Sujet de stage de recherche/ Internship subject M 2 / 4th year / MSc Durée/duration : 4 months

Encadrant/Supervisor

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Title : Petri net unfolding methods for supervisory control

Description :

Supervisors for a Discrete Event System Σ have the task to interact with Σ in such a way that the resulting behaviour of Σ satisfies desirable properties, e.g. a target state class is reached, and avoid undesirable properties such as security violations, overloads and the like. When the "plant", i.e. the system to be controlled, is very large and spatially distributed, Petri net models are more adaquate than automata since the number of global states grows exponentially in the number of state variables. The adaptation of supervisory control methods developped in the realm of finite automata, see [1], to Petri nets is always possible *conceptually*, via the net's state graph, and one can then try to benefit from reduction methods like sleep sets, BDDs etc. The purpose of this internship is, however, to leave completely the state graph representation, and to develop control in an asynchronous, *concurrent* setting via the partial order unfolding of the net. First results in this direction have been obtained by Giua et al [2] ; however, the properties of concurrent processes have not been fully exploited in this approach, which leaves room for improvements in several directions, e.g.

– find efficient constructions of complete *finite* prefixes of the unfolding, building on the framework of [5], that suffice for determining whether a supervisor exists, and for its synthesis ;
– refine the control tasks to be addressed to *weak* properties in the sense of [3, 4] : an event that is not causally dependent on any control action might still be made inevitable through an indirect effect of some action.

The purpose of the internship is to explore some or all of these leads, preferrably leading to efficient implementations that build upon the unfolding tools [6, 7] in the MExICo team .

Références

[1] C. G. Cassandras and S. Lafortune. *Introduction to Discrete Event Systems.* Kluwer Academic Publishers, Boston etc, 1999.

[2] A. Giua and X. Xie. *Control of safe ordinary Petri nets using unfolding.* Discrete Event Dynamic Systems, Vol. 15, No. 4, pp. 349-373, December 2005. `http ://www.diee.unica.it/giua/PAPERS/JOUR/05deds_b_draft.pdf`

[3] S. Haar. Types of Asynchronous Diagnosability and the *Reveals*-Relation in occurrence nets. *IEEE Transactions on Automatic Control* **55**(10), pages 2310–2320, 2010. Preprint at `http ://www.lsv.ens-cachan.fr/Publis/PAPERS/PDF/haar-tac10.pdf`

[4] S. Haar. What Topology Tells us about Diagnosability in Partial Order Semantics. Proceedings *WODES*'10, pages 221–226. 2010. Preprint at : `http ://www.lsv.ens-cachan.fr/Publis/PAPERS/PDF/SH-wodes10.pdf`

[5] V. Khomenko, M. Koutny and W. Vogler : Canonical Prefixes of Petri Net Unfoldings. *Acta Informatica* **40**(2) 95–118, Springer-Verlag 2003.

[6] Mole - A Petri Net Unfolder. `http ://www.lsv.ens-cachan.fr/ schwoon/tools/mole/`

[7] The cunf tool. A contextual net unfolder. `http ://www.lsv.ens-cachan.fr/ rodriguez/tools/cunf/`