Model-Based Integration Platform for FMI Co-Simulation and Heterogeneous Simulations of Cyber-Physical Systems

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Virtual evaluation of complex Cyber-Physical Systems (CPS) \cite{1} with a number of tightly integrated domains such as physical, mechanical, electrical, thermal, cyber, etc. demand the use of heterogeneous simulation environments. Our previous effort with C2 Wind Tunnel (C2WT) \cite{2} \cite{3} attempted to solve the challenges of evaluating these complex systems as-a-whole, by integrating multiple simulation platforms with varying semantics and integrating and managing different simulation models and their interactions. Recently, a great interest has developed to use Functional Mockup Interface (FMI) \cite{4} for a variety of dynamics simulation packages, particularly in the automotive industry. Leveraging the C2WT effort on effective integration of different simulation engines with different Models of Computation (MoCs), we propose, in this paper, to use the proven methods of High-Level Architecture (HLA)-based model and system integration. We identify the challenges of integrating Functional Mockup Unit for Co-Simulation (FMU-CS) in general and via HLA \cite{5} and present a novel model-based approach to rapidly synthesize an effective integration. The approach presented provides a unique opportunity to integrate readily available FMU-CS components with various specialized simulation packages to rapidly synthesize HLA-based integrated simulations for the overall composed Cyber-Physical Systems.

References

\begin{enumerate}
\item C2WT community wiki: wiki.isis.vanderbilt.edu/OpenC2WT.
\item HLA standard – IEEE standard for modeling and simulation (M&S) high-level architecture (HLA) – framework and rules: ieeexplore.ieee.org/servlet/opac?punumber=7179.
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