



PhD Position



Early validation of system design using a combined model-based and optimization engineering approach

Keywords: MBSE, MDAO, Systems Engineering

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3 years

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Location: ISAE-SUPAERO campus, DISC department

Context and problematic

The acronym MBSE was coined to denote model-based systems engineering approaches that enable to rely on methodology to design and implement a system. In parallel, the MDAO acronym denotes multi-disciplinary analysis and optimization techniques that apply to physical subsystems, e.g. mechanical or thermic ones, and allow one to validate design decisions on system dimensioning, thus enabling better mastering of the early design of a system through operational scenarios.

So far, coupling of MBSE and MDAO models has mostly remained manual and not yet automated. For instance, ModelCenter links SysML models to optimization and analysis tools such as Design of Experiment. MDAO models use artefacts but do not consolidate any reference model, which does not meet the requirements for an integrated and interoperable platform used in the context of UAV certification.

Consequently, a question of prime importance arises: how coherence among MBSE and MDAO models can be guaranteed as early as possible in the design phase? The question may be answered using generic models platforms.

A first research axis can be identified: providing experts with MBSE models to be relied on as repositories of reference models for building new solutions. Examples of MBSE tools to be used in that context include TTool, Capella and Papyrus.

Another key issue is to rely on modeling and optimization work achieved on critical systems in order to enhance the acceptance of the end-system. It becomes necessary to quantify the expressiveness of the concepts and models in use, but also to define new model composition rules ensuring a sufficient level of confidence in a model-based approach combining modeling, analysis and simulation.

Objective

The objective of this PhD work is to propose and implement a collaborative, MBSE and MDAO based, engineering methodology.

Expected work

- Survey of related work and benchmarking of MBSE and MDAO approaches in order to identify a set of target modeling language, tools and methods.
- Identify integration and interoperability capabilities among the previously identified languages, tools and methods.
- Define a formalization framework for MBSE and MDAO models integration and interoperability.
- Elaborate generic model patterns, in particular for UAVs, and implement them in a MBSE-MDAO platform.
- Propose a global methodology for model design and analysis.
- Make the methodology a toolled one.
- Apply the methodology to a UAV whose mission is to be defined.

References

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