

Assignment 2

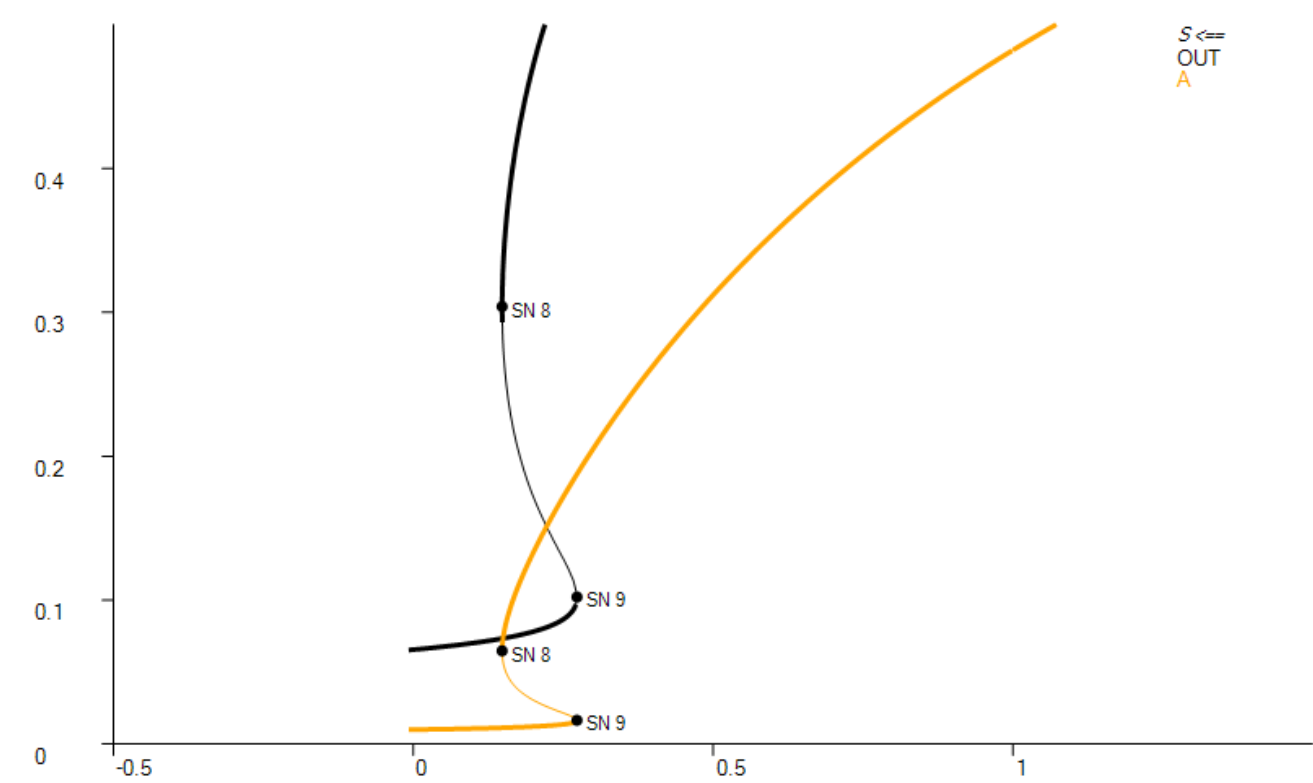
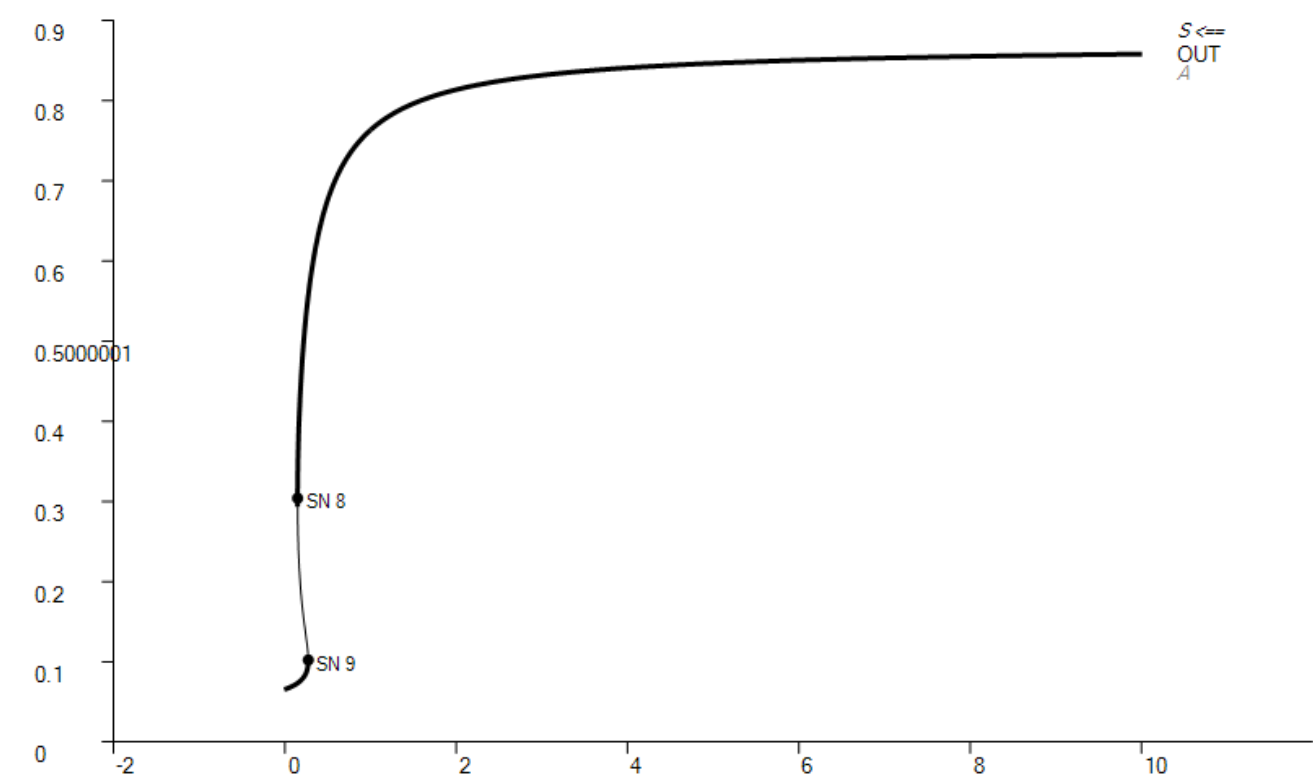
221505023 张牧原

Bifurcation Analysis

One Loop

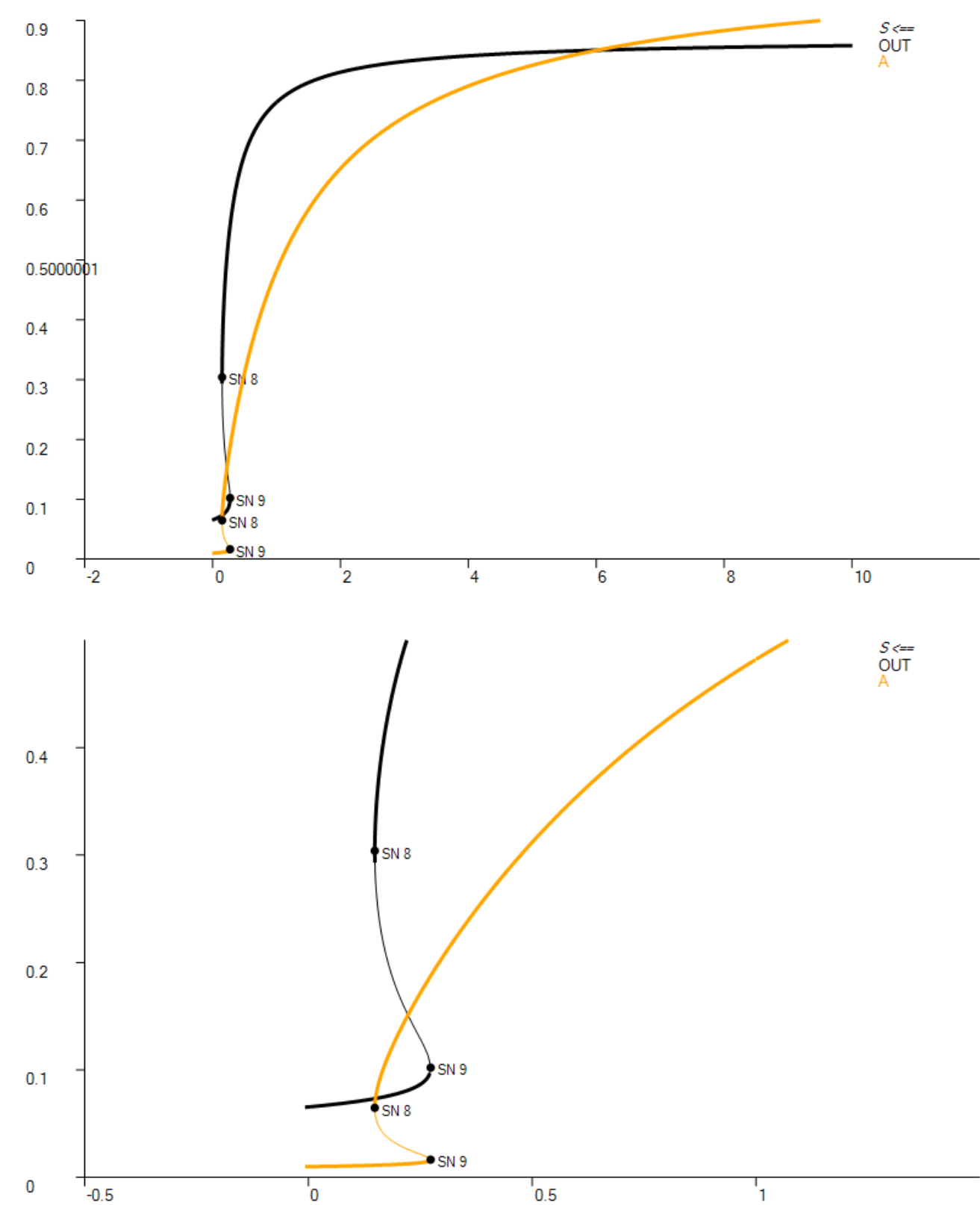
- 1. one fast loop

bifurcation diagram of one fast loop



2. one slow loop

bifurcation diagram of one slow loop

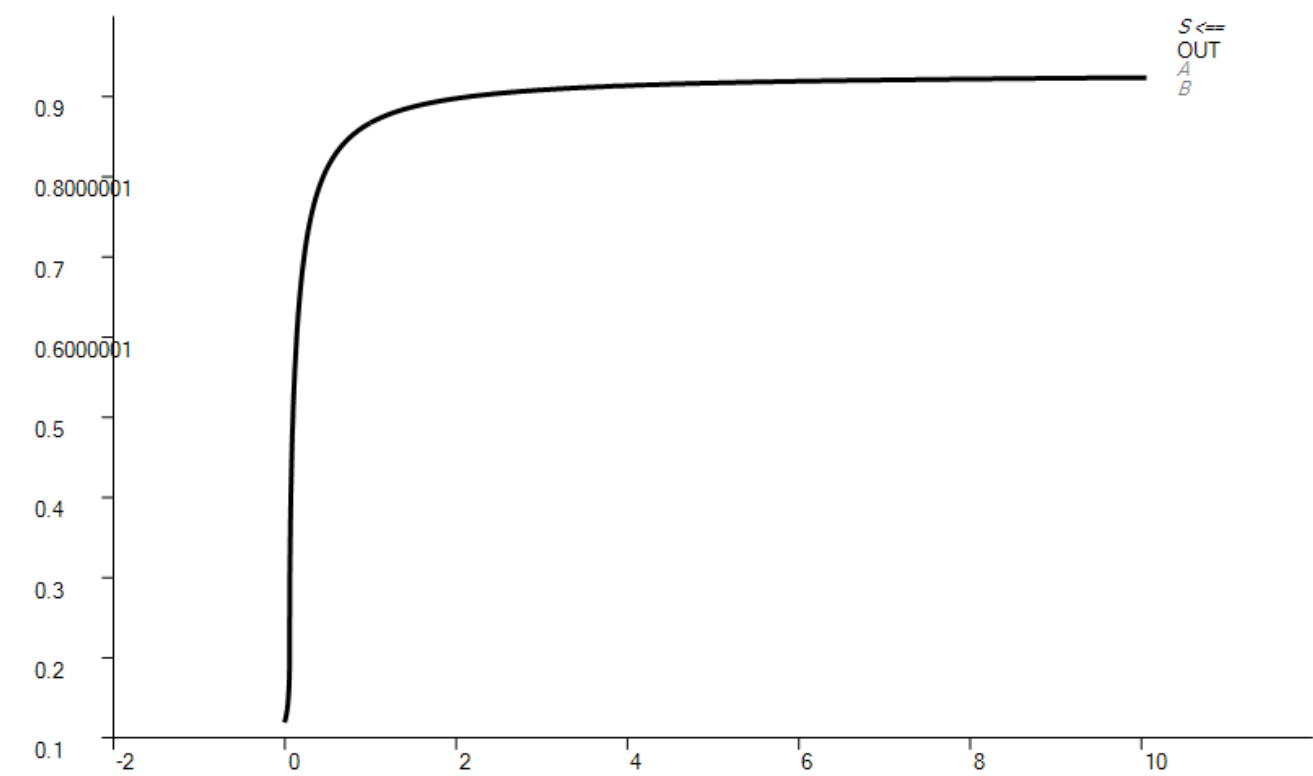


Both one-loop systems share the same bifurcation character, which contains TWO bifurcation points (SN).

Two Loops

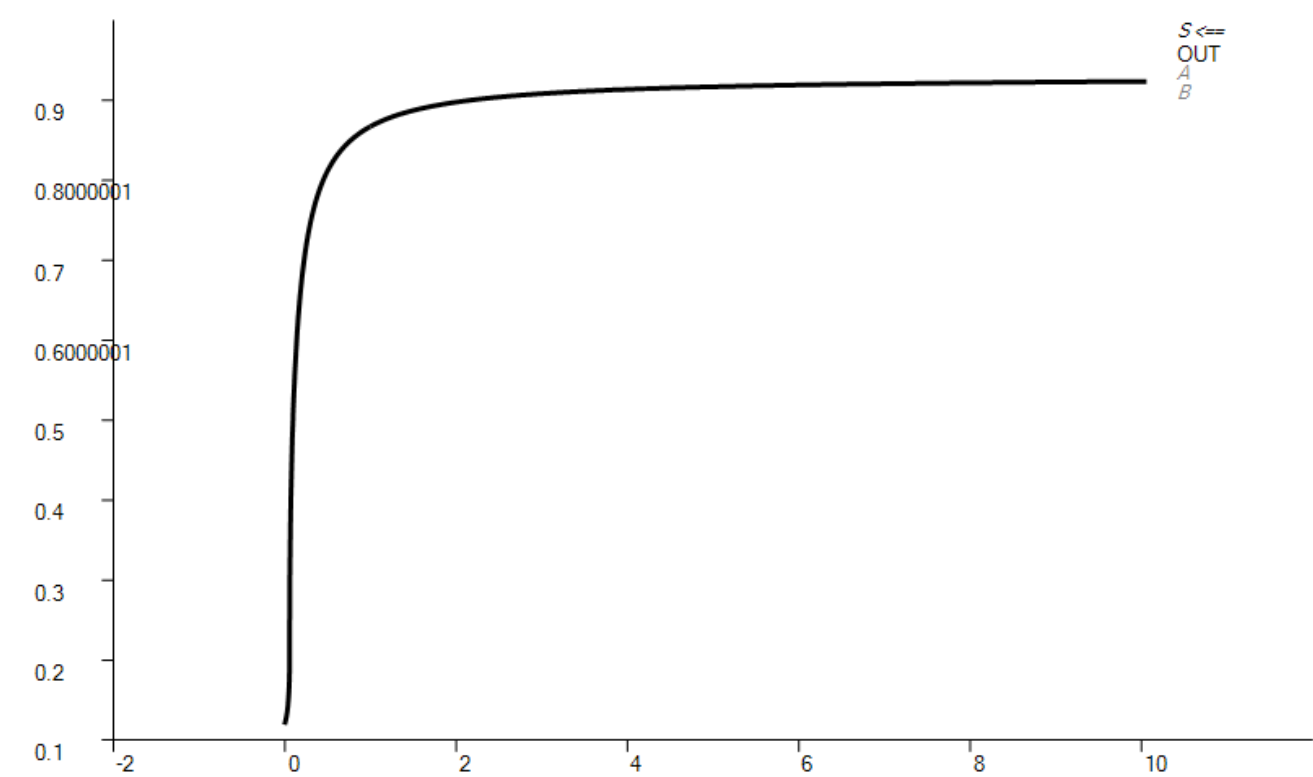
- 1. Two fast loops

bifurcation diagram of two fast loops



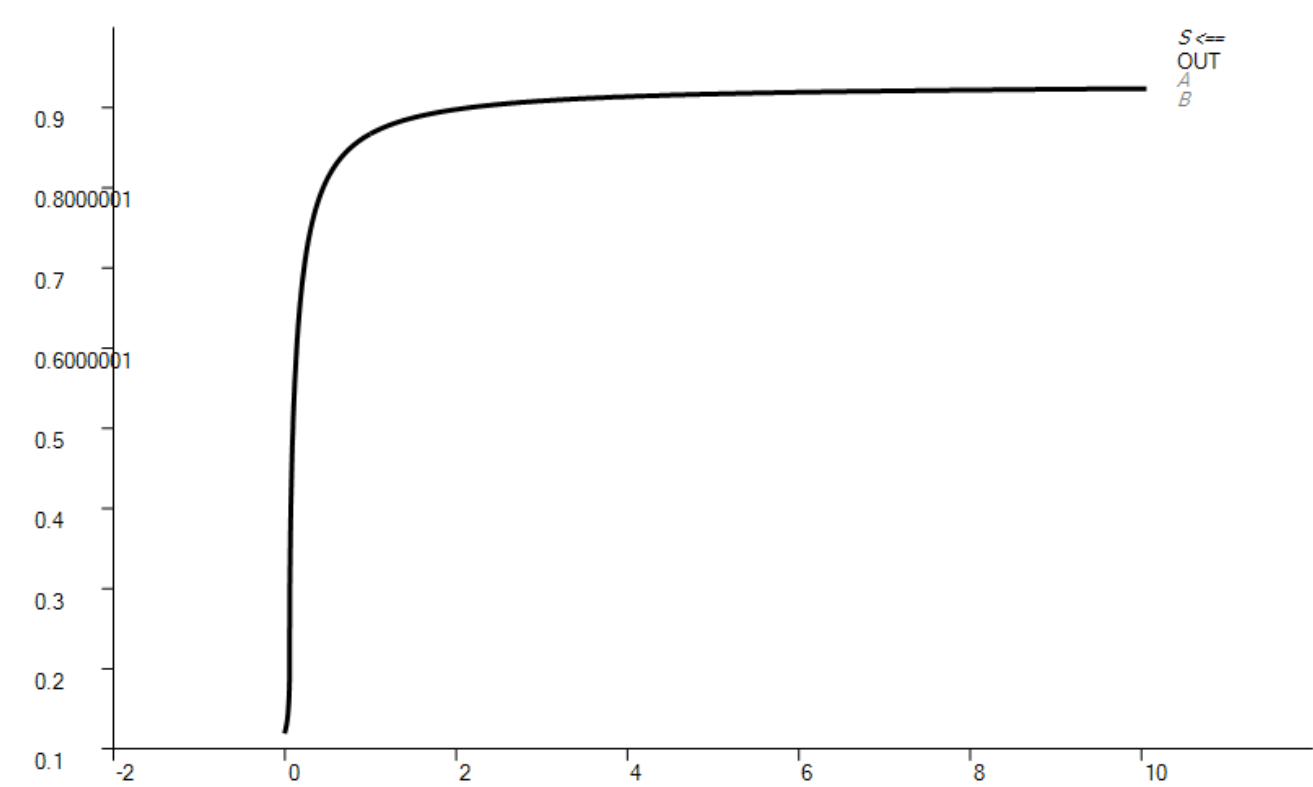
2. Two slow loops

bifurcation diagram of two slow loops



3. One slow and one fast loops

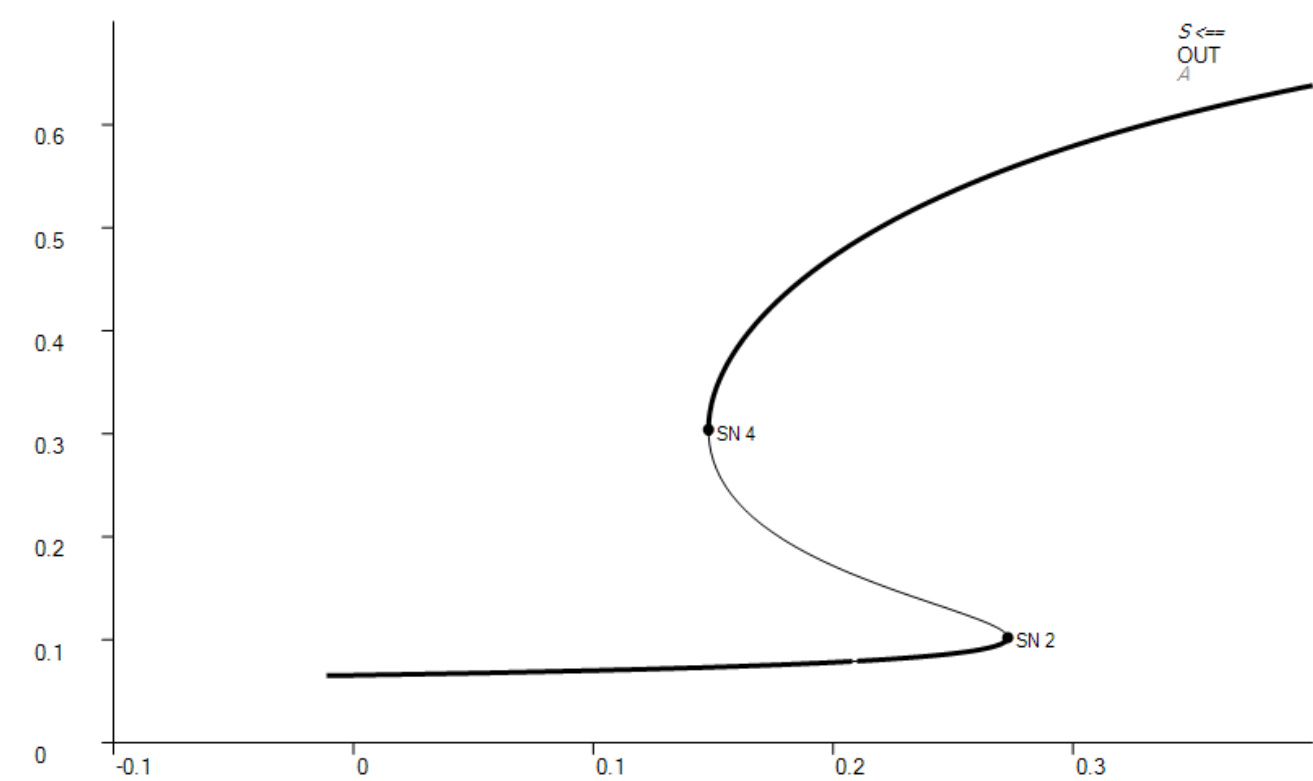
bifurcation diagram of One slow and one fast loops



All of the two-loop systems share the same bifurcation character, which contains NO bifurcation point.

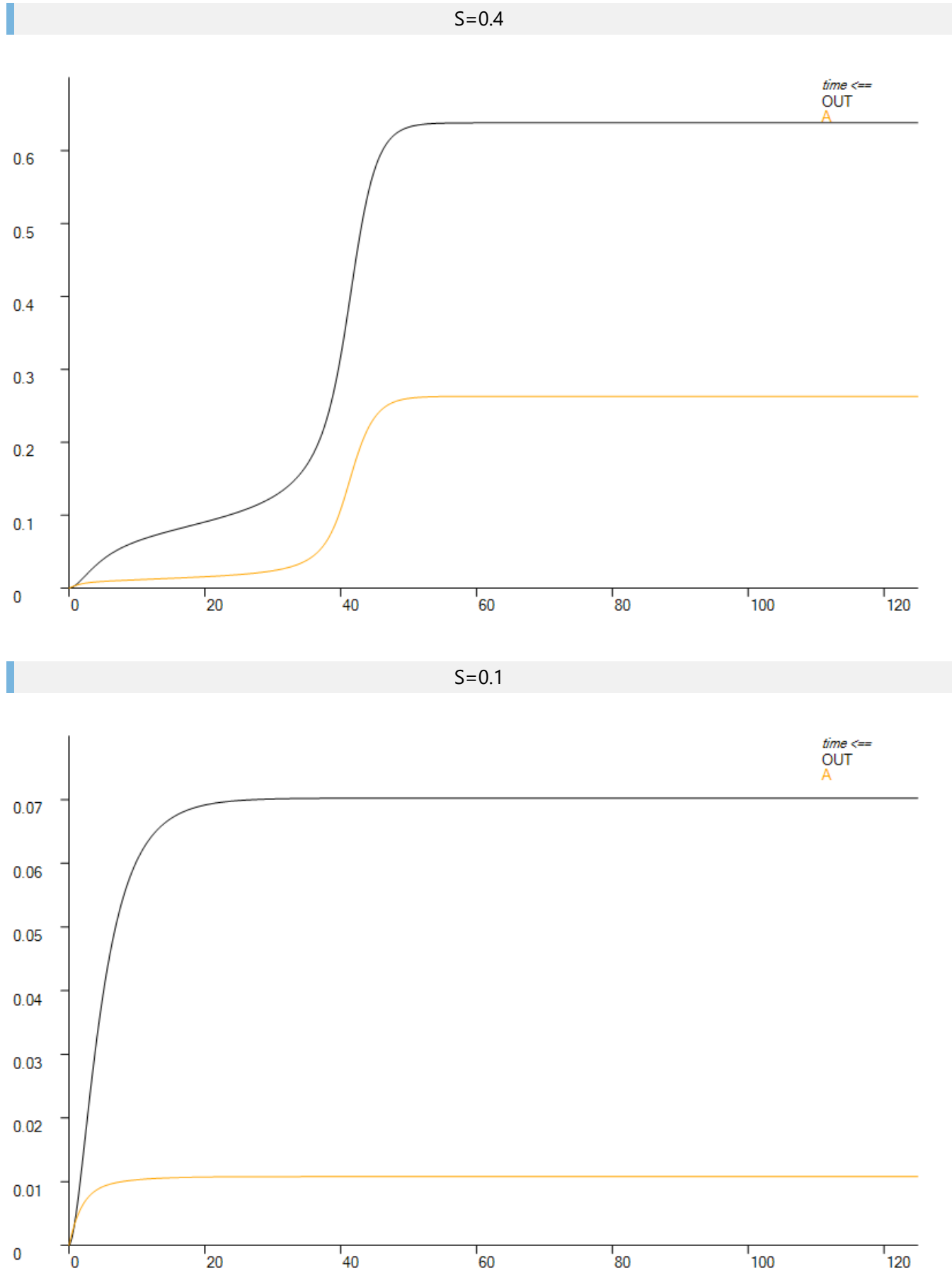
History-(In)dependent Properties of the System

Let's take the one-fast-loop system for instance. From bifurcation analysis above, we can infer that one-loop systems contains 2 SN points on approximately $S=0.15$ & 0.28 . Between them is called a bistable area, where coexist two steady states, one at a higher concentration of OUT , the other at a lower concentration of OUT .



To illustrate the history-dependent properties of the system, it's acceptable to find distinct steady states of

[OUT] and [A] outside the bistable area (here I chose $S=0.1$ and $S=0.4$). Then use them as two different sets of initial conditions of OUT and A to illustrate the "history effect" on system.

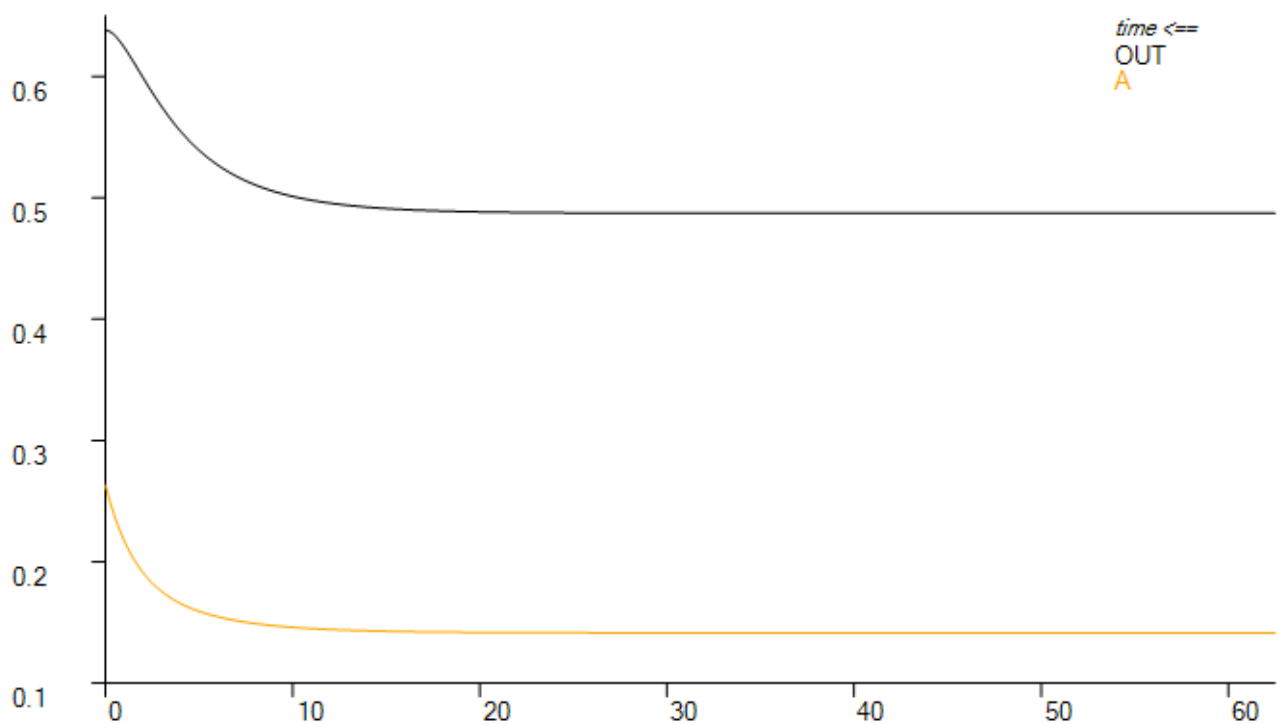


The result goes:

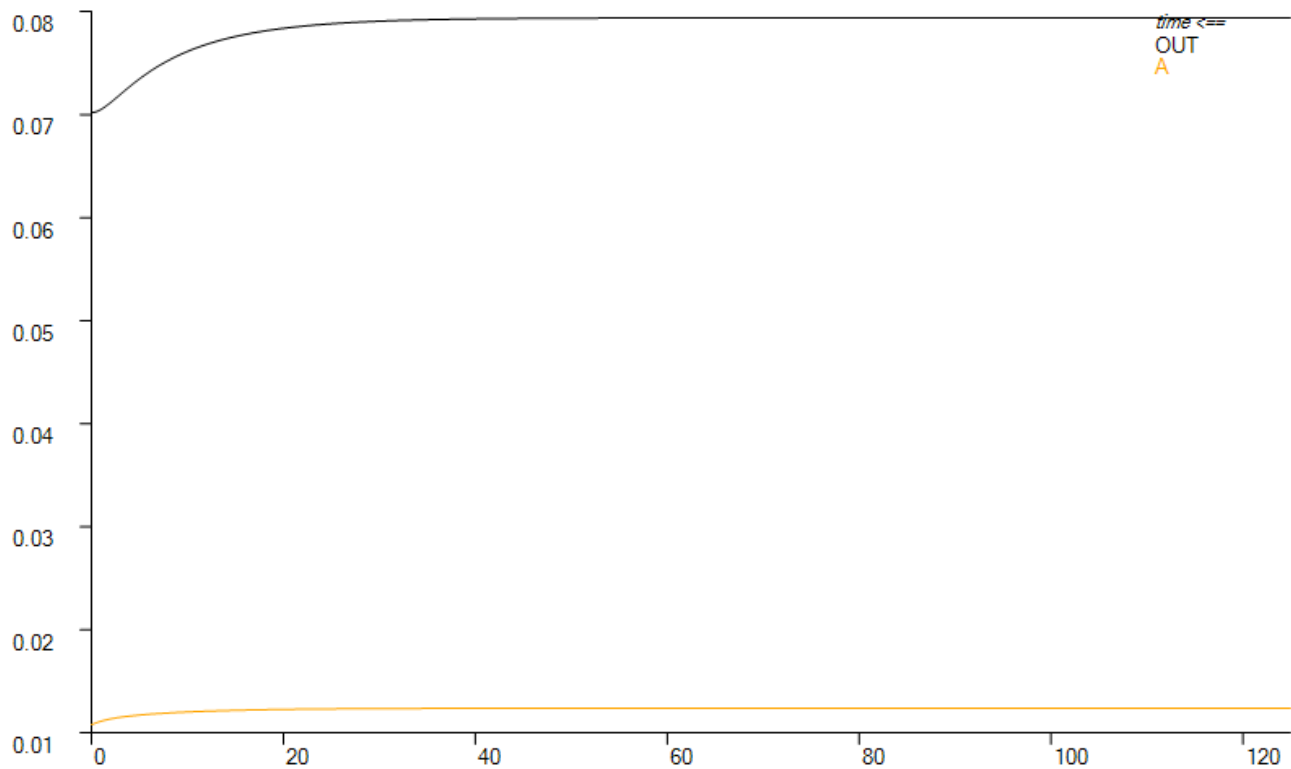
```
S=0.4 steady state:  
  [OUT]=0.638  
  [A]=0.263  
  it shows higher concentrations  
S=0.1 steady state:  
  [OUT]=0.0702  
  [A]=0.0108  
  it shows lower concentrations
```

Now it's time to invest the two different sets of initial conditions into the bistable area of the system (here I chose $S=0.21$). The result goes:

higher concentration set of initiation



lower concentration set of initiation



The result goes,

```
S=0.21,init=high,steady state:  
  [OUT]=0.487;  
  [A]=0.1415;  
S=0.21,init=low,steady state:  
  [OUT]=0.0794;  
  [A]=0.0124;
```

which means two different set of initial conditions can drive the same system into two different steady state, during bistable area.

DONE