

Net: spnNet_sim_example.project

Manual sections/chapters:

4.1.5 (SPN – Stochastic Petri nets)

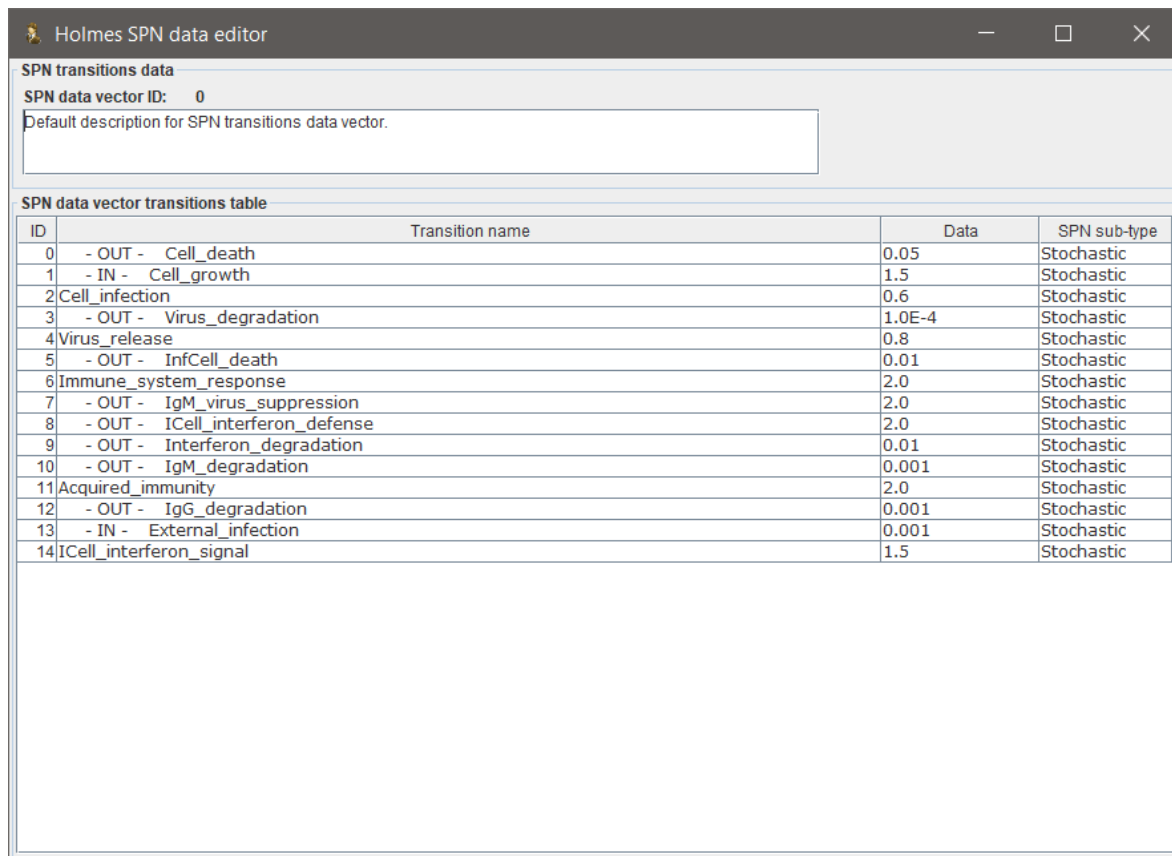
6.3 and **6.3.2** (stochastic simulator / firing rates manager)

6.5 (State Simulator window and its features)

Description of the example:

A simplified model of virus infection and the immunological system response given as stochastic Petri Net (SPN). Using the simulator (menu **Analysis** -> **State Simulator** (Ctrl+Q)) the dynamic behavior of the system can be seen. In **SimSettings** window (activated with a button with gear icon), 60 000 steps have to be set, with the **Simulator selection** set to „**Stochastic simulation for SPN**“. Also, **Mass Action Kinetics enabled** option is being set.

Net of this type requires firing rate values assigned for each stochastic transition. In the example model, the values are given as follows (window available by clicking **SimSettings** (button) -> **Fire Rate Manager** (button) -> (after selecting firing rate vector, 1st default one in the project file is already selected) -> **Edit SPN vector** (button) :



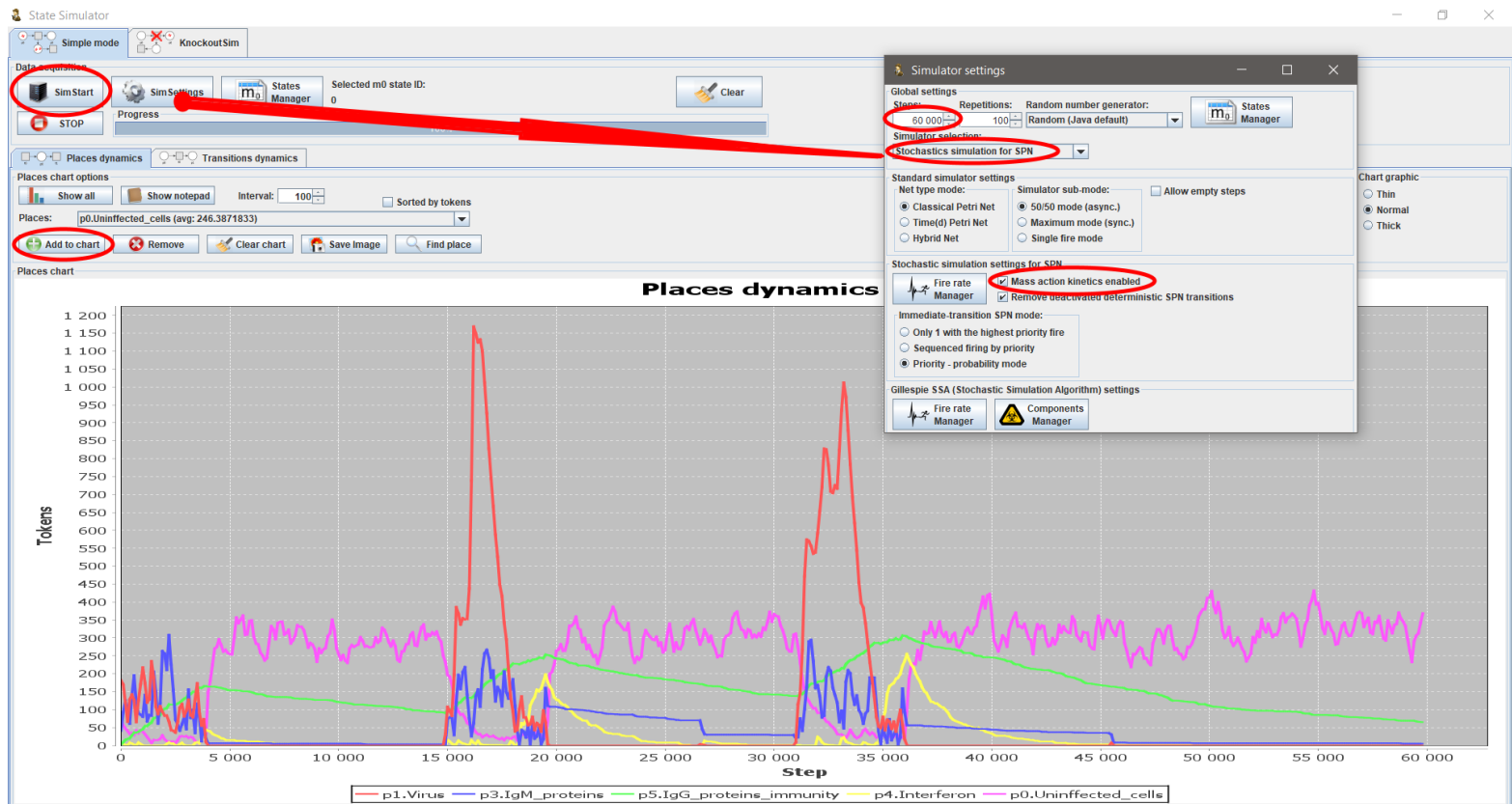
The screenshot shows the 'Holmes SPN data editor' window. It contains a section for 'SPN transitions data' with a text box for 'SPN data vector ID' (set to 0) and a description field. Below this is a table titled 'SPN data vector transitions table' with columns for ID, Transition name, Data, and SPN sub-type. The table lists 14 transitions with their respective firing rates and sub-types.

ID	Transition name	Data	SPN sub-type
0	- OUT - Cell_death	0.05	Stochastic
1	- IN - Cell_growth	1.5	Stochastic
2	Cell_infection	0.6	Stochastic
3	- OUT - Virus_degradation	1.0E-4	Stochastic
4	Virus_release	0.8	Stochastic
5	- OUT - InfCell_death	0.01	Stochastic
6	Immune_system_response	2.0	Stochastic
7	- OUT - IgM_virus_suppression	2.0	Stochastic
8	- OUT - ICell_interferon_defense	2.0	Stochastic
9	- OUT - Interferon_degradation	0.01	Stochastic
10	- OUT - IgM_degradation	0.001	Stochastic
11	Acquired_immunity	2.0	Stochastic
12	- OUT - IgG_degradation	0.001	Stochastic
13	- IN - External_infection	0.001	Stochastic
14	ICell_interferon_signal	1.5	Stochastic

Then, in State Simulator window **SimStart** button should be pressed.

In the chart below, places can be added to it by selecting from a list and each time pressing „**Add to chart**” button.

Example in Holmes can look as in the following picture (here, Simulator settings window is also shown, however it must be closed to activate the **SimStart** button).



As for the net, it should be noted, that an interesting feature of a double arc is used in the net. This type of arc can, but do not have to counterpart of a read arc. The latter have one weight, the former – two separate ones. In the example, to activate transition *Acquired_immunity*, 150 tokens from *IgG_proteins_immunity* place are necessary. However, then the *Acquired_immunity* fire, it will return only 140 tokens, not 150, as seen on the following picture:

