HoliDes

HOLISTIC HUMAN FACTORS AND SYSTEM DESIGN
OF ADAPTIVE COOPERATIVE HUMAN-MACHINE SYSTEMS

GreatSPN

Modelling and verification of systems.

ARTEMIS

Motivation

GreatSPN is a software framework for modeling, verifying and evaluating performance measures on systems using Generalized Stochastic Petri Nets.

The framework is composed by several tools, including a user-friendly GUI, that allows the modeler to draw an abstract representation of the modeled system using the different formalisms:

- PN/GSPN: Petri nets (place/transition nets), and Generalized Stochastic Petri nets;
- CPN/SWN: Coloured Petri nets (aka symmetric nets), and Stochastic Well-formed nets (SWN);
- MDPN/MDWN: Markov Decision Petri Nets with/without colors;
- MDP process with parametric uncertainty.

Techniques:

Structural analysis: place and transition invariants, deadlocks, boundedness, mutual exclusion, …
Properties derivable with linear programming: upper and lower bounds for places and transition through-puts.
State space generation, using advanced techniques like symbolic data structures.
Verification of logical and behavioral properties expressed in the CTL logic.
Numerical analysis of quantitative properties: average place distributions, expected transition throughputs, probability of exposing a specific behavior, …
Simulation techniques available for very large model, where the construction of the reachability graph is impracticable.
Optimization problem, described in the form of Markov Decision Processes (MDP).
Parametric uncertainty on MDP.

Contact Informations

Susanna Donatelli (susi@di.unito.it)
Elvio G. Amparore (amparore@di.unito.it)
Marco Beccuti (beccuti@di.unito.it)

Università degli Studi di Torino
Dipartimento di Informatica
C.so Svizzera 185, Torino, Italy

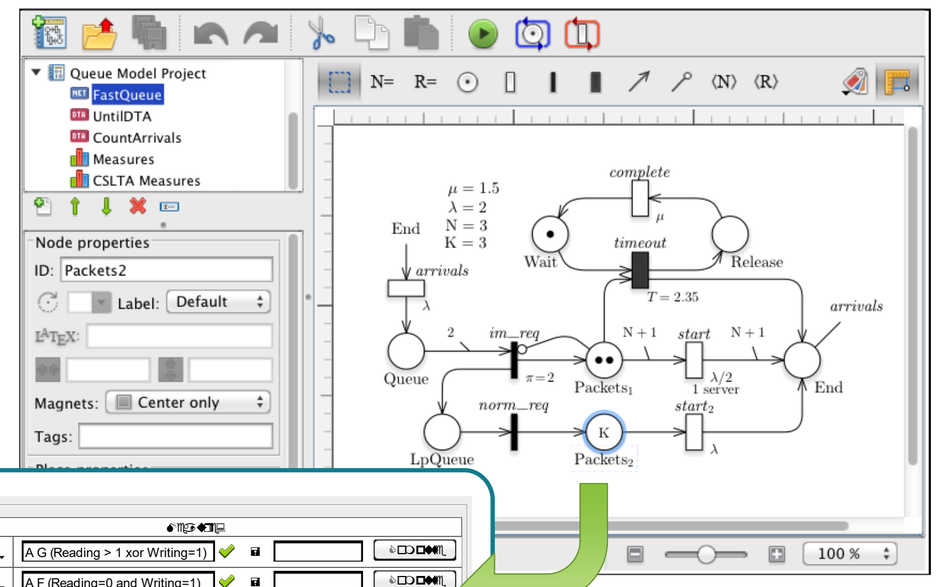
Methods, Techniques, Tools

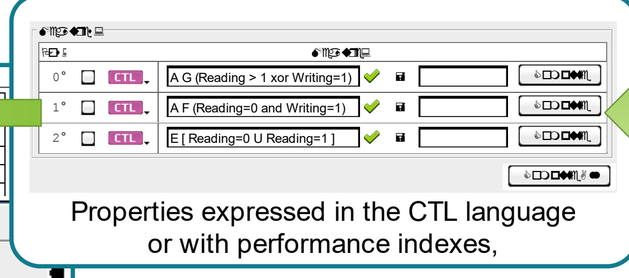
This is a …	X Method	X Technique	X Tool
Method	Analysis & verification of Petri net models		
Technique	Stochastic event-driven simulation		
Tool	GreatSPN framework (*non-lifecycle tool*)		

Overview of GreatSPN improvements in HoliDes

Improvements:
GreatSPN has been improved along several directions:

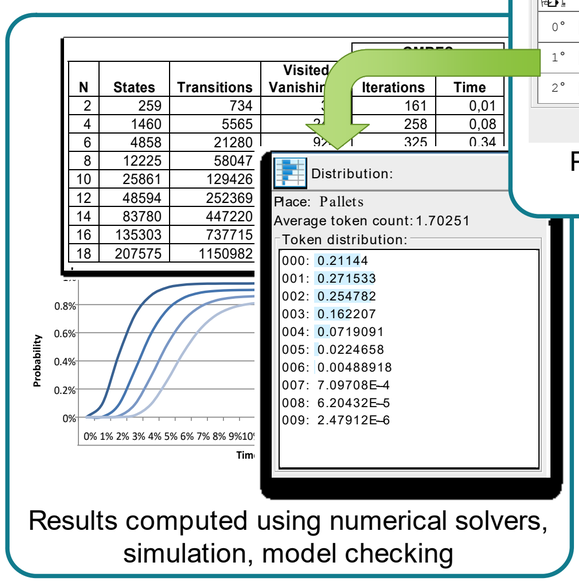
- Interactive token game of SWN models in the GUI
- Uncertainty of MDPs to account for physical sensor data subject to measurement errors.
- Modeling of system with adaptivity using two strategies:
  - marking dependency
  - sensitivity analysis





Properties expressed in the CTL language or with performance indexes,

User draws a model using Petri nets, and then specifies property to be verified by the solvers.



Results computed using numerical solvers, simulation, model checking

Modeling systems with Adaptivity:
Two basic approaches:

- marking dependency (e.g. geo-dependent selection of technicians in WP8 IREN model)
- sensitivity analysis:
  optimization: stability of strategy under parametric variation
  evaluation: of performance indexes for varying sets of parameters (e.g. % of SLA violation for multiple load conditions).

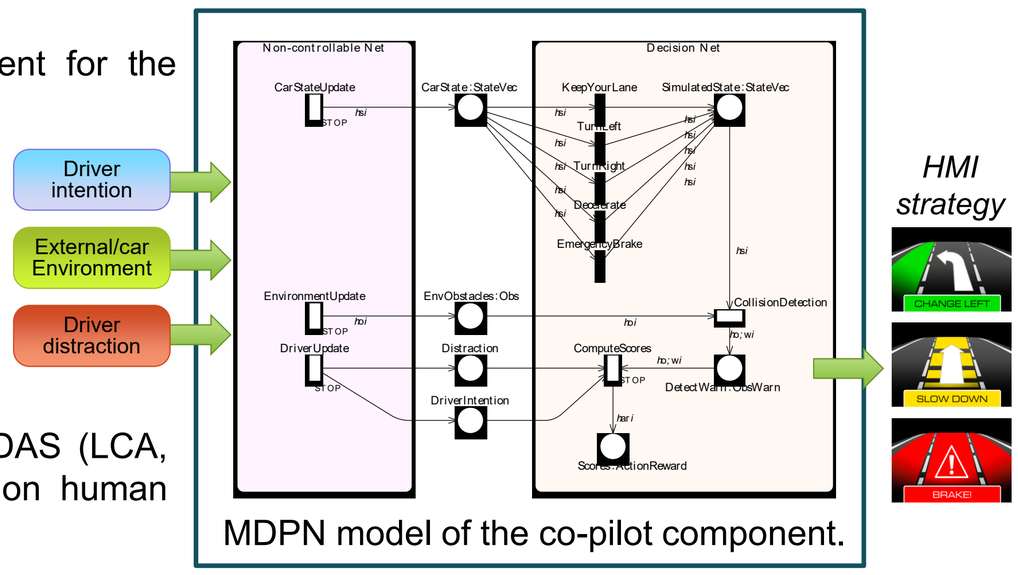
WP9 case study: decision process of the Adaptive Assistance AdCoS

Problem addressed:
Modeling of the Co-Pilot component for the Adaptive Assistance AdCoS.

Co-pilot strategies are planned using the AdCoS information state (*driver intention, distraction, world environment*).

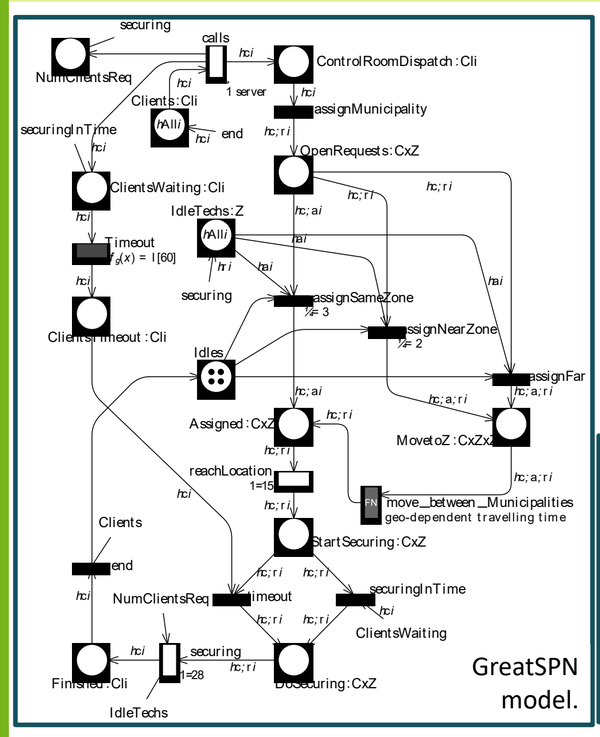
The decision process selects the strategy for the worst-case scenario.

Adaptation: integrates different ADAS (LCA, FCW) & makes them dependent on human factors (*int/distr*).



MDPN model of the co-pilot component.

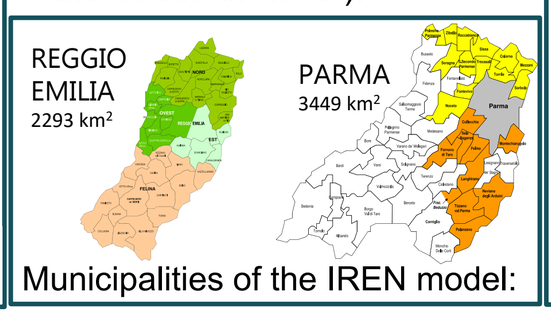
WP8 case study: modelling of the IREN control room.



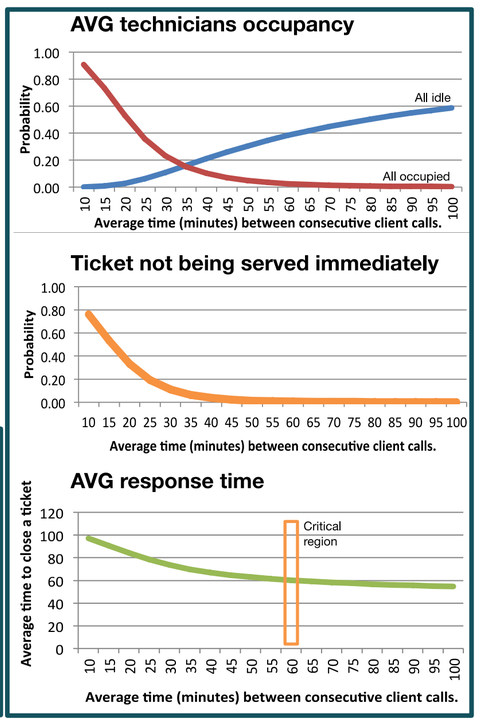
GreatSPN model.

Problem addressed:

- evaluate policies for assigning technicians to incoming client calls at the IREN control room.
- evaluate the rate of incoming calls that can be dealt with, without violating the National Energy Autorithy SLA (max 1 hour limit between client calling and technician on site).



Municipalities of the IREN model:



Consortium

OFFIS INSTITUTE FOR INFORMATION TECHNOLOGY · Atos · DLR · TAKATA · Honeywell · AIRBUS DEFENCE & SPACE · CRF CENTRO RICERCHE FIAT · CIVITEC · AnyWi · HUMATECTS · Human Factors Consult · BRNO UNIVERSITY OF TECHNOLOGY · ibeo · IFSTTAR · INTEGRASYS · INTEMPORA · iren · Lufthansa · AIRBUS GROUP · RE:Lab · UNIVERSITÀ DEGLI STUDI SUOR ORSOLA BENINCASA · tecnalia · PHILIPS sense and simplicity · TWT · ENAC · TRUESTREAM AEROSPACE HUMAN FACTORS · UNIVERSITÀ DEGLI STUDI DI TORINO

Acknowledgments

This research has been performed with support from the EU ARTEMIS JU project HoliDes (http://www.holides.eu) Any contents herein are from the authors and do not necessarily reflect the views of ARTEMIS JU.