Review of the Ph.D. Thesis "Boolean Satisfiability Modulo Differential Equation Simulations" by Tomáš Kolárik

Stefan Ratschan

January 10, 2024

The core of the thesis is based on the three publications listed below. In all cases, the author order of these publications is alphabetic and the contribution of T. Kolárik is as follows:

- Tomáš Kolárik and Stefan Ratschan. "SAT Modulo Differential Equation Simulations". In: *Tests and Proofs*. Ed. by W. Ahrendt and H. Wehrheim. Vol. 12165. LNCS. Springer, 2020:

  This paper introduces the basic theory and algorithms for Boolean Satisfiability Modulo Differential Equation Simulations. The theoretical part was developed mainly by me, with important input by T. Kolárik. The algorithmic part was developed in close cooperation. The implementation and computational experiments are completely the work of T. Kolárik.

- Tomáš Kolárik and Stefan Ratschan. "Railway Scheduling Using Boolean Satisfiability Modulo Simulations". In: *Formal Methods*. Ed. by Marsha Chechik, Joost-Pieter Katoen, and Martin Leucker. Cham: Springer International Publishing, 2023, pp. 56–73. ISBN: 978-3-031-27481-7:

  This paper introduces a new model of the railway scheduling problem and demonstrates how it can be solved in the Boolean Satisfiability Modulo Differential Equation Simulations framework. The results contain in this paper have almost completely been obtained by T. Kolárik alone. I only contributed the mathematical justification of braking curves and collaborated on the presentation.

- Tomáš Kolárik, Stefan Ratschan, and Pavel Surynek. "Multi-Agent Path Finding with Continuous Time Using SAT Modulo Linear Real Arithmetic". In: *International Conference on Agents and Artificial Intelligence*. Ed. by Ana Paula Rocha, Luc Steels, and Jaap van den Herik. To appear. SCITEPRESS, 2024:

  The basic problem setup was contributed by P. Surynek, the algorithmic solution in close collaboration by me and T. Kolárik, the design of the computational experiments in close collaboration by all three authors, and the implementation and execution of the experiments by T. Kolárik alone.

  This paper is on the short list of the best student paper award of the conference ICAART. At the time of writing, the winner has not yet been announced.

I would like to emphasize that the choice of publication fora was, to a large extent influenced by non-scientific criteria, for example being dictated by formal rules and deadlines of the doctoral program. The quality of a large part of the results contained in those publications would have had a good chance of being accepted at much more prestigious conferences.

In addition to material from the mentioned publications, the dissertation under review contains further implementation details, benchmark problems, and results of computational experiments. Concluding, it clearly documents the ability for independent scientific work of the candidate T. Kolárik. Due to this, I support the defense of this dissertation.