Standardized Integration of Real-Time and Non-Real-Time Systems: The Distributed Co-Simulation Protocol

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Extended Abstract

Modeling and simulation represent key methods for successful development of cyber-physical systems. With the introduction of co-simulation methodologies, holistic cross-domain or system simulations became possible. This enabled exchange and integration of simulation models, tools, and solvers from different sources. The automotive industry is characterized by a multi-tiered organization. A deep hierarchy of suppliers performs distributed development and integration of automotive components, parts, and systems, that in the end are manufactured to complete vehicles. Depending on the stage of development, simulation models or real prototypes are available. The advantage of simulation models is that they can be tested in terms of software. Software tests are comparably cheap. However, they typically do not consider timing aspects or uncertainties of measured quantities. On the other hand, prototypes are advantageous when it comes to product validation. A prototype shows real-world behaviour and interacts with the environment. The disadvantages are that prototypes are usually very expensive and safety critical. For these reasons it seems advantageous to combine simulation and real-world prototype based testing approaches. This especially includes the field of automated driving (Doms et al., 2018). Testing efficiency is key to successful product development. Interoperability of simulation tools and test infrastructure contributes to testing efficiency. Therefore the use of standards is essential.

The DCP (Distributed Co-Simulation Protocol) was developed in the ACOSAR project (Krammer et al., 2016). ACOSAR stands for "Advanced Co-Simulation Open System Architecture". ACOSAR was an ITEA 3[1] project. Three original equipment manufacturers (OEM), 9 companies from the automotive supply chain, including simulation tool vendors, system and component providers, as well as 4 partners from research and academia cooperated. Their main goals were (1) the specification and demonstration of the DCP, and (2) preparation of standardization of the DCP with a recognized standardization body in order to promote it as the next co-simulation standard. The DCP is introduced in (Krammer et al., 2018). It was granted as a Modelica[2] Association Project (MAP) in 2018[3].

[1] http://www.itea3.org

References

Thomas Doms, Benedikt Rauch, Bernhard Schrammel, Christoph Schwald, Edvin Spahovic, and Christian Schwarzl. Highly Automated Driving - The new challenges for Functional Safety and Cyber Security. White paper, TÜV Austria Holding AG and VIRTUAL VEHICLE, Vienna, Austria, 2018.

Martin Krammer, Nadja Marko, and Martin Benedikt. Interfacing Real-Time Systems for Advanced Co-Simulation - The ACOSAR Approach. In Catherine Dubois, Francesco Parisi-Presicce, Dimitris Kolovos, and Nicholas Matragkas, editors, *STAF 2016 Doctoral Symposium and Projects Showcase*, pages 32–39, Vienna, Austria, 2016. Dubois, Catherine Parisi-Presicce, Francesco Kolovos, Dimitris Matragkas, Nicholas.

Martin Krammer, Martin Benedikt, Torsten Blochwitz, Khaled Alekeish, Nicolas Amringer, Christian Kater, Stefan Materne, Roberto Ruvalcaba, Klaus Schuch, Josef Zehetner, Micha Damm-Norwig, Viktor Schreiber, Natarajan Nagarajan, Isidro Corral, Tommy Sparber, Serge Klein, and Jakob Andert. The distributed co-simulation protocol for the integration of real-time systems and simulation environments. In *Proceedings of the 50th Computer Simulation Conference*, SummerSim '18, pages 1:1–1:14, San Diego, CA, USA, 2018. Society for Computer Simulation International. URL http://dl.acm.org/citation.cfm?id=3275382.3275383.

[2] http://www.modelica.org
[3] http://www.dcp-standard.org