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Examination of Model Exchange and Distributed Co-Simulation using SSP Standard

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FMI and SSP are standards established by the Modelica Association for the exchanging of simulation models at various levels of abstraction and for establishing interoperability between tools. FMI is an interface standard that allows models to be exchanged or interconnected between tools by using a unit called FMU (Functional Mock-up Unit) as one model component. On the other hand, SSP is an interface standard for storing various meta-information for model connection and coupled simulation (co-simulation) by creating an FMU network that combines the functions of multiple FMUs. FMI has been supported by many tools since its first specification was released in 2010, but its use is not yet firmly established in model distribution. SSP, on the other hand, is a new standard whose specification was released in 2019. We believe it is important to demonstrate appropriate use cases, examples, and effects of using both standards.

In the European automotive industry, use cases of FMI and SSP are reported at the Modelica Conference. Prostep ivip white paper titled “Simulation-Based Decision Making and Release” describes that SSP standard essentially serving the interchangeability of simulation models including the model structure and the parameterization between different design and execution environments. The white paper also describes that the consistent introduction of the glue particle approach in a company through the documentation of metadata of the simulation tasks as well as the artefacts enables an efficient search for existing simulation models. The increased documentation effort due to the ongoing documentation of metadata is offset by a significant gain in efficiency regarding the retrieval of existing models available in the company.

We demonstrate the use of SSP in distributed co-simulation performed by separate two design teams shown in Fig. 1. In this scenario, Team A evaluates the fuel and electricity consumption of a hybrid vehicle using SURIAWASE2.0 guideline compliant model, while the high-voltage battery simulation is performed using the model and simulation environment owned by Team B.

First, the connection interface information between the simulation model of the high-voltage battery and the other models is described in SSP and exchanged by both teams. Next, the bus connectors were created from SSP are imported into both tools and wired to the models, then the distributed co-simulation could be executed.

By sharing the SSP among the design team to check and align the interface specifications of the models ahead of co-simulation, it is possible to avoid rework that may result in interface inconsistencies such as excess or deficient signals or mismatches in unit systems, polarity. Since the models were not passed between the two teams, there was no need to worry about converting the models to FMUs or maintaining confidentiality regarding the contents of the models for both teams. Because both teams performed their measurement evaluations concurrently, they were able to use the simulation environment used by each team to collect data of interest to each team in parallel.

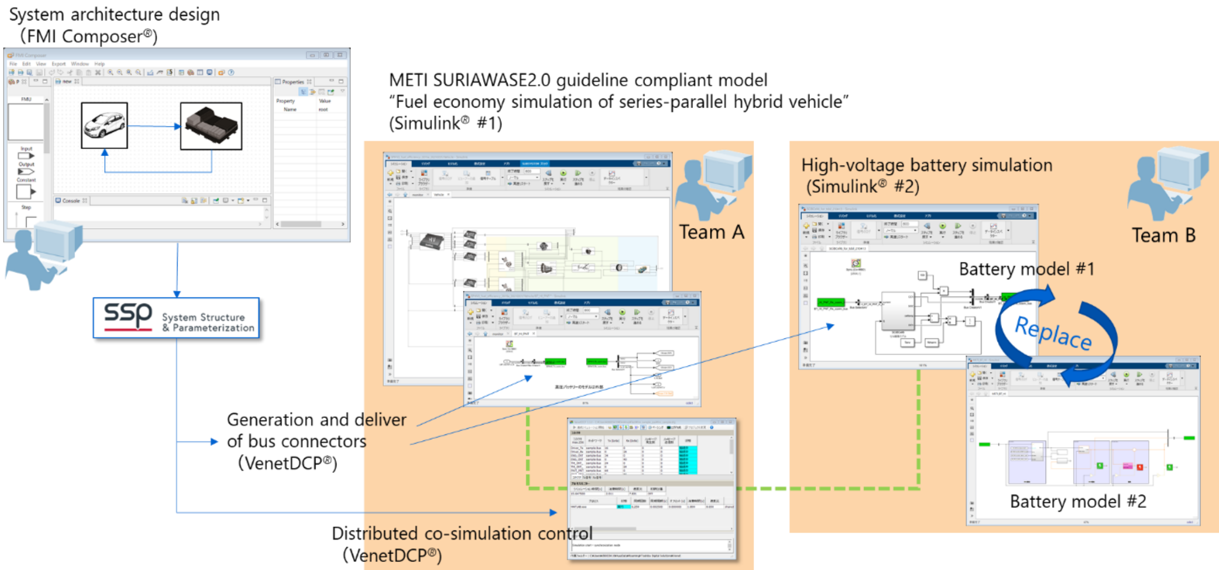

Fig.1 Distributed Co-simulation environment using SSP