DiffEqBiological Tutorial III: Steady-States and Bifurcations

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Several types of steady state analysis can be performed for networks defined with DiffEqBiological by utilizing homotopy continuation. This allows for finding the steady states and bifurcations within a large class of systems. In this tutorial we'll go through several examples of using this functionality.

We start by loading the necessary packages:

```
using DiffEqBiological, Plots
gr(); default(fmt = :png);
```

0.0.1 Steady states and stability of a biochemical reaction network.

Bistable switches are well known biological motifs, characterised by the presence of two different stable steady states.

```
bistable_switch = @reaction_network begin
    d,    (X,Y) → ∅
    hillR(Y,v1,K1,n1), ∅ → X
    hillR(X,v2,K2,n2), ∅ → Y
end d v1 K1 n1 v2 K2 n2
d = 0.01;
v1 = 1.5; K1 = 30; n1 = 3;
v2 = 1.; K2 = 30; n2 = 3;
bistable_switch_p = [d, v1 ,K1, n1, v2, K2, n2];
```

```
7-element Array{Float64,1}:
  0.01
  1.5
 30.0
  3.0
  1.0
 30.0
  3.0
```

The steady states can be found using the `steady_states` function (which takes a reaction network and a set of parameter values as input). The stability of these steady states can be found using the `stability` function.

```
ss = steady_states(bistable_switch, bistable_switch_p)
```