B.3. Modelling and Simulation Advances

Modelling and Simulation Advances. This stream invites contributions from all domains to share simulation and modelling advances relevant to systems engineering. These may include qualitative and quantitative approaches, and may be at any stage of development. Submissions are invited to share novel practice that can lead to better outcomes within the SE lifecycle.

Lead: Contact the Technical Committee if you can assist in Chairing this session
Domains: All domains welcome

Submissions Summary:

1. The Role of Model-Based Systems Safety in Ensuring Safe Implementation of Autonomous Technologies (Full Paper)
2. Virtual Rehearsal: Enhancing Constructability and Safety in Cast-In-Place Construction (Paperless Presentations)
3. Early Evaluation of Environmental Impacts by Coupling Architecture Models with LCA Tools (Paperless Presentations)
4. Survive the Swam! How modelling and simulation of emerging threats can reduce warship vulnerability. (Paperless Presentations)
5. Revolutionizing Digital Test and Evaluation: Harnessing Unreal Engine for Enhanced Simulation and Scalability (Paperless Presentations)

20697 The Role of Model-Based Systems Safety in Ensuring Safe Implementation of Autonomous Technologies

Faizan Mr Muhammad Ramzan 1, Julia Ms Gibney 1, Nova Systems, Nollamara, WA, Australia

Keywords: MBSE,MBSS,Modelling,Autonomous

Type: Full Paper
Stream submitted: B.3. Modelling and Simulation Advances

Model-Based Systems Engineering (MBSE) offers a holistic approach to understanding complex system architectures, enabling early detection to design flaws and integration of multidisciplinary perspectives. By directly incorporating safety considerations and optimising system performance through the use of model-based-system safety (MBSS) processes, we can ensure safer, more efficient and reliable autonomous systems. This study aims to identify challenges and opportunities in assuring the safety and cybersecurity of autonomous systems, proposing Model-Based Systems Safety (MBSS) as a promising framework to address these complexities effectively. Through a comprehensive review of current safety processes, this paper identifies gaps exacerbated by disruptive technologies. Building upon model-based engineering principles, a framework for MBSS is formulated to systematically assess and mitigate safety risks in autonomous systems, emphasizing the seamless integration of MBSE and MBSS throughout the system lifecycle. The adoption of MBSS offers a structured approach to enhance safety and cybersecurity assurance in autonomous technologies. This paper provides both theoretical insights and practical implications for industry stakeholders, policymakers, and researchers, highlighting the potential of MBSS to foster trust and reliability amidst technological disruption. In conclusion, this paper underscores the pressing need for innovative strategies to navigate the intersection of disruptive technologies, system safety, and cybersecurity. By embracing MBSS, stakeholders can effectively manage risks associated with autonomous systems, ensuring resilience, and maximizing the transformative potential of emerging technologies.

20604 Virtual Rehearsal: Enhancing Constructability and Safety in Cast-In-Place Construction

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Keywords: Virtual Rehearsal,Construction,Safety,Constructability,Digital Construction

Type: Paperless Presentations
Stream submitted: B.3. Modelling and Simulation Advances

This presentation delves into the transformative realm of virtual rehearsal and its profound benefits for the construction industry, spotlighting a recent Australian project exemplifying cast-in-place construction methodologies. The focus will be on the utilization of innovative techniques such as incrementally launched casting beds and balanced cantilevers from travellers. Subsequently, we will elucidate how these design principles can be seamlessly applied to more conventional structures and methodologies. Virtual rehearsal, a digital technique, empowers project teams to meticulously plan, test, and refine work sequences within a simulated environment before embarking on real-world implementation. Leveraging building information models (BIM), this form of virtual reality enables collaborative interactions among personnel involved in planning and executing tasks. The immersive technology facilitates a dynamic interaction with designs, allowing for the rehearsal of various aspects of construction, maintenance, repurposing, and risk assessment within the context of new infrastructure. Key Points: -Integration of virtual 3D models with the project program for visualizing and analyzing construction activities. -Visualization and analysis of project design before and during construction phases. -Enhancement of user understanding regarding the spatial relationships within the project. -Identification and proactive addressing of safety concerns or potential issues. Advantages: -Establishment of rich engagement with owner/operator stakeholders through immersive experiences. -Improvement of design and service outcomes through engaged reviews, comments, and option testing. -Automated prevention of safety risks, reducing reliance on human behavior. -Stakeholders gain a comprehensive understanding of the design, facilitating informed decisions early in the construction process. This presentation aims to showcase the transformative impact of virtual rehearsal on cast-in-place construction methodologies, underlining its potential to enhance constructability, safety, and stakeholder engagement across a spectrum of construction projects.

20761 Early Evaluation of Environmental Impacts by Coupling Architecture Models with LCA Tools

Stephane Lacrampe 1, Obeo, Comox, BC, Canada

Keywords: Sustainability,Life Cycle Assessment,System Architecture Design,MBSE,Environmental Impact Assessment

Type: Paperless Presentations
Stream submitted: B.3. Modelling and Simulation Advances

This presentation showcases the outcomes of the EcoPlex R&D project (https://www.ecoplex.fr/index_en.html), focusing on a novel methodological approach and software solution that integrates life cycle assessment (LCA) with systems architecture design. The EcoPlex project aimed to develop a comprehensive framework for evaluating the environmental impacts of systems throughout their entire lifecycle.By enriching system models with detailed information such as component life expectancy, material usage, consumption rates, and emissions, it becomes possible to generate a comprehensive inventory of the environmental flows associated with the system. This inventory is then processed by LCA software to analyze and identify the system's ecological impacts from raw material extraction to end-of-life. Integrating system models with LCA analysis not only saves time by eliminating redundant data entry but also enables the rapid identification of components with the most significant ecological impacts, thanks to the fact that the data in the LCA tool follows the component structure of the system model. This facilitates quick modifications to the architecture model, promoting an iterative process for environmental optimization early in the development of the system.The presentation will illustrate these concepts and processes using a case study in the naval domain, specifically focusing on the Mobula 8 and Mobula 10 boats, which are designed to collect plastic waste from the oceans. We will demonstrate the application of the Ecodesign for Capella add-on and its integration with OpenLCA, an open-source LCA software, to highlight the practical benefits and efficiency of this integrated approach.

21232 Survive the Swam! How modelling and simulation of emerging threats can reduce warship vulnerability.

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Keywords: T&E,Maritime

Type: Paperless Presentations
Stream submitted: B.3. Modelling and Simulation Advances

Overview-Over the last decade, there has been an increased need to combat emerging threats that exploit military systems weaknesses, and accelerate the delivery of new and improved systems to the war fighter. By establishing the capability Digital Thread, which is the use of digital tools and software to maintain through life data/models of a system. Digital assurance methods such as modelling and simulation can support Test, Evaluation, Certification and System Assurance (TECSA) during the early stages of system design and requirement development. Context-Digitally enabled assurance, through modelling and simulation supports capability risk decisions throughout the capability development and systems engineering process. Through the use of QinetiQs Survive Software, ship survivability and venerability can be modelled to provide feedback to customer and influence platform and combat system designs. Purpose-The presentation will provide an overview of how modelling and simulation can support TESCA, and provide an example of a modelling and simulation event, using the Survive Software. Approach-The presentation will outline the outcomes of the Survive Software modelling and simulation scenarios for warship vulnerability against swarming uncrewed aerial vehicles using Survive Software. Insights-The presentation will outline how modelling and simulation supports TESCA, and how it provides opportunities to undertake T&E activities at early stages in the capability lifecycle. This can remove the requirement to undertake additional testing during transition into service phases and can improve the delivery of new capability to the war fighter.

21240 Revolutionizing Digital Test and Evaluation: Harnessing Unreal Engine for Enhanced Simulation and Scalability

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Keywords: digital test and evaluation,modelling and simulation,technical innovation

Type: Paperless Presentations
Stream submitted: B.3. Modelling and Simulation Advances

Overview This work explores the application of Unreal Engine in the digital test and evaluation (DT&E) domain, highlighting its potential to revolutionize testing methodologies. Context The DT&E domain is undergoing significant transformation, driven by the need for more precise and efficient testing frameworks that can support the capture of objective quality evidence and augment traditional assurance activities. Traditional methods often fall short in terms of scalability and adaptability to complex scenarios and the ability to deliver with an accelerated timeline. Purpose The primary objective of this research is to assess how Unreal Engine can support emerging trends within the DT&E domain. The evaluation criteria was based around the idea that Unreal Engine's advanced simulation capabilities can significantly improve the realism and scalability of DT&E processes. The investigation aims to understand the practical benefits and potential limitations of integrating Unreal Engine into DT&E workflows. Approach The research adopted an Agile Methodology to deliver a Minimal Viable Product that could demonstrate the viability of integrating Unreal Engine into DT&E workflows. Simulations were created using Unreal Engine, replicating various DT&E scenarios. These simulations were evaluated based on their realism, scalability, and efficiency compared to traditional methods. Integration options were also explored to ascertain the viable use of higher fidelity models and information sources. Insights Key insights reveal that Unreal Engine significantly enhances the realism of DT&E simulations, providing an immersive and accurate testing environment. Additionally, its scalability allows for the efficient handling of complex scenarios, which is often a limitation of traditional methods. These findings suggest that integrating Unreal Engine into the digital T&E domain can lead to effective and reliable digital testing processes, supporting future trends and technical innovations that support an accelerated operational delivery of capability.
