Towards an Integrated Approach of Systems Behavior Modeling and Specification.

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Abstract. As highlighted by the OPM standard, the architecture of systems can be addressed through 2 main perspectives: from a structural viewpoint and from a behavioral viewpoint. To deal with all aspects of systems behavior, people often have to consider many different kinds of methods, viewpoints, modeling languages and tools. The system behavior can be expressed in various ways: as sequences of events, from the viewpoint of states changes, as transfer functions, discrete or continuous, through time-based simulations, through mathematical equations resolution, or as requirements that formalize the system expected behavior. The modeled behavior that result can be prescriptive, representing how we expect the system to behave, or descriptive, representing or anticipating how the system would behave, considering how it is / will be implemented (e.g. represented laws of physics in an acausal way).
The goal of this presentation is to highlight an approach, under development within Airbus, to address systems behavior, through a set of integrated viewpoints and model kinds. This approach relies on the ISO-42010 principles and the elicitation of an ontology, formalizing clear semantic foundations for the description of the behavior of systems. The approach relies on the parallel use of a set of different views and viewpoints, managed in consistency, and that can be associated with different modeling tools and modeling languages. The implementation of the approach also relies on an extensive use of automated modeling and analysis features, to get maximum benefits from its application.
These automated features first aim to support automatic views generation. They aim to ensure the semantic consistency across views , whatever the model kind, tool or modeling language used. Goal is, for the system engineer, to only have to model the information once, and then, to be able to get the best of each generated view. For example, operational and functional scenarios can allow a simple modeling of the expected behavior, in a storytelling way, breaking the complexity, for each scenario, by focusing on only one use case, for a single set of conditions of operation . On the other hand, behavior modeling of functions in a functional architecture model, can allow to obtain a global structured description of the overall expected system behavior, whatever the use cases and conditions. In between, this behavior can also be modeled in the form of functional requirements, expressed as formal properties. They can allow to represent this behavior in an atomic, unambiguous, traceable and testable manner, supporting the overall requirements engineering and testing activities.
By modeling requirements as formal properties and using the Property Model Methodology (PMM), these automated features can also support the requirements validation and verification, using both formal proof analysis and factual testing by simulation . It allows to ensure the overall consistency of requirements, to ensure their attainability and to improve their completeness, ensuring that the overall scope of operation is addressed by at least one requirement. It also allows to validate the captured expected behavior that results, by running interactive simulations with stakeholders and to verify that it behaves as expected .
Finally, it can also be used to support factual verification of both the design and the product, by automatically checking that the requirements are well respected, when doing automatic or interactive tests, by simulation or by testing the real product.
The presentation will first introduce the topic and describe associated needs. It will then be followed by a practical demonstration, presenting the approach, and highlighting resulting benefits. It will highlight an example of what can be achieved thanks to the extensive use of the modeling, analysis and automation features. This demonstration will be based on specific developments built upon the MATLAB-Simulink framework.
Following this practical demonstration, the presentation will detail underlying principles and the used semantic reference. Presented principles will then be extended considering the SysML language, diagrams, and their implementation upon the CAMEO tool suite. The presentation will finally end with presenting the way forward and summarizing main benefits that can be expected from such an approach.

This presentation aims to show to the audience how an integrated approach of the systems behavior modeling and specification can provide significant enhancements of our workflows, methods and usage of modeling features. It aims to show how it can improve the usability of modeling capabilities, improving easiness and intuitiveness of use. Goal is to demonstrate, on a practical example, how it can drastically improve efficiency of use of MBSE, thanks to an extensive application of automated modeling and analysis features, and by the way, to show how it allows to strongly improve the overall maturity of models and of the resulting architecture, design definition and

specification (completeness, consistency and attainability).
Goal is also for the audience to get an understanding of key principles of the approach.
It will also allow both to share and discuss the used reference semantics and ontology, and to share the way forward.
Such a presentation also represents a mean for us to progressively share and extend the approach to our partners, supporting its use in extended enterprise, and to share foundation of the approach across the SE community , with other companies, tool vendors and academics.

Biography

Jean Duprez (Airbus Operations SAS)
Jean Duprez works for Airbus since 2001. For the past 8 years, he has been in charge of developing future Airbus strategies about Modeling and Simulation of Aircraft Systems ; studying various aspects of the MBSE deployment across the overall Airbus Systems Design Office. He is currently in charge of the study, definition and deployment of future SE processes, methods and tools for the Powerplant Center of Competence. Jean also co-chairs the INCOSE Knowledge Management and Ontology Working Group and is part of the TLI (Technical Leadership Institute) cohort 6.

Laurent Royer (The MathWorks)
Laurent Royer is a principal application engineer supporting users of MathWorks products on the customization and deployment of MBSE solutions. Prior to joining MathWorks in 2011, Laurent also accumulated 13 years of experience in Model-Based Design applied to powertrain control at Renault. Graduated in Control and Computer Science from Centrale Lyon, Laurent got a Ph.D. in Robotics at Paris VI.

Raphael Faudou (Samares Engineering)
Raphael Faudou is the founder and CEO of Samares Engineering. Samares Engineering was founded with the main goal to focus on MBSE method definition and to support its deployment within industry. Raphael is currently supporting Airbus on DDMS project. He is also co-chair of MBSE technical committee for AFIS, the INCOSE French chapter.