Petri Net Based System Analysis
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Verification of Technical Systems
- requirements certification
- quality improvement
- proof engineering

Typical Net Properties
- ordinary
- 1-bounded
- live, reversible
- communicating state machines
- exponential, state space growth

Production Cell [16]

Apoptosis in Mammalian Cells [15]

Conceptional Framework

Verification of Technical Systems
- requirements certification
- quality improvement
- proof engineering

Typical Net Properties
- ordinary
- 1-bounded
- live, reversible
- communicating state machines
- exponential, state space growth

Validation of Natural Systems
- understanding
- experiment design
- behaviour prediction

Typical Net Properties
- non-ordinary
- k-bounded / unbounded
- live, reversible, BUT: how to prove?
- apparently unstructured
- over-exponential state space growth

Tool Kit

Static – Net Structure
- Net classes
- Deadlock Trap Property
- Place/Transition invariants
- Dependent Sets

Dynamic – Reachability graph
- Liveness, reversibility, dead states
- Explicit CTL/LTL model checker
- Path search
- Visualization
- Analysis of TPN
- Shortest/Longest paths

Modelling/Animation
- Different Petri net formalism
  - e.g., QPN, (X)SPN, CPN, GHPN, TPN
- Colored nets: QPN, (X)SPN, CPN, GHPN
- Hierarchies, Coloring

Analysis
- Stochastic Simulation Algorithm (SSA)
- Stiff/unstiff ODE solvers
- Fast adaptive uniformization (FAU)

Import/Export
- SBML, (C)ANDL, CSV

Qualitative Analysis of bounded nets
- Symbolic State Space representation with Interval Decision Diagrams (IDDs)
- Reversibility, liveness, dead states, SCCs
- CTL model checking

Numerical Analysis of bounded (G)SPNs
- IDD-based “on-the-fly” CTMC representation
- Transient/steady-state analysis (multi-threaded)
- CSRL model checking (multi-threaded)

Simulation Analysis of unbounded (X)SPN
- Stochastic Simulation Algorithm (SSA)
- PLTLc model checking

References

Analysis Methods / Tools
- CHARLIE
- MARCIE

Analysis
- Fast adaptive uniformization (FAU)

Applications
- Numerical Analysis of bounded (G)SPNs
  - IDD-based “on-the-fly” CTMC representation
  - Transient/steady-state analysis (multi-threaded)
  - CSRL model checking (multi-threaded)

Theses

Cooperations
- Gianfranco Balbo, Univ. Torino
- Rainer Breitling, Univ. Glasgow
- David Gilbert, Brunel Univ. London
- Jetty Kleijn, Univ. Leiden
- Kurt Lautenbach, Univ. Koblenz
- Wolfgang Manwan, Univ. Magdeburg
- Louchka Popova-Zeugmann, HU Berlin
- K. Siram, IIT Delhi, India
- Soliman Sylvain, INRIA Paris