

A Steering Server for Collaborative Simulation of Quantitative Petri Nets

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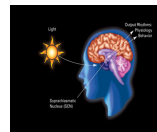
Tunis 2014

Agenda



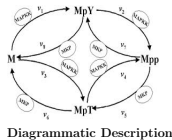
- 1 Introduction
- 2 Interacting with S^4
- 3 Architecture
- 4 Use Case
- 5 Conclusion

Modelling of Biochemical Reaction Networks

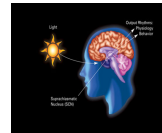


Biological Phenomenon

Modelling of Biochemical Reaction Networks



Understanding



Biological Phenomenon

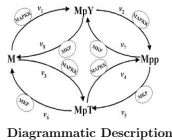
Modelling of Biochemical Reaction Networks



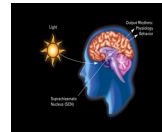
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ODEs

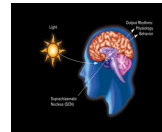
Formulation



Understanding

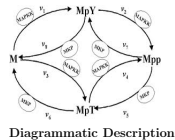


Modelling of Biochemical Reaction Networks



Biological Phenomenon

Understanding



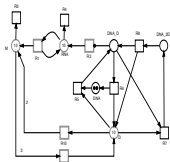
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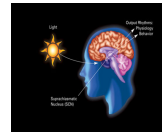
ODEs

Representation



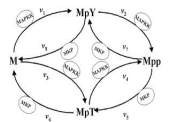
Petri nets

Modelling of Biochemical Reaction Networks



Biological Phenomenon

Understanding



Diagrammatic Description

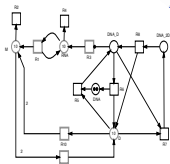
Formulation

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ODEs

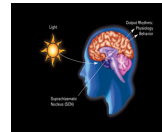
Representation

Formulation/Representation



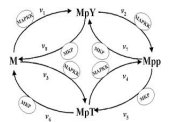
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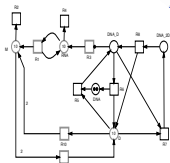
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ODEs

Representation

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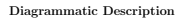


Petri nets

Execution



Simulation



ODEs

Monitoring



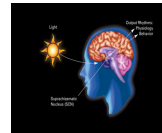
Simulation

Representation

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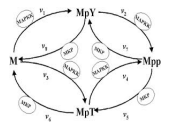


Modelling of Biochemical Reaction Networks



Biological Phenomenon

Understanding



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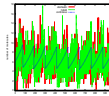
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ODEs

Results



Monitoring



Simulation

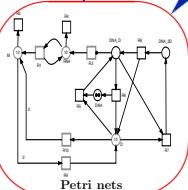
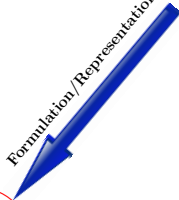
Execution



Representation



Formulation/Representation



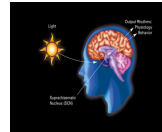
Petri nets

Interpretation

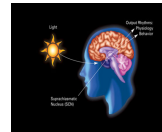


Users

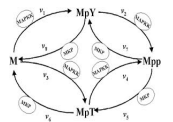




Modelling of Biochemical Reaction Networks



Biological Phenomenon



Diagrammatic Description

Understanding

Formulation

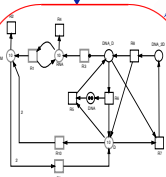
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ODEs

Representation

Formulation/Representation

Execution

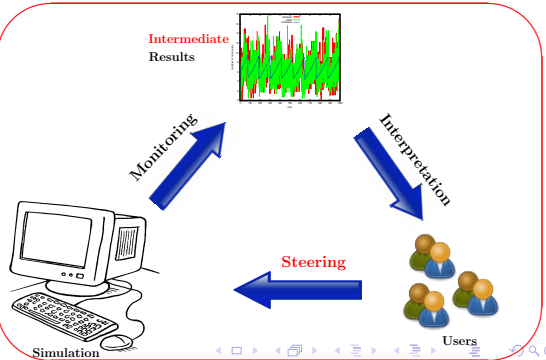


Petri nets

Monitoring

Interpretation

Steering



S^4 – Motivations



- Currently existing Petri net tools focus on facilitating model constructions, but pay little attention to simulation features.
- Certain biological models require sophisticated simulation environments during model execution.
- Utilize the computational power of high performance computers.
- The need to reduce the overall required time to run an experiment.
- The need to promote knowledge sharing between different users.

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S^4 – Features



- Remotely run and control a simulation.
- Execution of one model using different simulation algorithms.
- Managing different models concurrently with possibly different simulators.
- Defining different views to explore simulation results.
- Exploring the running models on-the-fly.

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S^4 – Features (Cont.)



- Steering simulation parameters while a simulation is running.
- Controlling the simulation speed.
- Connecting to a simulation at any time from whatever place.
- Collaborating with other people while simulating a model.
- Platform-independent implementation.

S^4 – Features (Cont.)



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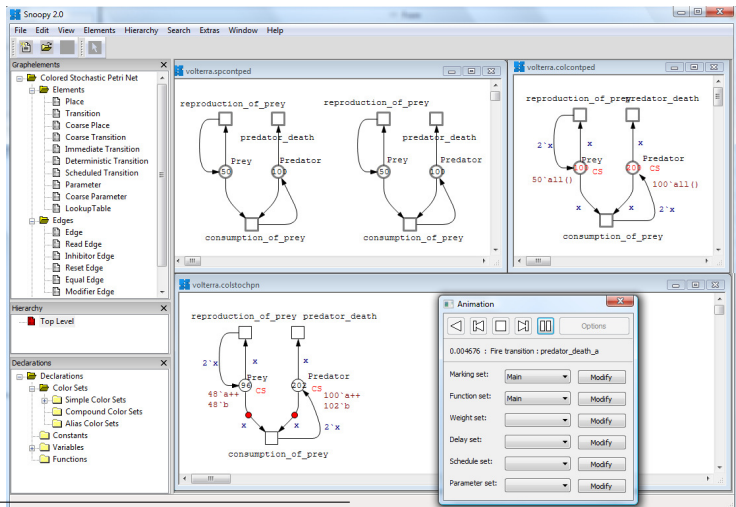
Model Definition



We can define a model via:

- Snoopy
- Application Programming Interface

Model Definition via Snoopy¹



¹Heiner et al. 2012

M. Herajy and M. Heiner 2014

Snoopy Steering and Simulation Server - S^4



Model Definition via API

```
spssa::Model* CreateModel()
{
    //The model is named "My model" with one transition and three places
    spssa::Model* l_pcMyModel=new spssa::Model (NULL,wxT("My Model"),1,3);

    return l_pcMyModel;
}

void AddPlaces(spsa::Model* p_pcModel)
{
    //add the places
    spsa::VectorString l_asPlaceNames;
    l_asPlaceNames.clear ();

    //p1
    l_asPlaceNames.push_back (wxT("p1"));
    //p2
    l_asPlaceNames.push_back (wxT("p2"));
    //p3
    l_asPlaceNames.push_back (wxT("p3"));

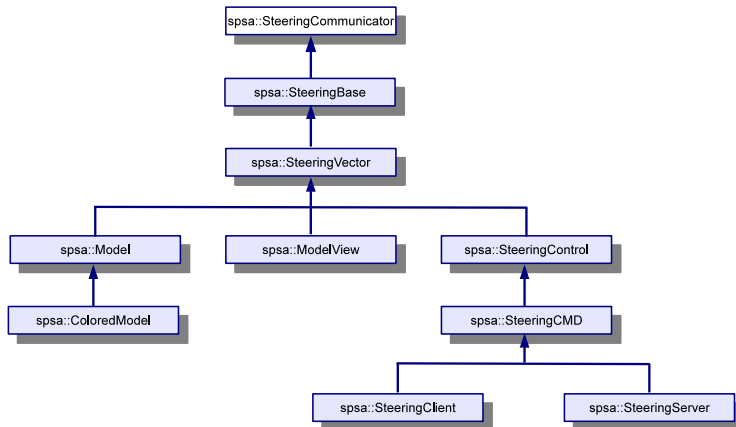
    //set place names
    p_pcModel->SetPlaceNames(l_asPlaceNames);

    //Set place types
    spsa::VectorPlaceType l_asPlaceTypes;
```

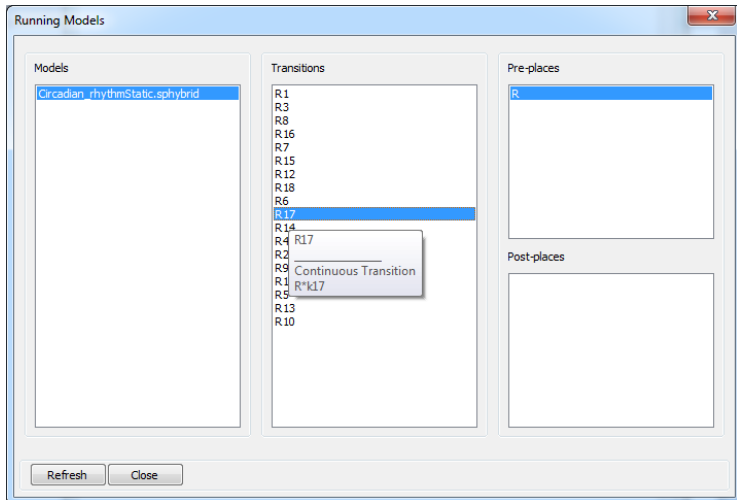




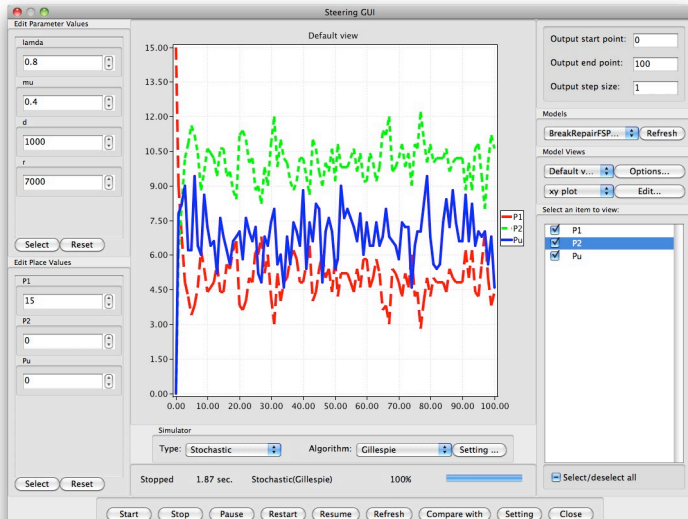
Model Definition via API (Cont.)



Model Exploration

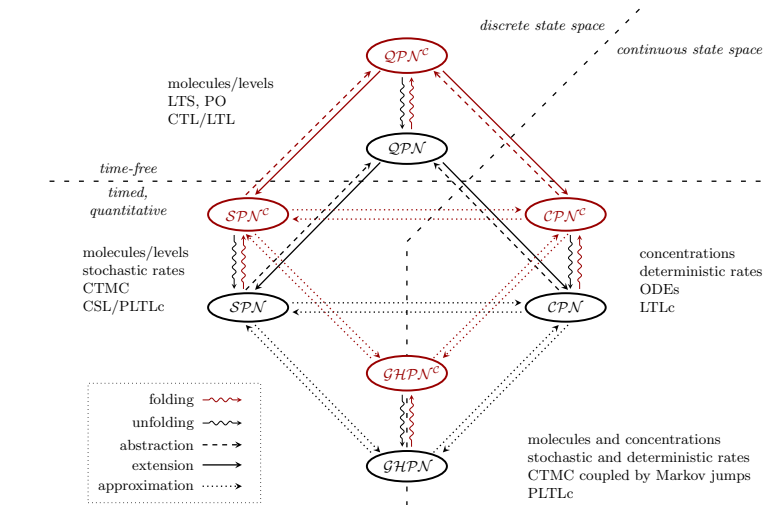


Monitoring and Steering





Supported Petri Net Classes ²

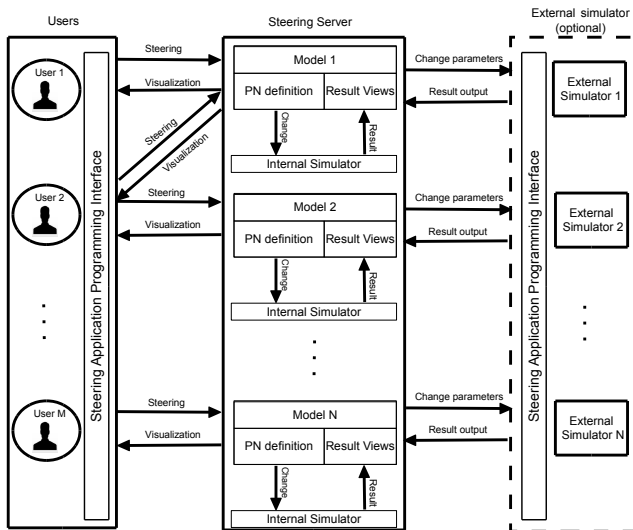


²Heiner et al. 2012

M. Herajy and M. Heiner 2014

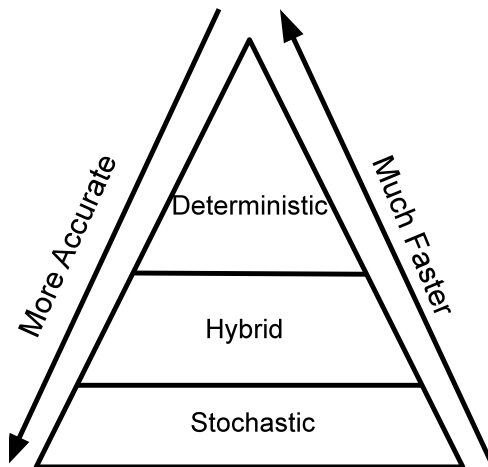
Snoopy Steering and Simulation Server - S^4

Architecture





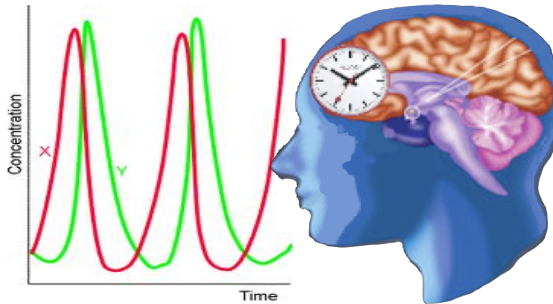
Available Simulators³



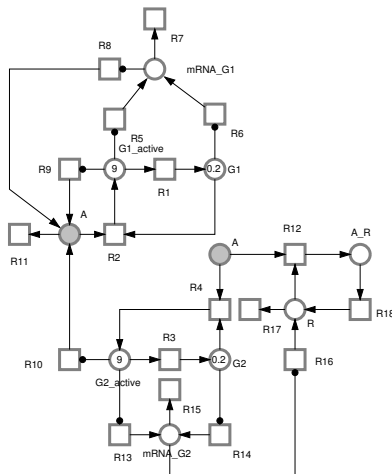
³M. Herajy and M. Heiner 2012

Use Case

Circadian Oscillation

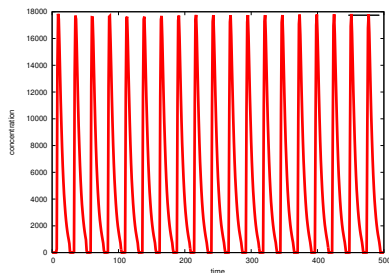


Circadian Oscillation



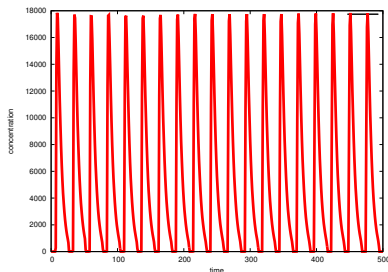
50 k1	1 k2
100 k3	1 k4
500 k5	50 k6
10 k7	50 k8
50 k9	100 k10
1 k11	2 k12
50 k13	0.01 k14
0.5 k15	5 k16
0.2 k17	1 k18

Circadian Oscillation (Cont.)

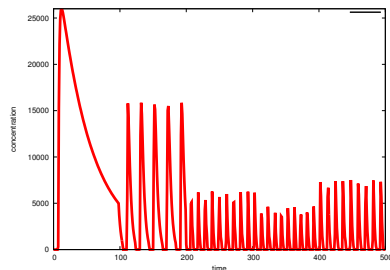


Without S^4

Circadian Oscillation (Cont.)



Without S^4



With S^4

Live Demo using S^4

For More Information:



- Visit our website: <http://www-dssz.informatik.tu-cottbus.de/DSSZ/Software/Snoopy>
- S^4 user manual
- Join us at the Tools Exhibition, Thursday 13:30

Thank You