Test of Basic Co-Simulation Algorithms Using FMI

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Since the FMI technology gains ground in industrial environment, the demand for robust co-simulation increases. In a master-slave concept the master algorithms define the quality of a co-simulation whereas the properties of the coupled FMUs for co-simulation restrict the variety of possible master algorithms.

At first a notation to describe coupling algorithms is introduced. Based on this notation basic coupling algorithms are described. These algorithms can be a starting point for developing further coupling algorithms.

In addition an existing experimental master tool with three basic master algorithms was improved to support FMI 2.0 as well as 1.0. For testing more than 20 Modelica examples were developed from which FMUs for co-simulation were generated by established simulation tools (e.g., Dymola, SimulationX). The examples demonstrate differences of the three master algorithms Gauss-Seidel method, Gauss-Seidel method with one iteration step, and Newton-Raphson method. Four of the 20 examples are described more detailed and the numerical results are discussed.

The experience collected with the test examples so far is summarized in recommendations for tearing as well as improving the master algorithms.

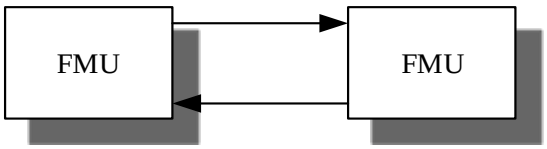

Figure 1. Coupling with feedback between two FMUs

References

FMI project website, https://www.fmi-standard.org/

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Tom Schierz, Martin Arnold and Christoph Clauß. Co-simulation with communication step size control in an FMI compatible master algorithm. In: Proceedings of the 9th International Modelica Conference, Munich, Germany, 2012.