C.7. Modelling approaches

Modelling: bridging system modelling and analytical modelling. Contributions to this stream are invited to explore emerging applications and innovations in digital engineering that bring together MBSE and analytical modelling approaches to advance mission engineering, capability acquisition, and system design across defence, transport, energy and other domains.

Lead: Matthew Wylie, Stephen Cook, Indi Arachchige
Domains: Digital Engineering, All domains welcome

Submissions Summary:

1. Measuring MBSE Model Maturity (Full Paper)
2. The Mission Computing Subsystem of the Block 2 Boxer - tentative title (Full Paper)
3. STRATA: A Strategic Layers-Based MBSE Modeling Approach for Comprehensive Test & Evaluation Coverage (Full Paper)
4. Model-based document engineering. A Cameo/CATIA Magic How To. (Tutorials)
5. One Model to Rule them all (?) (Paperless Presentations)
6. Model-based Systems Engineering Methods for Rapid Product Development (Paperless Presentations)
7. Mission Engineering with Capella - Aligning Systems with their Missions (Paperless Presentations)

20639 Measuring MBSE Model Maturity

Derek Rogers 1, Brett Morris 1, Shoal Group Pty Ltd, Adelaide, SA, Australia

Keywords: measurement,MBSE,maturity,metrics

Type: Full Paper
Stream submitted: B.0. Advances in Approaches

This paper covers recent work undertaken at Shoal to investigate and develop maturity metrics to increase understanding of the maturity of MBSE models that are built on Shoal and Shoal client projects. Maturity metrics are an important engineering tool that can collectively serve as a leading indicator for project performance. If a project is at a lower level of maturity heading into a major milestone than required there is a good chance of cost and schedule over-run, or quality deficiency. The paper commences with a review of the open literature that identified different methods to track model maturity. The information uncovered during the literature review is then synthesised into an MBSE model maturity assessment method that includes the ability to select MBSE model maturity metrics from a library. The work undertaken to generate a metrics library is presented and the paper concludes with some observations and lessons learned, as well as plans for further work. The approach presented could be used by organisations undertaking MBSE modelling to build their own library of metrics to measure the maturity of their MBSE models they are developed.

21310 The Mission Computing Subsystem of the Block 2 Boxer - tentative title

James Edge-Williams 1, Rheinmetall Defence Australia, Director of Tactical Systems, Brisbane, QLD, Australia

Keywords: Boxer CRV,Simulation,Mission Computing Subsystem,DDS,Vehicle

Type: Full Paper
Stream submitted: C.7. Modelling approaches

Placeholder for a potential talk on the "mission computing subsystem of the Block 2 Boxer, with its DDS approach, and how they simulate their digital solution in their software development environment" by James Edge-Williams, Director of Tactical Systems, Rheinmetall Defence Australia.

20881 STRATA: A Strategic Layers-Based MBSE Modeling Approach for Comprehensive Test & Evaluation Coverage

Brian Selvy 1, Zuken Vitech, Marana, ARIZONA, United States

Keywords: MBSE,Modeling Methodology,Digital Engineering

Type: Full Paper
Stream submitted: C.7. Modelling approaches

Overview: This paper introduces the STRATA model-based systems engineering (MBSE) methodology, emphasizing its key aspects and unique advantages in verification, validation, test, and evaluation domains. Attendees will gain insights into its applicability and advantages in complex modeling scenarios. Context: Navigating the initial stages of MBSE model formulation in any tool can be challenging, particularly within collaborative teams. Implementing a methodology offers a structuredroadmap, enhancing model organization, usability, and collaboration. The STRATA methodology addresses these challenges, and combined with its model validation rulesets, provides the user feedback on model consistency and completeness. Purpose:The STRATA methodologyis structured in terms ofdefined levels or layers of the system architecture (the rows) and systems engineering,program management, and specialty engineering concept groups (the columns) affords.. The research aims to elucidate the benefits of adopting the STRATA methodology, particularly in the context of verification and validation. By defining clear model objectives and scope,the STRATA frameworkallows a modeling team to model what they know regardless of where it fits in the matrix. This supports the early involvement of test and evaluation teams in the requirements refinement and systems architecture definition processes. We will show how the STRATA methodology supports multiple engineering design scenarios. Approach: Utilizing the GENSYS MBSE tool, the paper demonstrates the practical implementation of STRATA through a representative problem.A comparison of the V&V concepts available in the Comprehensive Systems Design Language (CSDL), the natural language metamodel supporting STRATA, will be reviewed and compared to those provided in SysML v1 and v2. Interoperability of the languages will also be discussed. Insights: Participants will glean the value of modeling methodologies and discern the distinctive advantages of STRATA. We will see how utilizingSTRATA enhances modeling precision and efficiency, ultimately improving system design and development processes.

21246 Model-based document engineering. A Cameo/CATIA Magic How To.

Emily Balaburov 1, Sam Mancarella 1, MEMKO, Melbourne, VICTORIA, Australia

Keywords: MBSE,Cameo/CATIA Magic,Document Generation,Metamodel

Type: Tutorials
Stream submitted: C.7. Modelling approaches

Format: A hands-on tutorial on using CATIA Magic (aka: Cameo) to generate documents and tabular data automatically from system models. Overview: This tutorial will take the audience through the step by step process of producing deliverable documents using systems definition data defined as a Cameo/CATIA Magic Model Based Systems Engineering (MBSE) model. It will detail the use of the Report Wizard to produce documents, spreadsheets and presentations from the MBSE model; and how to tailor the structure and format of the produced documents. This tutorial will also showcase how to represent derived model data in tabular format using the Metachain functionality. Audience: Model-Based Systems Engineering (MBSE) practitioners, engineering managers, Cameo/CATRIA Magic users. Line Up: refer presenters

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20707 One Model to Rule them all (?)

Jawahar Bhalla 1, Shoal Group / University of Adelaide, Harrington Park, NSW, Australia

Keywords: Model of Systems Models,One model to rule them all

Type: Paperless Presentations
Stream submitted: C.7. Modelling approaches

Models are central to understanding systems and to the engineering of systems. Systems engineers employ various types of models to communicate shared understanding, through system life-cycle models that enable the transformation of functional models to physical models, that are then realized as tangible systems of benefit to society. The recognition of the central nature of models to the engineering of systems resulted in the forming of Model Based Systems Engineering (MBSE) wherein the essence of the system of interest is contained within a system model in contrast to traditional documents. However, the evolution of model-types employed, both to understand and to engineer systems, appears to largely have been a pragmatic activity driven by the needs of the numerous individual engineering and management subdisciplines. This paper briefly examines extant taxonomy of systems models used in the engineering of systems and in understanding operational systems and considers the question of whether there is a suitable system meta-model that naturally contains all types of systems models used therein. It explores this question through a systems-thinking lens, in conjunction with concepts on mental models from biology and philosophy. This analysis gives rise to framework for systems models and to the proposition that all (systems) models take on one of two forms: as reference models that aid in the engineering of systems or as representative models that aid in understanding operational systems. The paper concludes that it is possible to propose an emergent model of systems models that combines these two classes in an evolutionary way. This construct is offered for consideration and refinement by the systems community.

21203 Model-based Systems Engineering Methods for Rapid Product Development

Tom Davis 1, Mark Papinczak 2, BAE Systems, Adelaide, SA, Australia, BAE Systems, Canberra, ACT, Australia

Keywords: mbse,method,acquisition,development

Type: Paperless Presentations
Stream submitted: C.7. Modelling approaches

Overview: The current and emerging defence environment has placed heightened emphasis on the need to rapidly develop mission-fit products across land, maritime and air domains. This presentation provides an introduction to novel model-based systems engineering methodologies (MBSE) established and actively utilised at BAE Systems Australia. Context: It is well established that the development of certifiable, software intensive, systems must balance the rigour and traceability of conventional systems engineering (SE) programs with the demands of an agile and rapidly evolving product development program. This tension of delivering minimal viable capability and first-of-type systems at pace to validate customer need, whilst maintaining sufficient rigour to facilitate future certification and mitigate accretion of technical debt, is a difficult technical and programmatic challenge to navigate. Purpose: Blended MBSE methods adapting principles from above-the-line architecture frameworks and mission engineering concepts, object-oriented SE methods, and evolutionary lifecycle development models, was hypothesised to provide an optimal SE framework for such programs. Secondary aims included methods to support programmatic product development, product line management and variant management. Approach: A bespoke MBSE approach, encompassing training, processes and tool customisation, was derived, trialled and refined across a range of product development projects. Insights: It has been determined that prioritisation of several key SE drivers and core modelling viewpoints (at various stages of product maturity) provide a robust yet adaptable framework for system development. A summary of the problem drivers, key learnings and an introduction to the meta-method used in the derivation of this approach will be provided.

21234 Mission Engineering with Capella - Aligning Systems with their Missions

Steven Spencer 1, Thales Australia, Eagle Farm, QLD, Australia

Keywords: Mission Engineering,MBSE,Capella,Digital Transformation

Type: Paperless Presentations
Stream submitted: C.7. Modelling approaches

Overview A novel Capella viewpoint has been developed to enrich a Systems Engineering Model with Mission Engineering concepts. This presentation will explore the use and value of such a viewpoint when employed with Model Based Systems Engineering techniques. - Context Mission engineering provides an approach with appropriate rigour for the acquirer of capability to clearly outline their needs and expectations of solutions to meet their needs. Model Based Systems Engineering provides an approach to effectively master complexity of a system from concept to implementation. Harmonising the two viewpoints is not straightforward. - Purpose This presentation will demonstrate a prototype viewpoint for the Capella MBSE toolwhich willallow the representation of Mission Engineering concepts within the MBSE model. By enhancing the operational concept representation and enriching that representation with key Mission Engineering views and measures, the system designer shouldmake better decisions when architecting and implementing the system. - Approach A Capella model viewpoint (add on) has been developed and will be demonstrated interactively to show how the additional Mission Engineering concepts can be leveraged throughouta system's lifecycle in an example model. Key mission engineering concepts such as Mission Threads and Mission Engineering Threads, Measures of Success, Performance and Effectiveness will be demonstrated. How thesenew elements can be leveraged through a system design will be explored. - Insights By formally representing Mission Engineering concepts into the implementation of systems through Model Based Engineering approaches, Systems acquirers and designers should be able to talk the same language, across the different contexts, which will improve outcomes for the development of prime items and complex systems integration.
