A Modular Technique for Automotive System Simulation

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Increasingly challenging requirements such as environmental legislation and costumer demands are leading to a need for more overall system understanding in the automotive sector. Modelica, as a suitable way for multi-physics modeling, is therefore applied by Bosch, e.g. to investigate energy flows amongst domains.

In this paper, we present a modular approach to an overall vehicle system simulation. It consists of two implementation parts: a vehicle component library which is adapted to handle modular interfaces and a co-simulation environment as shown in figure 1. This allows us, to decouple stiff hybrid DAE systems and run subsystems faster in parallel via solver coupling.

The library contains subsystems of the mechanical, thermal, hydraulic, electrical and control domain to configure different vehicles. The object-oriented nature of Modelica is used for the data handling or to replace subsystems by an interface to the co-simulation environment.

The latter, MDPCosim, was developed at TU München [1]. In the present paper, further work on MDPCosim, such as extrapolation methods and an adaptive macro step size are discussed. Such coupling aspects were and recently are under investigation, e.g. [2]. It is broadened in the present paper to the widespread use-case of drivecycle simulation. Some results of a coupled vehicle simulation with adaptive communication stepsizes are given and analyzed having regard to error and performance aspects.

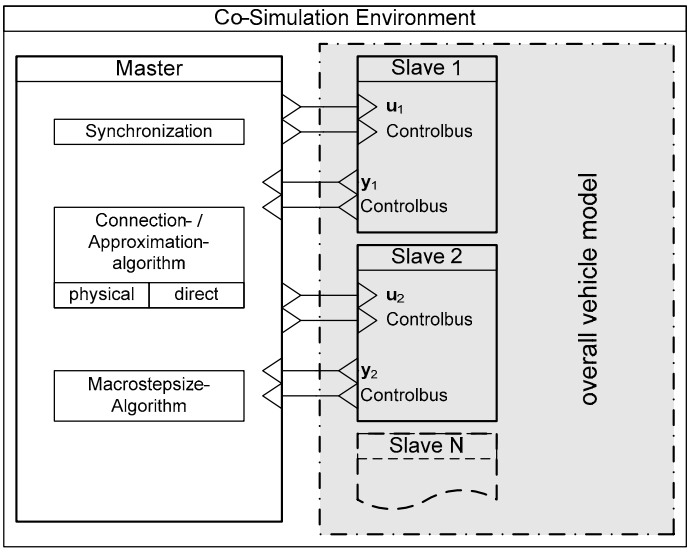

Figure 1: modular vehicle simulation with master-slave architecture for co-simulation

References

[1] Friedrich, M., Schneider, M., Ulbrich, H. A Parallel Co-Simulation for Mechatronic Systems. The 1st Joint International Conference on Multibody System Dynamics, Lappeenranta, Finland, 2010.

[2] Clauß, C., Arnold, M., Schierz, T., Bastian, J. Master zur Simulatorkopplung via FMI. ASIM-Konferenz STS/GMMS 2012, ISBN 978-3-901608-39-1, Wolfenbüttel, 2012.