INTEGRATING MODEL BASED SYSTEMS ENGINEERING TOOLS WITH ENGINEERING ANALYSIS TO IMPROVE OVERAL ENGINEERING SYSTEM DESIGN

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ABSTRACT

Engineering systems have become increasingly complex and traditional methods of managing complexity through documentation systems are giving way to software tools which are better able to manage this complexity. Such software approaches, known as Model Based Systems Engineering (MBSE) aim to improve upon the document based systems approach by capturing all the relationships between requirements, design, analysis, test information etc. into a single unified model. Without the model based approach, information is distributed across many documents and this makes it difficult to ensure completeness, consistency and conformance to requirements.

Whilst the MBSE approach has greatly improved the ability to manage complex systems, MBSE tools would be further enhanced through better links to automated engineering analysis software so that proposed designs or changes to existing designs can be easily assessed to check whether they continue to comply with requirements. Conversely, the implication of changes to requirements could more easily be assessed to see if they continue to be met by existing designs. However, only simple parametric equations have traditionally been utilised for the system level analysis in MBSE tools and this makes it difficult to predict with accuracy the implications of design or requirements changes.

At the same time as developments have been made with MBSE tools for System Engineering, there have been developments in the engineering analysis arena to automate the running of engineering analysis workflows which involve the integration of software applications to improve design productivity. This could be, for example, to link software tools for geometry creation, finite element meshing, problem set-up, solution and post-processing but it could also be to integrate applications for various disciplines or system components into a unified more holistic, multi-disciplinary and multi-component model. These integration frameworks are used for design exploration and optimisation and are often referred to as process integration and deign optimisation (PIDO) frameworks.

Traditionally, systems engineers and engineering domain experts have operated more independently using very different tools and methods and have relied on ad-hoc communication and manual translation of data. This process is both error-prone and time consuming, and can significantly limit the number of design configurations that can be evaluated. However, the development of MBSE tools and of frameworks for engineering analysis integration and automation now offers the opportunity to bridge the gap between the system and engineering domains.

Through examples, this paper will show how MBSE tools based on SysML (System Modelling Language) can be linked to a PIDO framework for automating design workflows. System analysts can run design workflows directly from their MBSE software without requiring knowledge or direct use of the PIDO software. Likewise, engineering analysts can confirm automatically that system requirements are met (or modify their design so that they are) directly from their PIDO framework without requiring knowledge or direct use of the MBSE tools. The result is an improvement in both the overall system design and the design process because the design team can respond rapidly and productively to changing requirements.

SUGGESTED THEMES

Systems Engineering, Process Integration/Automation