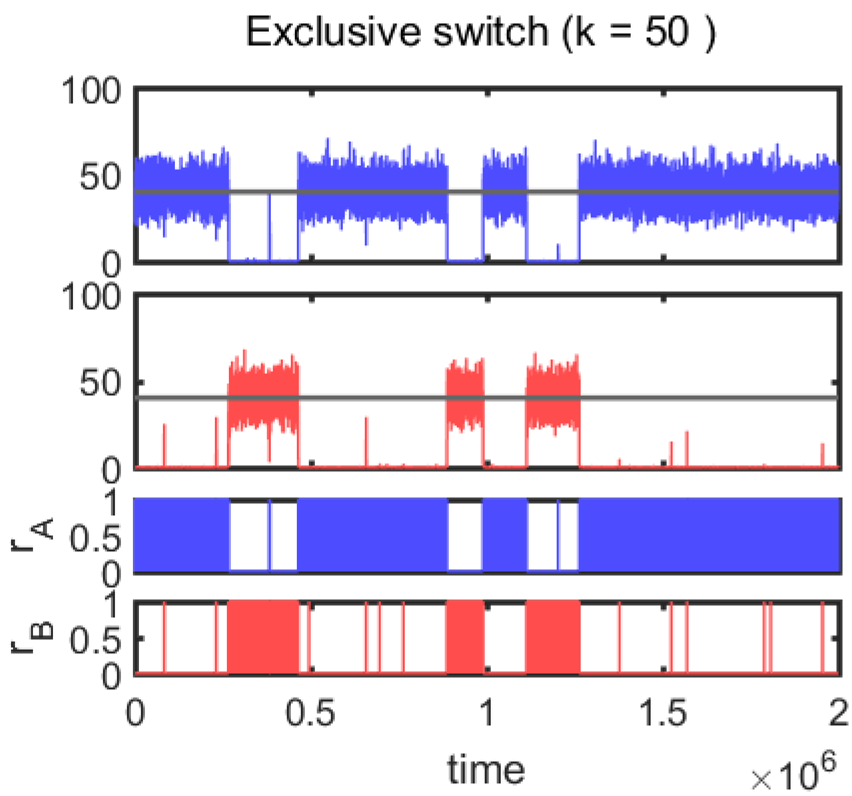
```
    clear; clc
global k  gA gB dA dB alpha0 alpha1
    gA = 0.2;      gB = 0.2;
    dA = 0.005;  dB = 0.005;
    alpha1 = 0.01;
 % initial value, as in the text
    X0 = [gA/dA, 0, 0 0];      % [A B rA rB]
    rng(1) % set seed
```

Simulations

```
I used the Gillespie method to simulate the system with k = 50, k = 1, k
= 0.05, and k = 0.005.
```

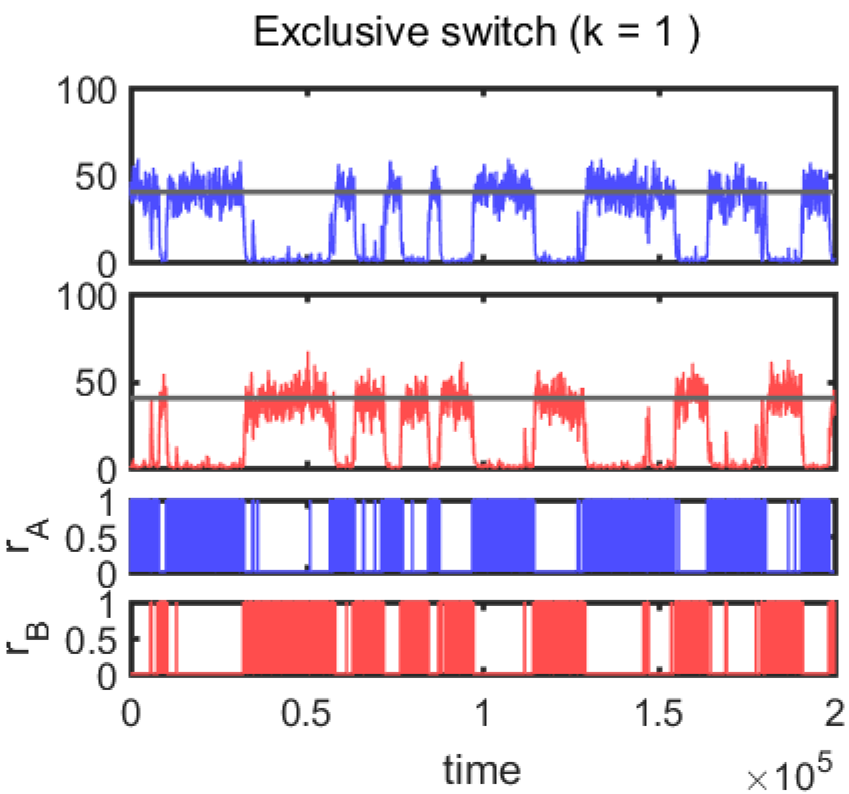
k = 50

```
   k = 50;
       alpha0 = alpha1*k;
       tlim = 2e6;
% Simulation:
    [t, x] = switchGillespie(X0, tlim);
% Plotting the results: The plotting scripts are saved in a separate
 m-file
    script_plot_switchGillespie
```



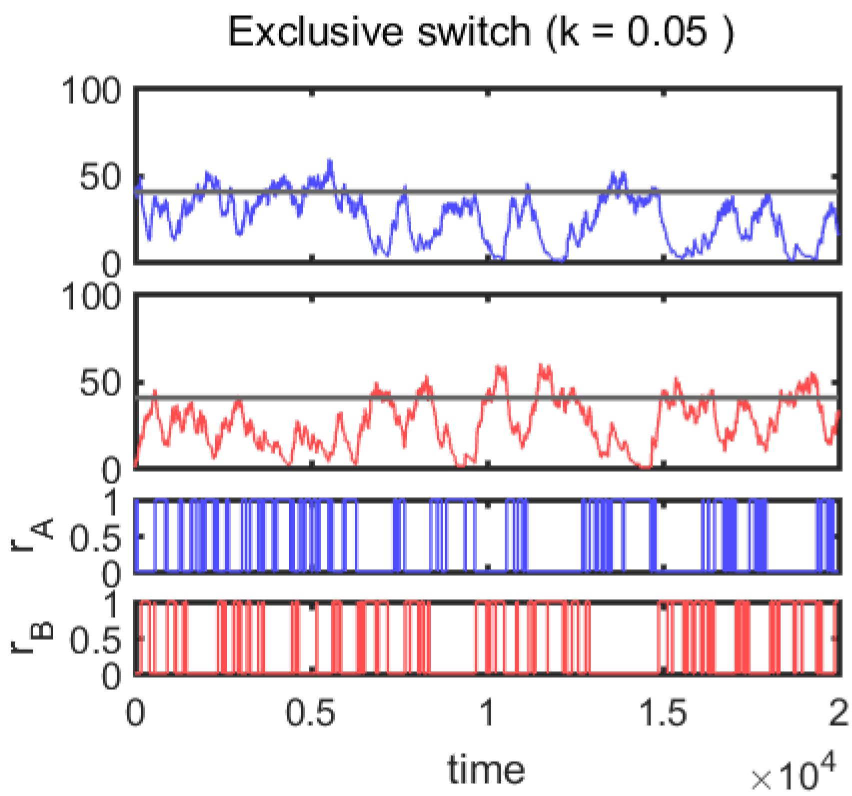
k = 1

```
    k = 1;
        alpha0 = alpha1*k;
        tlim = 2e5;
% simulation
     [t, x] = switchGillespie(X0, tlim);
% plotting the results
     script_plot_switchGillespie
```



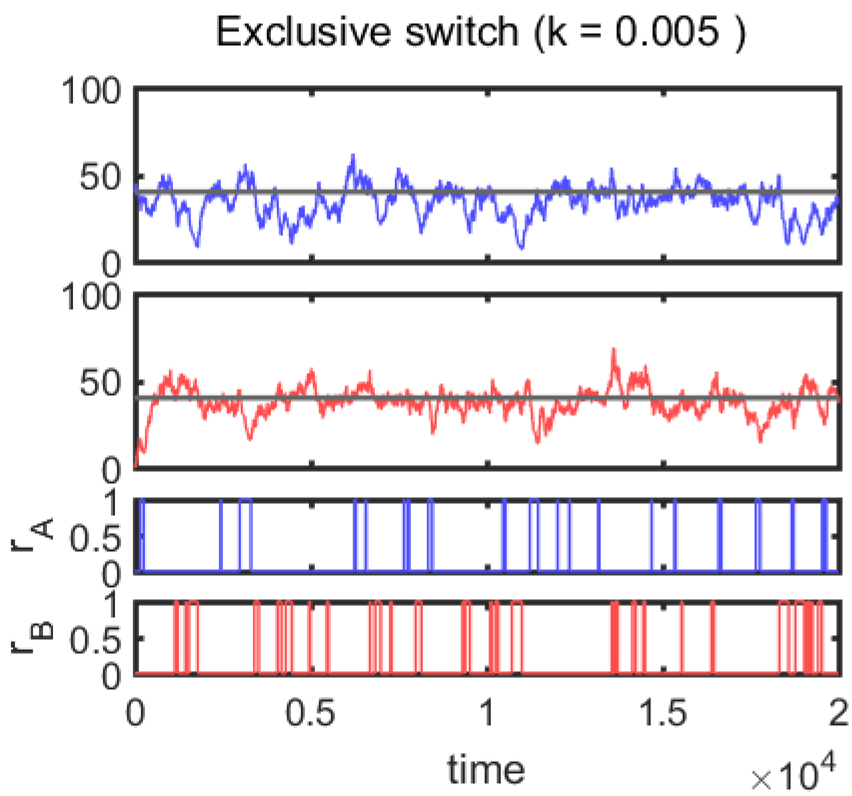
k = 0.05

```
k = 0.05;
    alpha0 = alpha1*k;
    tlim = 2e4;
% simulation
    [t, x] = switchGillespie(X0, tlim);
% plotting the results
    script_plot_switchGillespie
```



k = 0.005

```
k = 0.005;
    alpha0 = alpha1*k;
    tlim = 2e4;
% simulation
  [t, x] = switchGillespie(X0, tlim);
% plotting the results
  script_plot_switchGillespie
```



Synopsis

(Note that the time scales (x-axes) are different in the four plots.)

The switching time between the two states increased with increasing k (increasing alpha0, the binding rate).

With larger k (k = 50 and k = 1) and NA and NB reach the "carrying capacity" (g/d, the gray lines) between the switches, and the exclusive binding site was occupied most of the time (rA = 1 or rB = 1).

With small k (k = 0.05 and k = 0.005), NA and NB both fluctuate about the the carrying capacity, the switches is much more frequent and thus not obvious on the plots. The exclusive binding site was not occupied for a lot of times points (rA = rB = 0), thats when the fluctuatuation of NA and NB seem unrelated.

Published with MATLAB® R2016b