Coupling Model Exchange FMUs for Aggregated Simulation by Open Source Tools

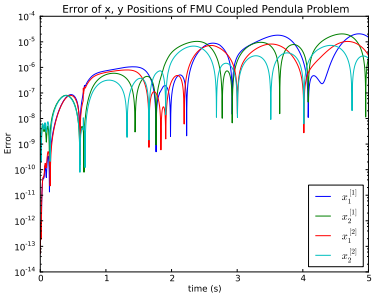
Pukashawar Pannu[1] Christian Andersson[1,2] Claus Führer[1] Johan Åkesson[2]

[1]Centre for Mathematical Sciences, Lund University, Sweden
[2]Modelon AB, Sweden

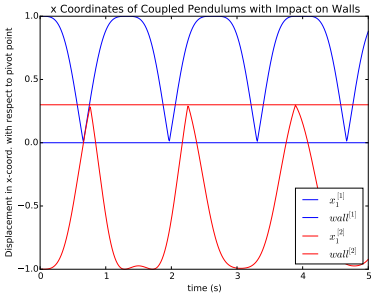
With the Functional Mock-Up Interface standalone sub-systems can be modelled to be part of larger systems that needs a framework for coupled integration. This paper suggest one way of solving the issue by aggregating sub-systems to one unified system that internally handles sub-system communication by coupling. The aggregated system can then be solved by applying a single solver with the benefit of using an aggregated Jacobian and the ability to monitor all sub-system events.

Figure 1a shows proof of concept where two FMUs, each modelling a pendulum with an external force acting on the pivot, are coupled together with a spring and simulated as an aggregated system using the `CVode` solver in Assimulo. As reference a monolithic model of the coupled system was made as an FMU and integrated using `CVode`.

The framework is not limited to coupling of FMUs but can be used to couple Python based problem classes defined by Assimulo. It can also add events to the aggregated system externally. The latter is demonstrated in Figure 1b where walls are added to the aggregated system of two pendulums coupled with a spring to block each pendulums motion. The figure shows displacement in x-coordinate with respect to the pendulums pivot.



(a) Error of aggregated system of coupled pendulums with a spring modelled with FMUs.



(b) Externally added events representing walls blocking coupled pendulum motion.