

On Set-Membership Estimation of Hybrid Systems via SAT Modulo ODE*

Andreas Eggers*, Nacim Ramdani**, Nedialko S. Nedialkov***
& Martin Fränzle*

*Carl von Ossietzky Universität, Oldenburg, Germany,
(e-mail: {eggers/fraenzle}@informatik.uni-oldenburg.de).

**Université d'Orléans, PRISME, 18020 Bourges, France,
(e-mail: nacim.ramdani@univ-orleans.fr).

***McMaster University, Hamilton, Ontario, Canada,
(e-mail: nedialk@mcmaster.ca)

Set membership estimation (SME) of nonlinear hybrid systems is still a challenging issue. Although SME of nonlinear continuous systems has made significant progress recently, the direct extension of these methods to the hybrid case is not easy.

Meanwhile, satisfiability (SAT) checkers for Boolean combinations of arithmetic constraints over real- and integer-valued variables have made significant progress, as they can effectively deal with algebraic constraints between variables and non-linear ODEs, what is denoted as SAT Modulo ODE [1]. Finally, the corresponding solvers solve in a natural way the hybrid differential and algebraic constraints satisfaction problems that underlie SME of hybrid systems.

This talk presents the first results of the application of such a SAT Modulo ODE solver to SME of hybrid dynamical systems [2].

References

- [1] A. Eggers, N. Ramdani, N. S. Nedialkov, and M. Fränzle. Improving SAT Modulo ODE for hybrid systems analysis by combining different enclosure methods. In G. Barthe, A. Pardo, and G. Schneider, editors, *Software Engineering and Formal Methods*, volume 7041 of *LNCS*, pages 172–187. Springer, 2011.
- [2] A. Eggers, N. Ramdani, N. S. Nedialkov, and M. Fränzle. Set-membership estimation of hybrid systems via SAT Mod ODE. In *16th IFAC Symposium on System Identification, SYSID 2012, July 11-13, Bruxelles, 2012*.

*This work has been supported by the German Research Council DFG within SFB/TR 14 “Automatic Verification and Analysis of Complex Systems” (www.avacs.org), by the French National Research Agency under contract ANR 2011 INS 006 04 “MAGIC-SPS” (projects.laas.fr/ANR-MAGIC-SPS), and by the Natural Sciences and Engineering Research Council of Canada.