Efficient Incorporation of ML and AI in Model-Based Systems Engineering for Cyber-Physical Product Development

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ABSTRACT

We address the efficient incorporation of Machine Learning (ML) and Artificial Intelligent (AI) methods, algorithms and tools, into Model-Based Systems Engineering (MBSE) frameworks for cyber-physical product development and product life management (PLM). We describe our recent development, validation and demonstration of a methodology and software tool suite that is comprised of three primary innovative tools, integrated towards this ambitious goal. The first methodology and tool address the efficient mapping of generic autonomy stack components to SysML components: PERFECT (PERFormance Evaluation Composable Tool). We demonstrate on autonomous ground vehicle (AGV) task execution of various autonomy stacks from SysML in variable complexity environments. The second methodology and tool address the critical TRadeoff Analysis and DEsign Space EXploration (TRADES-X) on SysML and improvements with data-driven methods. We demonstrate efficiency in computational complexity and orders of magnitude savings in required simulation and real-life experiments and testing using several AGV examples. The third methodology and tool address the VERIfication of Trusted Autonomous Systems (VERITAS). We demonstrate its superior performance in cyber-physical autonomous systems examples. We close with a brief description of current and future research directions and goals.

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