Review of the PhD thesis "*On Extensions of Process Rewrite Systems*" by Mgr. Vojtěch Řehák

Summary: I rate this PhD thesis as *very good*, but not outstanding, and recommend that it be accepted.

Detailed review:
This thesis defines extensions of process Rewrite Systems and investigates the decidability and computational complexity of formal verification problems for them. In particular, it considers (weakly) state-extended process rewrite systems (i.e., sePRS, wPRS, fcPRS) and various subclasses.

The main results lie in four different areas, and will be discussed separately.

- Chapter 5: Results on the relative expressive power of the subclasses of wPRS.

  Many (non-)expressibility results were already known in this area, and the author has added some more for his extended classes. This gave a better (but not quite complete) picture of their relative expressive power.

  However, many of the results in this chapter are obtained by small adaptions of the constructions and proofs of previously existing results. So this is a nice but not particularly deep contribution.

  The main weakness of this chapter is the failure to establish the relative expressive power of the process classes PRS, fcPRS, wPRS and sePRS. This is a problem, since fcPRS and wPRS are the very classes that the author has newly introduced (while PRS and sePRS were known before).

- Chapters 6 and 7: Strong and weak bisimulation equivalence checking.

  Chapter 6 is only a summary of existing results on strong bisimulation. The main new result in chapter 7 is the undecidability of weak bisimulation for wBPP and fcBPP, which has a nontrivial proof using new techniques.

  The other results in this chapter (e.g., undecidability for fcBPA) are obtained by relatively straightforward adaptions of previous results on pushdown automata (by J. Srba and R. Mayr).

- Chapter 8: The reachability problem.

  I consider this chapter the 'core' of this thesis. The main result is the decidability of reachability for wPRS. It is a non-trivial generalization of a previous decidability result for PRS, and has many applications in model checking problems.

- Chapters 9,10,11: Model checking problems.

  The main new result in chapter 9 is the decidability of reachability of properties which are expressible in HM-Logic. The author has also discovered a substantial error in a

related (but weaker) theorem in the original paper on PRS by R. Mayr. This shows a deep understanding of the subject and a very thorough investigation.

Chapters 10 and 11 study model checking problems for wPRS and many different fragments of LTL. While general LTL model checking is trivially undecidable, many non-trivial fragments are decidable. A complete picture of the decidability of model checking for wPRS is established. This chapter contains many new non-trivial results and is another highlight of this thesis.

Generally, this thesis makes a significant contribution to the field of verification of infinite-state systems. It contains several interesting new results (as detailed above) which are presented in a clear and readable style. The author has also been very thorough in citing relevant previous work and in distinguishing new results from previously existing ones.

This thesis is mainly based on 3 conference and 4 workshop papers, which are of high quality. In particular, the conference papers appeared in very competitive conferences like CONCUR and FST&TCS. Furthermore, the author has several other publications on different topics.

To summarize, I rate this PhD thesis as *very good*, and recommend that it be accepted.

The reason why I do not rate this thesis as 'outstanding' is that its topic is not sufficiently original. It is mostly a follow-up to previous closely related work by P. Jančar, F. Moller, A. Kučera, J. Srba, R. Mayr and others. Still, it is a very good work.

Sincerely,

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