Overview of submitted abstracts for CA2X2 forum 2024

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Title: M&S support to Cognitive Warfare Concept development

Author: Jan Hodicky

Abstract:

NATO defines Cognitive Warfare (CW) as a type of warfare that involves activities carried out in coordination with other instruments of power to influence, protect, or disrupt the cognition of individuals, groups, or populations, to gain an advantage over an adversary. Supporting the development of the Cognitive Warfare project, a validation and assessment activity was developed through the support of HQ SACT JFD Modelling Simulation and Learning Technologies Branch. The project aimed to investigate how modelling and simulation (M&S) could be used to support the development of capabilities to enable NATO in the cognitive dimension, improve NATO defence against cognitive warfare adversaries, and enhance NATO resilience against Cognitive Warfare activities. The project deliver a simulation system employing the human behaviour modelling approach that demonstrated key elements of the concept by the end of 2023. The paper deals with details the design, execution and findings of this activity. Key recommendations and findings related to the Cognitive Warfare concept and Lessons Identified from applied M&S in Concept Development process are to be considered the primary output of the paper.

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Title: Decision Support for HQ using AI and Simulation

Author: Hans ten Bergen and Beatriz Garmendia Doval

Abstract:

MASA has developed different tools to add analysis power to the simulation for Command Post Training and Wargaming. SWORD has also been integrated into several C2 Systems using the provided APIs both to use the simulation to stimulate the C2 System and to use it to receive information from the C2. Here we present the proof of concept for a powerful decision support center created by combining all these tools together and that will allow Headquarters staff to automate the Course of Action (CoA) Analysis step of the Military Appreciation Process (MAP).

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Title: Workshop on NATO M&S Individual Level Education and Training Requirements: requirements update, gap analysis and proposed M&S courses content (closed workshop)

Author: Jan Hodicky

Abstract:

In this 90 minutes closed workshop, HQ SACT in its role of Requirement Authority (RA) for Education Training Exercises Evaluation (ETEE) for Modelling and Simulation Functional Area wants to inform on the results of a gap analysis initialized by update of the E&T requirements. The main effort of the workshop is focused on socializing, updating and completing products of Training Analysis Needs to agree on the Course Control Document – IIs: Course Proposals. This step is important to inform NCS and Nations on close future opportunity to further develop their M&S professional cadre. One new F2F M&S course and two new ADL courses are expected to fulfil current E&T needs.

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Title: Quantum and 6G technologies evolution in the future of warfare and radar development

Author: Giovanni Gasbarrone

Abstract:

Next generation 6G and "Quantum technologies represent a revolution in military operations that will change in the future the way of operations, from cybersecurity to communications in tactics,operational and warfare strategies in modelling & simulation. Quantum technologies are dual-use technologies, and therefore are of interest to the defence and cyber security industry and military.

The recent RADAR systems and the 5G and 6G antennas have contiguous or even overlapping operating principles that allow the development of solutions in a dual use perspective. The convergence between radar and telecommunications can be glimpsed in the use of electronically scanned antennas that for 5G and 6G transmissions use "smart antennas" MIMO -Multiple Input Multiple Output. In the future, we begin to glimpse the evolution towards quantum radar while the "quantum" revolution in 6G with cognitive radio will be the next generation architecture thanks to quantum computers that already allow in 5G the optimal cellular planning of frequencies and transmission network. We are now working on the fusion of technologies with Quantum Machine Learning for 6G networks.

Global Quantum Warfare: a rapidly evolving and growing market

The global quantum warfare market size had a revenue of around USD 136 million in 2022.

Quantum Warfare (QW) is a domain for new defense scenarios in which quantum technology is used for strategic military objectives and requires new employment doctrines.

NSA fears quantum computing surprise: "If this black swan event were to happen, then we are really screwed." Intelligence fears China and other adversaries may make breakthroughs in key technology.

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Title: Leveraging Large Language Models for Enhanced Wargaming in Multi-Domain Operations

Author: Max Meltschack and Dominic Weller

Abstract:

This proposal explores the integration of Large Language Models (LLMs) into wargame development, operation, and evaluation, offering a novel approach to enhancing analytical capabilities within multi-domain operations (MDO). Drawing upon the inherent strengths of both wargaming and machine learning, our research seeks to leverage synergies between these disciplines to optimize decision-making processes and strategic outcomes.

Our methodology involves the conceptualization and implementation of a technical demonstrator showcasing diverse applications of LLMs in supporting wargames across various domains. Specifically, we employ LLMs to simulate opposing forces, provide advisory functions to players, facilitate information accessibility, generate game content, and obfuscate adversary actions, thereby mitigating the complexities associated with MDO wargame development and operation.

Through our experimentation, we address critical challenges such as the prohibitive costs and limited scalability of traditional MDO wargames, as well as the scarcity of subject matter experts available to represent opposing forces and doctrines. Our findings demonstrate that integrating LLMs into wargaming not only enhances game realism and accessibility but also fosters collaboration among military, political, and academic stakeholders.

We conclude that the fusion of LLMs with wargaming methodologies presents significant opportunities for synergistic cooperation, unlocking enhanced analytical capabilities and strategic insights essential for navigating the complexities of modern warfare in an unstable world. Our proposal underscores the potential for ongoing interdisciplinary collaboration to advance military advantage and foster resilience within the international defense community.

Title: CDE during Exercise Vigorous Warrior 24

Author: Marian Ivan

Abstract:

The objectives of the various experiments conducted during Vigorous Warrior '24 and Clean Care '24 were centered around enhancing medical training and operations through the integration of innovative technologies and methodologies. Specifically, the experiments aimed to evaluate the effectiveness of VR and AR systems in medical training, the utility of a Near Real Time Surveillance (NRTS) tool for capturing patient data, the interoperability of civil-military medical teams, and the impact of Capturing Patient Evacuation Timelines and recreating the Casualty Stream with the help of a Computer Simulator. These experiments sought to improve preparedness, response times, and overall medical readiness in complex, multinational military settings, with a particular focus on combat casualty care, mass casualty management, and handling of CBRN scenarios. The experiments yielded several key findings and recommendations aimed at enhancing military medical operations. AR was found to be a more effective training tool due to its immersive and interactive capabilities. It is recommended to integrate AR into military medical training programs and provide comprehensive training on its use. The NRTS tool effectively captured relevant medical data and facilitated timely responses. Recommendations include refining the alert system to avoid redundancy, improving connectivity for better usability, and integrating NRTS with other reporting systems like EpiNATO to streamline medical reporting and enhance response times. Both civilian and military teams managed triage effectively, but differences in triage algorithms and performance times were noted. The use of digital MCCS forms improved data accuracy. It is recommended to standardize triage algorithms, enhance training on digital tools, and ensure consistent case management to improve joint medical operations. Significant differences were observed in how nations manage triage and treatment for CBRN and trauma patients, highlighting the need for standardized protocols. Improved coordination for patient transport and enhanced training for dealing with CBRN injuries are essential. The data collected will be used to refine medical readiness strategies through simulation models. Recommendations include developing unified triage and treatment protocols, investing in specialized training for CBRN scenarios, and enhancing interoperability among multinational medical teams. These experiments underscored the importance of innovative technologies and coordinated approaches in improving military medical readiness and response capabilities in complex and large-scale operations.

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Title: Electromagnetic Layer for Multidomain Operations (ELMO) interoperability implementation and testing.

Author: Piergiorgio Ventura

Abstract:

The 2024 M&S CoE follow-up of the project ELMO consist of its technical evolution providing additional features beyond the ones already developed. The system provides jamming area calculation and coverage visualization capabilities for communication and Position, Navigation and Timing (PNT) devices. ELMO is now capable of generating and sharing georeferenced files with other M&S systems, including Computer Generated Forces (CGF) tools. Files sharing is carried out with the Wargaming Interactive Scenario Digital Overlay Model (WISDOM) tool capable of data exchange through HLA1516e. Connection tests have been conducted with VBS4, JCATS and SWORD simulators. This improved feature increases the CGF tools capability to manage EMSO events in the field of Education and Training (Exercise), Support to Operations - Execution (Decision Support), Concept Development & Experimentation (CD&E), Mission Rehearsal, Planning and Procurement.

An additional ELMO technical feature has been developed for air defence radar range calculation, taking into account all target characteristics (cross section, altitude, speed, etc.). Similarly to the jamming area, the radars and the targets data can be shared, visualized and used in other M&S tools to conduct synthetic Multi Domain Operations.

This presentation describes ELMO Project's achievements, with a specific focus on the jamming area calculation, HLA relevant data sharing and system interoperability new capabilities, providing evidence of ELMO versatility of use in all M&S application fields.

Title: MAIDEN (Military Artificial Intelligence for Decision making and Experimentation within NATO): a project to integrate M&S tools with Artificial Intelligence/Machine Learning in support of decision-making.

Author: Piergiorgio Ventura

Abstract:

The decision-making process could be sharply boosted by the integration of AI with Modelling & Simulation (M&S), including any possible technical solution such as Deep Learning and Supervised Learning, becoming a fundamental technical and operational value for the benefit of military operations and concept/capability development.

Whilst conditional algorithms are structured on an inductive logic, the fundamental peculiarity inherent in the main AI/ML applications lies in the deductive programming mode. The aforementioned deductive logic represents the foundation of the initial concept, or rather, an adequate integration of the AI/ML with M&S.

In particular, the proposed integration provides an architecture based on the bi-directional connection between a neural network and M&S tools, in order to extend the peculiarities and results provided by a synthetic environment with algorithms based on deductive logic. The technological coherence of the proposed integration is essentially based on the main characteristics of the computational processes put in place by a constructive/virtual simulator, which refer to stochastic results.

The final result would be an integrated system able to "predict" the best behaviour (Course of Action) in a specific situation, based on its experience in similar situations. This integrated system would be applied for decision-making support within training activities or, ideally, for real operations, at least in the planning phase.

This presentation describes in detail the conceptual project, named MAIDEN (Military Artificial Intelligence for Decision making and Experimentation within NATO), to integrate M&S tools with AI.

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Title: CBRN activities within Modelling & Simulation: CASTLE Project

Author: Piergiorgio Ventura, James Ghirardo and Logan Saunders

Abstract:

Modelling & Simulation in support of CBRN and Environmental Protection has not been fully exploited to its maximum potential within the M&S areas; namely, Education and Training (Exercises), Support to Operations, Planning (Course of Action Analysis), Execution (Decision Support), Mission Rehearsal, Concept Development & Experimentation (CD&E) and Procurement. Many CBRN tools already exist, such as those providing models to simulate the dispersion of CBRN Agents, or the wearing of IPE during training. However, a comprehensive approach to maximize its effectiveness is still missing.

An innovative approach, which integrates existing tools and provides those not yet developed, represents a powerful M&S asset to fill the gap of this military problem.

The CBRN layer has been created and tested. Several dispersion simulation tools for the CBRN agent are included in the architecture (ALOHA, HOTSPOT) and the data received from the NATO JCBRN CoE obtained by HPAC were also included in the testing activities. The architecture includes MASA SWORD and VBS4 as CGF (Computer Generated Forces) tools. The Wargaming platform WISDOM is also included, not only for visualization of the agents propagation, but also to use its HLA plugin to hare the information. The scenarios have been built to simulate a synthetic CBRN environment with contamination and diffusion data. Several tests have been performed to verify the possibility to integrate all components of the architecture.

The final objective is to test the capability of providing the Commander with a comprehensive synthetic visualization of the CBRN framework on the battlefield. The related effects of the presence of the agent in the field have been tested using CBRN tools embedded in the CGF simulator.

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Title: Modeling and Simulation of Multi-Domain Autonomous Systems with Secure Standards-Based Commercial Communications Software

Author: J Schlesselmann and Thijs Brouwer

Abstract:

This presentation describes a practical use case in the application of secure open commercial standard software to model, simulate and rapidly assemble functional multi-domain distributed autonomous systems. The specific system mission requirements are generalized to illustrate the broader security, performance, and quality of service (QoS) attributes needed.

The approach uses the Object Management Group® (OMG®) Data Distribution ServiceTM (DDSTM) family of specifications, along with other key standards, to achieve communications between system components including sensors, actuators, navigation, maneuver, and effectors.

This session will be of particular interest to simulators of unmanned systems that require secure authoritative data in order to make autonomous decisions in distributed environments with needs for access control of data at different security levels, since tradeoffs between throughput, latency, and security functionality were evaluated.

The use of model-based systems engineering (MBSE) tools along with the creation of a Digital Twin (DT) of the physical system are also examined, as both were instrumental in achieving program objectives. Notably, the use of a Government-managed data model and open communications standards greatly enabled the overall M&S workflow. This includes system modeling (SysML/UML) and mathematical (Simulink®) simulation.

The key advantages for NATO MS&T include:

1. Scalability and Performance

Peer-to-Peer Architecture: DDS operates using a brokerless, peer-to-peer, publish/subscribe model, which supports dynamic discovery and multicast communication. This architecture allows for rapid scaling of new live, virtual, and constructive (LVC) environments.

High Throughput and Low Latency: DDS provides high throughput with low latency, essential for real-time simulations. It supports fine control of Quality of Service (QoS) parameters, including reliability, bandwidth control, delivery deadlines, and resource limits.

2. Interoperability

Standardized Protocols: DDS is based on open standards managed by the Object Management Group (OMG), ensuring interoperability across different systems and platforms. It supports syntactic and semantic interoperability, allowing seamless data exchange between heterogeneous systems.

Integration with Legacy Systems: DDS enables the integration of High-Level Architecture (HLA) and Distributed Interactive Simulation (DIS) simulations, as well as other entities like gaming platforms and hardware-in-the-loop (HIL) systems.

3. Flexibility and Adaptability

Auto-Discovery: DDS supports the auto-discovery of applications and endpoints, simplifying the integration process and reducing the need for manual configuration.

Data-Centric Model: Unlike traditional message-centric middleware, DDS uses a data-centric model where data and services are global concepts. This model supports loosely-coupled systems that can handle changes in topology and system reconfiguration without impacting running applications.

4. Security:

Built-in Security Capabilities: DDS includes security features that enable senders to publish data they are authorized to send and receivers to subscribe to data they are authorized to receive. This ensures secure data exchange without the need for the sender and receiver to have prior knowledge of each other.

5. Ease of System Integration:

Decoupling Complexity: DDS excels at decoupling the complexity of managing many variables and complex state relationships in intelligent systems. This reduces the integration effort and risk, especially in large systems with multiple independent modules.

6. Reliability:

Redundancy and Failover: DDS supports natural redundancy and failover mechanisms, ensuring continued operation even in the event of failures.

These advantages make DDS a powerful and versatile middleware solution for distributed autonomous simulations, enabling efficient, secure, and scalable integration of diverse simulation components.

Although this presentation describes experience with autonomy, its principles are applicable to other domains as well.

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Title: A Proof of Concept for Adding Non-Kinetic Models to MAK's Kinetic Constructive Simulation

Author: Peter Swan and Douglas Reece

Abstract:

Computer Assisted Exercises (CAX), wargames and operational planning systems need to consider both kinetic and non-kinetic dimensions of the battlespace. Current simulations, particularly at the tactical and operational levels, tend to focus on kinetic operations, but often don't support complex non-kinetic models. Therefore, it is necessary to manually integrate the two, or develop custom interfaces between different simulations. Can a well-designed constructive simulation seamlessly do both?

Well-designed constructive simulations have a number of common characteristics. Two of these characteristics are:

• Openness. If the user cannot understand how the models work and how decisions are made within the simulation, the system becomes a black box. If the user cannot access the internal data from the simulation, they are unable to analyze the results of the scenario.

• Customizability. For a constructive simulation to have the flexibility to model future systems and capabilities and localized conditions (doctrine, culture, natural environment and so forth) it must allow a user to modify the existing models, behaviors and missions or create completely new ones.

These characteristics are inherent to MAK's constructive simulation, VR-Forces, but it only fully simulates the kinetic (physical) dimension. MAK has therefore conducted a proof of concept that shows how a user can create and test non-kinetic (virtual and cognitive) models within the VR-Forces simulation engine, and to activate, control and visualize them in the user interface.

This presentation will discuss the architecture and implementation of the proof of concept, detail example models that have been developed, and describe their interaction with the kinetic models and the synthetic environment.

Title: AI in Autonomous Military Systems

Author: Francesca Perino

Abstract:

While unmanned systems have uses in civilian life as well, in the field of tactical unmanned operations they have many purposes, including reconnaissance and surveillance. The use of drones (unmanned aerial systems) illustrates the huge potential of unmanned systems.

While remotely-controlled drones are probably the most prominent example of unmanned systems technology, the latter's true potential covers all military services and domains (land, sea, air and space). The current deployment of remote-controlled unmanned systems marks just the beginning. Future developments in unmanned systems are expected to achieve greater levels of autonomy through Artificial Intelligence (AI) or cognitive computing. The initial focus on achieving autonomy concentrated on navigation, but has since broadened to include self-protection. Presently, the emphasis has shifted towards harnessing sensors and effectors for mission-specific tasks. When deployed in swarms, drones can surpass their individual capabilities, and integrating data from various sensors allows surveillance and autonomous systems to maintain their position, orientation, and situational awareness. This presentation explores:

• The fundamental capabilities required by all autonomous systems: sensing, perceiving, decision-making & planning, and acting.

• The role of sensor fusion within these capabilities.

• The advantages of integrating multiple data sources and the impact of sensor fusion.

Moreover we will explore advantages of the same development platform to design, test, and deploy your AI applications in autonomous mobile robots (AMRs), UAVs, and other robotics systems. Using some examples we will gain insights into:

• Reducing manual effort with automatic data labeling

• Detecting and classifying objects using deep learning for robotics applications

• Motion planning using deep learning

• Controlling robot motion using reinforcement learning

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Title: Advancing Army Data Centricity through Emerging Technologies and Modern Architectures to Enable Multi-Domain Operations

Author: Amit Kapadia, Paul Butler, Rick Osborne and Ricardo Escobar

Abstract:

As the U.S. Army executes continuous transformation to develop the Army of 2030 for Multi-Domain Operations (MDO), senior leaders have significantly advanced priorities for readiness and modernization through digital transformation pillars. This cross-cutting initiative not only includes technologies, processes, and human capital investment, but also cultural change/adoption. More specifically, Army policies and directives that communicate the immediate need of putting the right data, at the right time, at the right place to deliver rapid decision making in the modern battlefield. Even more paramount, data centricity becomes the core technical foundation for big data analytics, performance assessments, and dynamic artificial intelligence (AI) implementations.

Specifically, the U.S. Army Program Executive Office for Simulation, Training and Instrumentation (PEO STRI) is aligning to strategic Army data architectures and approaches through integration of emerging technologies with pragmatic pilots that sets the conditions for aligning its MDO enabling training, test, and threat modernization programs to include the Synthetic Training Environment (STE) ecosystem. This data centric approach using novel architectures, standards, and technology stack is a fundamental break from the Army's current and legacy Live-Virtual-Constructive (LVC) training environments that often used independent system data silo, manpower intensive operations, and bulky data gateways for complex systems-of-systems interoperability to replicate the operational environment. PEO STRI's approach to modernize and include data centric concepts, architectures, and processes will immensely shape an ability to rapidly instantiate an immersive MDO-enabled battlefield with end-to-end data incorporation at the right place and right time.

In the past year, PEO STRI has embarked upon a multi-faceted pilot that aligns with DoD's data strategy featuring VAULTIS (visible, accessible, understandable, linkable, trustworthy, interoperable, and secure) objectives. This paper then encapsulates an early adoption approach of the Army's Unified Data Reference Architecture (UDRA) initiative. UDRA is the Army's data mesh concept that allows Army authoritative data producers, consumers, and associated data catalog infrastructure to seamlessly discover, re-use, adopt, and govern data that traditionally has required rather cumbersome data integration processes. PEO STRI advanced UDRA concepts by exploring a proof-of-principle open-source data hub technology as a modern data stack platform to evaluate data production, consumption, and querying across the data lifecycle using open interfaces, standards and metadata that will be covered. Furthering this approach, PEO STRI employed sample 3D geospatial terrain datasets as a common enterprise data product that could be published, data tagged, queried, and consumed by others. This approach gained tremendous feedback and lessons learned at the PEO STRI and Army level regarding data best practices, data ownership, its governance, and iterative updates. This paper will highlight the breadth and depth of the data centricity approach coupled with how additional data sets could be more relevant across the PEO STRI enterprise for re-use and convergence across its enterprise portfolio coupled as its AI strategy foundation. These foundational efforts maintain and advance readiness in a complex and changing threat environment.

Title: Verification and Validation for Sim-AI

Author: Mihaela Lechner, Daniel Seufferth and Oliver Rose

Abstract:

The integration of Artificial Intelligence (AI) and simulation as a hybrid approach is increasingly benefiting various applications, offering significant advancements across complex domains such as thermodynamics (Daw, et al. 2017), autonomous driving (Lee, et al. 2019), biomedicine (Deist, et al. 2019), education (Dai and Ke 2022), or logistics (Jackson, Saenz and Ivanov 2024). In the recent year this method is also used in military operations as seen in (Wei, et al. 2020), (Davis and Bracken 2022), (Möbius, et al. 2023), or (Lechner, et al. 2023). Despite the remarkable capabilities of this approach in solving challenging military decision-making problems, the deployment of these systems into production necessitates ensuring their stability, robustness, and safety.

Currently, there are numerous techniques for verifying and validating AI and simulation systems separately. However, there is a noticeable gap in guidelines specifically tailored for verifying and validating hybrid AI-simulation systems. This presentation aims to address this gap by presenting comprehensive techniques used in the Verification & Validation (V&V) process of systems that combine simulations with AI. We will explore the unique challenges and potential weaknesses of these hybrid systems.

To illustrate these V&V techniques and their practical applicability, we will present an example from an ongoing project with Airbus Defence and Space. This project involves a combat simulator that utilizes reinforcement learning to optimize troop movements and attack strategies. Our discussion will cover the methodologies employed to ensure the reliability and effectiveness of such a complex system, emphasizing the importance of thorough V&V processes in the successful integration of AI and simulation technologies.

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Title: Large Language Models as Interpretation Agents for Raw Simulation Output Data

Author: Armando Geller and Francesco Sponchiado

Abstract:

Multi-domain operations involve heightened complexity and accelerated pace. Analyzing command and control networks and kill webs is crucial left of, at, and right of boom. Simulations generate massive amounts of data to support this analysis. However, the time and personnel available to extract meaningful insights from this data are limited. More resources are typically devoted to engineering and running simulations than to analyzing their outputs. Large language models (LLMs) can serve as interpretation agents to address this imbalance. We present preliminary work that involves using a pre-trained, private LLM to process raw simulation output data and generate initial insights, which humans then further analyze. The raw simulation output data is generated by OPTIMA, our constructive AI-driven multi-agent simulation environment for data farming adversarial encounters on the operational level. We discuss how we refine the LLM with specific prompts to align with our analytical requirements, verify the quality of the LLM's interpretations, adapt our workflow, and benefit from human-machine collaboration.

Title: A bottom-up approach to the simulation of Multi-Domain Operations

Author: Philip Muurmans and Armon Toubman

Abstract:

The NATO definition of multi-domain operations (MDO) describes the creative interplay between activities in multiple domains aimed at achieving an advantage by pressuring the adversary's decision-making process. Studying this interplay is the domain of simulation, and capturing MDO in computational models may lead to opportunities for rich training and CD&E applications. However, given the nature of MDO, there is no one-size-fits-all simulation approach. Therefore, instead of fitting the definition of MDO into a simulation environment, we aim to enrich the simulation environment towards the MDO philosophy instead. In this paper, we describe the application of the practical essence of MDO by using a bottom-up approach and outline how state-of-the-art simulation and artificial intelligence technology can be connected to create and execute rich MDO scenarios.

In our approach, we connect scenarios from computer generated forces (CGF) simulation packages to large language models (LLMs). CGF simulation scenarios offer precise control over simulation starting conditions, while the application of LLMs provides coherent automatically generated narratives and courses of action. The possible courses of action follow from the capabilities of the entities in the simulation environment, leading to scalable MDO simulations. Put together, a decision-maker using the simulation for MDO practice can be immersed in a rich interconnected world with minimal effort from scenario builders.

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Title: Modernization in Tandem: Synchronization of US/UK Simulation Strategies

Author: Richard Osborne, Ricardo Escobar and Adam Coffman

Abstract:

The US Army's training systems interoperability with Five Eyes (FVEY) partners is essential for seamless collaboration during multinational operations. This interoperability not only boosts the effectiveness of training exercises but also improves operational readiness and mission success. It cultivates a mutual understanding of tactics and procedures, bolstering the collective defense capabilities of these nations.

As part of the Modeling, Instrumentation, and Simulations for Training Systems (MIST) working group, the U.S. Army Program Executive Office for Simulation, Training, and Instrumentation (PEO STRI) and the UK Ministry of Defence (MOD) Army's Collective Training Transformation Programme (CTTP) have crafted a multi-phased roadmap. This roadmap aims to integrate US and UK virtual and constructive training systems using the U.S. Army Synthetic Training Environment (STE) Software.

The STE Software is a transformative technology that provides immersive, multi-level training and mission rehearsal capabilities for Soldiers. It acts as the "operating system" for various training platforms. These platforms enable individual weapon skills development, Air/Ground Combined Arms Collective training, Live training, and Commander/Staff training.

The team is employing agile prototyping to swiftly achieve training system interoperability, starting with small echelons and gradually expanding to support higher echelons of multinational training. The first phase of the roadmap includes the integration of UK virtual systems and US virtual/constructive systems, enabling small unit collective training. This represents a first step (and success) in demonstrating interoperability between two FVEY partner nations' transformational training systems.

This paper describes PEO STRI's and CTTP innovative approach for rapidly achieving interoperability. It documents the multi-phased approach, the challenges faced, and the lessons learned from Phase 1. The pioneering practices highlighted in this approach are expected to serve as the blueprint for continued and expanded integration with other FVEY partners. Given the speed that the U.S. and U.K. have demonstrated success with this small coalition exercise, the STE Software offers a viable "operating system" solution for allied partners integration, enhancing interoperability and boosting the effectiveness of multinational operations.

Title: Enhancing Realism in Crowd Simulations: A Hybrid Machine Learning Approach

Author: Michael Bearss and Michael O'Connor

Abstract:

Realistic crowd movement modeling is critical for applications ranging from urban planning and disaster management to modeling realistic civilian movements during a military exercise. Traditional crowd simulation methods often rely on simplistic rules and do not capture the complex, emergent behaviors seen in real-world scenarios. This presentation describes a novel approach to modeling realistic crowd movements using machine learning techniques. Our method leverages overhead recordings of pedestrian traffic to train a model capable of predicting individual and group behaviors in diverse environments.

We employ a combination of Generative Adversarial Networks (GANs) and genetic algorithms to generate high-fidelity simulations that replicate the intricate patterns observed in actual crowds. The GANs learn and reproduce the fine-grained details of crowd dynamics, while the genetic algorithm optimizes the model parameters to enhance the realism and accuracy of the simulations.

While our model is still in development, preliminary results are promising, indicating a significant improvement over traditional simulation methods regarding realism and adaptability. Early tests demonstrate the model's ability to handle varying densities and diverse scenarios with greater precision. Further research and extensive demonstrations are planned to fully validate the model's effectiveness and explore its potential applications in the planning and management of crowded spaces. More accurate crowd modeling will enhance the fidelity of simulations affecting various domains, such as urban combat simulations, infrastructure design, and optimizing evacuation procedures in emergency situations.

Title: Enhancing operations and training applying advanced UI and behavior capabilities

Author: Peter Meyer zu Drewer, Karsten Scholtyssik and Marcus Voigt

Abstract:

Today's armed forces are facing complex challenges with increasing demand on operational readiness at any time and any place. Modern operations are characterized by increased speed, requiring faster and more efficient decision cycles. Armed forces are confronted with the shortage of personnel and equipment, dual use of off-the-shelve drone, asymmetric, multi-domain ops, cyber warfare and many other factors, leading to higher cognitive demands and workload.

Combining Natural Language Processing (NLP) and Unit Behavior Modeling (UBM) presents a promising avenue for enhancing the decision-making capabilities of commanders and their staff. NLP techniques simplify the access of operators, commanders and their staff to computerized systems, providing a more 'natural' interface and thus allowing faster interaction with less mental workload. On the other hand, UBM provides a structured framework for defining complex decision-making logic to translate commands into simulation actions and to automate simulation processes.

This paper/presentation will introduce the use of Natural Language Processing (NLP) and Unit Behavior Modeling (UBM) for realistic human/unit behavior modeling to improve course of action (CoA) development and operation support, Concept Development and Experimentation (CD&E) and training. It will describe military use cases/military operations where NLP and UBM can be applied and the impact of NLP and UBM on those. The paper shows how a constructive simulation system was combined with NLP and UBM, explaining the overall architecture, the use of Coalition Battle Management Language (C-BML) and providing examples of utilizing NLP and UBM.

Finally, the paper reflects on lessons learned and proposes future developments.

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Title: MSG-223 Status Update on AMSP-04, IVCT and HLA Certification

Author: Zeynep Çakır, Björn Löfstrand, Andrea De Simone, Reinhard Herzog and Kristine Haugan

Abstract:

High-Level Architecture (HLA), IEEE 1516-2010, is a standard for modeling and simulation (M&S) for connecting and integrating simulation components with a model-driven approach. The purpose of the HLA services is to facilitate coordinated, efficient, and synchronized data exchange that is ideal for distributed simulation. However, existing M&S applications and services are not using the full potential provided by HLA or the NETN-FOM, which is a HLA Federation Object Model (FOM) represented in AMSP-04 NATO standard (STANREC 4800), which provides a summary of all NETN-FOM modules, key design patterns and main concepts for developing interoperable distributed simulation systems. AMSP-04's newest edition is pre-released on March 2024 and different editions of this FOM causes systems to interoperate substandard in a federated distributed simulation environment. Similarly, the Integration, Verification and Certification Tool (IVCT) -which supports the integration of simulations in federations, verification of the standard specifications and evaluation of the interoperability capabilities through predefined scenarios- lacks coverage to verify compliance with HLA and AMSP-04. Additionally, The HLA certification process and supporting functions have not reached final operating capability (FOC). In order to address these issues, the research task group MSG-223 aims to improve the interoperability maturity of M&S applications & services and by that increase the effectiveness when creating synthetic environments by providing opportunities. This presentation will introduce MSG-223 and provide a status update on its objectives, expected achievements and activities.

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Title: Training for the Future Fight with Cutting Edge Technology: A Virtual Reality Platform to Train All Service Members in Prolonged Casualty Care in Austere Settings

Author: John Dorsch, Michael Barrie, Joy Tiyasirichokchai, Martijn Boosman, Nilesh Patel, Talia Weiss, Michael Poppe, Ryan Ribeira, Jennifer Polson and Karthik Sarma

Abstract:

Modern near-peer conflicts highlight that basic combat casualty care trauma resuscitation does not prepare service members to manage critically wounded casualties in austere locations for prolonged periods of time when rapid evacuation is not feasible. Current prolonged casualty care (PCC) training modalities are prohibitively resource intensive, including consumable supplies, training manikins, and standardized patient actors. Digital transformation of this critical, but costly, training requirement is essential in order to prepare NATO forces for future multi-domain operations (MDOs) in which traditional casualty management practices will be overwhelmed. A virtual reality (VR) platform has the potential to drive this transformation by immersing participants in highly realistic medical scenarios, replicating far-forward environments, and condensing prolonged PCC timescales. To develop such a novel VR platform while supporting operational requirements for PCC, the VALOR research collaborative formed a team of subject matter experts in medical simulation and VR. Learning objectives were based on content outlined in the DOD Clinical Practice Guidelines. This technology can extend into areas where traditional simulation is impractical. Participants can access virtual tools that may be limited in real-life training exercises, can experience more realistic and immersive scenarios, and can accelerate the simulated passage of time. Participants can work in teams with options for remote participation.

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Title: Interoperability of Cyber Ranges with LVC Systems for Improved MDO Training

Author: Jeff Kiet Truong, Omar Hasan, Mark Evans, Jeffrey Welch, Derek Crane, J. Allen Geddes, Jason Strauss, W. Cory Bogler and Alf Betancourt

Abstract:

The United States (U.S.) Army and the North Atlantic Treaty Organization (NATO) member nations are accelerating the rollout of their Multi-Domain Operations (MDO) training to prepare for operational conflicts that involve land, sea, air, space, and cyber domains. With that new mandate, an increasingly greater number of kinetic-focused Live, Virtual, and Constructive (LVC) training events are seeking to incorporate cyber domain training into their events.

The Persistent Cyber Training Environment (PCTE) is a cloud based virtual training platform developed by U.S. Army's Program Executive Office for Simulation, Training, and Instrumentation (PEO STRI) to support the U.S. Cyber Command (USCYBERCOM) Cyber Mission Force (CMF). PCTE enables individual and collective Defensive and Offensive Cyber Operations (DCO/OCO) training and mission rehearsal. Recently, USCYBERCOM and the PCTE Program Office have received requests to investigate the feasibility of incorporating the cyber domain into kinetic-focused LVC training events to meet emerging MDO training compliance requirements. Blended cyber-kinetic training more realistically depicts the modern warfare scenarios – for example, a cyber-attack that disables critical infrastructure (such as a power plant) which in turn negatively affects the kinetic dismounted operations within the region served by the power plant.

There are multiple PCTE challenges that must be considered when participating in an LVC exercise. PCTE is designed as a standalone system for cyber training events, whereas kinetic-focused LVC training is typically performed using systems federated together using a pre-defined data model and protocol. This presents challenges when kinetic-focused LVC exercises incorporate cyber domain training into their overall scenario, as cyber ranges are emulators that do not support the same communication protocol and data model as LVC simulations. Coordination of the cyber effects between these environments is currently executed manually via white card or swivel chair synchronization.

In collaboration with U.S. Army Combat Capabilities Development Command – Soldier Center (DEVCOM SC) Simulation & Training Technology Center (STTC), using DEVCOM SC's cyberspace interoperability framework (termed Cyberspace Battlefield Operating System Simulation [CyberBOSS]), we have prototyped a novel architecture to automate the cyberspace effects between a cyber range and LVC systems, improving coordination over the current manual intervention methods. The design utilizes a sensor-driven solution to detect and propagate cyber battle damage assessment (BDA) of network and system states in the cyber range with cyber operator actions (from Blue or Red Team). This cyber BDA is communicated to the LVC simulation environment using CyberBOSS so that generated cyberspace effects have an operational impact on simulation models and connected Command, Control, Communications, Computers, and Intelligence (C4I) interfaces. We plan to demonstrate the initial proof-of-concept in an upcoming U.S. Army Reserve (USAR) Combat Support Training eXercise (CSTX) event in August 2024. We will present the details of our architecture, concept of operation, and the outcome of our CSTX demonstration.

Title: Strategic Disruption in Military Supply Chains; Multi-Domain behind the Line

Author: Alexander Roman and Oliver Rose

Abstract:

Motivated by the crucial role of military supply chains in ensuring national security, especially highlighted by ongoing conflicts such as in Ukraine, this study introduces a simulation framework designed for military operations, focusing on establishing Effects-Based Operations (EBO).

Our framework simulates a national-scale Energy and Material Transportation Network. It examines how military engagements create localized demand fluctuations and how forced infrastructure shutdowns disrupt civilian supply chains. Additionally, we explore the feasibility and benefits of strategically coordinating these effects within military campaigns.

The primary objective is to identify key infrastructure components and production facilities essential for military success.

Our methodology employs agent-based, stochastic, and discrete-event simulation. We use open-source data and software for this feasibility study, with plans to incorporate confidential sources once the framework's performance is validated.

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Title: CIRSIUM: Developing an analytical wargame for NATO's Allied Rapid Reaction Corps

Author: Andy Hodgson, Jeremy Cogman and Darren White

Abstract:

NATO's Allied Rapid Reaction Corps needed the capability to support operational planning for high intensity warfighting with Course of Action and analytical wargaming. RED Scientific was contracted to design the wargame environment, develop the combat algorithms, build the software, and compile a complete dataset, ensuring that the key factors affecting combat outcome were represented. The development made extensive use of existing and original historical analysis and the combat algorithms were validated against a dataset of over one hundred historical combat engagements, varying in date from the Boer War (1899) to the Gulf War (1991).

The wargame represents all aspects of operational level land operations, including ISTAR, manoeuvre, fires and close combat engagements. It is played using a flexible turn-length, allowing complex interactions to be played in detail while speeding over operational pauses. This is achieved by an innovative visualisation of the phasing of activities in a synchronisation matrix. It also supports a sophisticated representation of target acquisition and intelligence; players give orders on the basis of the intelligence available to them from their sensors, rather than having a 'god's eye' view of the battlefield. Equipment support, logistics and casualties can also be modelled.

The game is currently played between human players, however development is underway on a four-year programme to create an AI player that will provide a worthy training opponent for human players, and pave the way for AI vs AI simulation of conflict and course of action analysis.

There are many challenges to AI model development that the programme will have to overcome:

• Computational speed

• What actually is learned?

• What models need to be built?

• What decisions need to be made?

• What determines when an operation is complete and who won?

• How should an engagement be scored?

This presentation will give a brief overview of these challenges, and more.

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Title: Utilising live simulation data (TES) to enrichen traditional observation mechanisms

Author: Duncan Parkinson

Abstract:

4C is a world leader at producing collective training exercise management software. Assessment of training audience performance during a field training exercise has traditionally been supported by the manual capture of subjective observations by observers in the field. This presentation explores the integration of live simulation data, collected through the Tactical Engagement System (TES) utilizing the Distributed Interactive Simulation (DIS) standard, to enhance traditional manual observation methods in military training exercises at the company and battalion levels. By combining TES data with manual observations to enrichen the available data, observers are better able to make end of mission evaluations and are able to provide improved feedback to the training audience. Additionally, a critical examination of data limitations inherent to the DIS standard and available TES solutions will be conducted to draw conclusions relating to how future training management and live simulation integrations could be enhanced to provide improved data fidelity.

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Title: AI-Enhanced Wargaming: Leveraging Large Language Models for NATO's Strategic Wargaming

Author: Ugur Uysal, Marcus Gaul and Talia Beech

Abstract:

We explore the integration of Artificial Intelligence (AI) into NATO's strategic wargaming. Utilizing Large Language Models (LLMs), we simulated human decision-making within predefined scenarios.

Through prompt engineering and retrieval-augmented generation (RAG), we accurately replicated the strategic thinking of red and blue teams, as well as the adjudication of their moves per turn. Separate LLM agents were employed for each team, each with tailored system prompts and relevant documents, ensuring a comprehensive understanding of the wargaming context.

Our findings demonstrate that the LLM's decision-making closely resembles that of human players, providing consistent responses in significantly less time. While further research and more extensive trials are needed, these initial results suggest that AI could be a promising tool for enhancing the effectiveness of military decision-making and contributing to improved multi-domain operations and operational readiness.

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Title: Future-proofing NATO: The impact of open systems on multi-domain operations

Author: Mimi Keshani and Craig Beddis

Abstract:

In the rapidly evolving landscape of global security, NATO faces increasing pressure to respond swiftly to unpredictable threats, including near-peer adversaries, while optimising resources, managing the complexity of joint operations, and adhering to constrained budgets. This presentation underscores the critical importance of adopting emerging technologies and a modular open system architecture approach to achieve these objectives, with a particular focus on contested logistics as a case study.

Modular open systems are essential for NATO's ability to do more with less. They could play a critical role in the evolution of NATO Standardisation Agreements, increasing the scope of possible suppliers with an emphasis on openness and encouraging commercial technology to contribute. Open architecture facilitates a modular approach, avoids vendor lock, and allows NATO to integrate and experiment with more diverse and novel technology. This flexibility is crucial for maintaining operational readiness and efficiency across multi-domain and multinational operations. The US's Modular Open Systems Approach (MOSA) serves as a pertinent example, demonstrating how such strategies can enhance NATO's capabilities.

As the adage goes, "Amateurs talk tactics. Professionals talk logistics." Effective logistics are fundamental to enabling multi-domain operations, ensuring that resources are optimally distributed and sustained across various operational theatres. Open systems like spatial computing and AI, that are defined by their interoperability and interchangeability, can play a crucial role in enhancing Modelling and Simulation (M&S) systems for logistics training and operations. By simulating contested supply chain scenarios, NATO can better understand the impact of unforeseen disruptions on command decisions and operational tempo, ultimately facilitating more strategic resource allocation and planning.

Furthermore, the integration of AI agents in simulations represents a transformative approach to addressing logistical challenges. Multi-agent simulations can provide detailed insights into the dynamics of supply chains under duress, offering predictive analytics and decision support tools that enhance strategic planning. AI-driven wargaming can also improve NATO's readiness for multi-domain operations, enabling rapid adaptation to complex, unpredictable threats.

This presentation will explore how embracing open systems and leveraging advanced M&S technologies, including AI, can enable NATO to enhance its operational efficiency, manage the complexity of joint operations, and maintain a decisive edge in an increasingly contested global security environment

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Title: Seeding Success: Generating valid and realistic PMESII start values for serious wargames and simulators.

Author: Bernd Weissenberger

Abstract:

PMESII (Politics, Military, Economic, Social, Information, and Infrastructure) is widely accepted as parameters to judge and measure the condition of a country.

The success of each game and simulator depends, among other things, on the right starting conditions. Especially in the field of serious military wargames, it could be hard to get realistic data about the condition of a played country. Therefore, data from free available sources and the weighting and processing of this data could be immensely helpful to generate realistic starting values.

Using open-source databases and the method of cross-impact weighting will increase the reliability of generating PMESII start conditions for wargames and simulators.

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Title: How to use the current metaverse for recruitment and familiarization of military occupations and specialties

Author: Seth Crofton

Abstract:

Best Practices from the Consumer Game World metaverse for Government Projects for recruitment and to inform the general public in regards to unique needs and opportunities to serve.

1. Design Documentation to create outreach within consumer facing metaverses (Roblox, Minecraft and others) USE case scenario US NAVY/

2. Creating scalable documentation that grows with the project.

3. Historical use of outreach through consumer games

4. Ways to use AI throughout the process.

After covering these sections the Audience will then participate in outlining potential use case scenarios for their own NATO affiliated countries and services.

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Title: Simulation Requirements for Training a Multi-Domain Task Force (MDTF)

Author: Thomas Lasch

Abstract:

The U.S. Army version of the Multi-Domain Task Force (MDTF) is a theater-level maneuver element designed to synchronize precision effects and precision fires in all domains against adversary anti-access/ area denial (A2/AD) networks in all domains. To properly and realistically provide a synthetic environment for an MDTF, trainers and simulation developers alike must first learn and understand the capabilities of the MDTF. The MDTF structure and capabilities are still evolving, and we as synthetic environment providers must keep pace with the organizational and technological advances. This presentation will inform the audience of the MDTF structure and capabilities to derive a sound strategy for future training capabilities.

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Title: From trends to evolution, a snapshot of the simulation innovation process culminating in 2024

Author: Sergio Re and Seb Loze

Abstract:

In the last years since the epidemic hiatus our world went through, what was once trendy concept, have matured, been experienced and confirmed as actual evolution factors. Given the current technology growth pace we are witnessing, the interactions within the simulation community between industry, education and operational teams are more than ever in need to improve to avoid obsolescence of systems and methods.

Join Seb Loze, Vice President for Products Innovation at Bohemia who will be in this keynote describing the ways cloud based, AI driven, data centric and open trends are handled by the entire simulation community and can find their ways into the next generation of simulation software for modelling and simulation.

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Title: Proposals to deal with Complexity in Multi-Domain Operations: Ontology supporting an Agent-Based Model

Author: Michael Romei de Socio, Gianluca Pozzato and Alessio Merlo

Abstract:

Although the expression "Multi-Domain Operations" (MDO) has been used for some years, there is still no unified definition of what this actually means. One sure point in common in all possible definitions is that operations in all five domains will be used throughout the competition continuum cycle among different state and non-state actors.

But to achieve the intended effects on the Operational Environment (OE), simply using actions across domains is not enough. Instead, the use of all the instruments of power in a coordinated and synchronized manner is of absolute importance to perform a real MDO with effects in the desired "dimensions": physical, virtual, or cognitive. Nonetheless, we must be fully aware of the actual effects of such actions, which do not necessarily coincide with those intended by those who acted. Even relatively small tactical scenarios show clearly all the characteristics of a Complex System, including the so-called emergent behaviors, which cause the formation of more or less complex patterns on a large scale starting from even relatively simple interactions at a local level.

Since "a complex system is by definition too complicated to be comprehended by just using everyday common sense", planning a MDO requires a diverse and integrated knowledge base. This is essential to conceive a Multi-Domain Operation (MDO) but requires that heterogeneous data from multiple sources be collected, processed, analyzed, and systematized for use relying on appropriate models with limited human supervision.

To accomplish this task what appears to be the most suitable is an Agent-Based Model (ABM) integrated with a complex network based model and combined with a Geographic Information System (GIS) by virtue of the non-negligibility of the space-time dimension. The coordinated use of Artificial Intelligence tools with a specific support Ontology are essential requirements for the above to function correctly

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Title: Learning from wargaming and foresight methodologies and practices applied to education and training for Multi-Domain Operations

Author: Claudio Corrêa and Sabrina Medeiros

Abstract:

This short article is a description of the presentation of some of the Defence University's M&S research and projects using wargaming and foresight methodologies and practices applied to education and training to improve multi-domain operations in support of military operations and decision making.The demands for Multi-Domain Operations to provide from humanitarian relief to armed forces engagement come from reactions of the nations to great disasters, wars and conflicts. These are complex phenomena that take place in an uncertain and dynamic environment where human and nations power relations, new and on-going developing technologies and the forces of nature, such as hurricanes and tsunamis, are very powerful and somehow unpredictable. In this sense, we must do our best through modelling and simulation, but because the necessary data, information and knowledge has huge different and interconnected sources, the way it is done can be improved through inter-agency and civil-military cooperation as well as, long range vision of alternative futures.

This paper investigates the collaborative dynamics, anchored in Brazil's experience, in wargaming and scenarios planning conducted by the Scenarios and Simulations Lab (a sector of the Brazilian Naval War College) and other examples involving civilian and military researchers and practitioners, emphasising their integral role in bringing out of the box thinking , forward looking perspectives and signs of interest to the Multi-Domain Operations with a focal lens on the Global South perspective. A framework is employed to analyse industry and academia participation, inter-agency cooperation and foresight methodologies and practices. It is innovative to glean comprehensive insights into maritime security dynamics, simulations and scenarios. Here they are considered as different plausible future environments that can be imagined, are used not only as an alternative to single line forecasts, but as an intelligent strategic conversation language allied to the organizational learning process. In sum, based on an analysis of the experiences of wargaming, simulations and scenarios, highlights the importance of providing cooperation between various sources of knowledge, alternative futures thinking and a multidisciplinary approach as requirements for improving the contribution of Modelling and Simulation to Multi-Domain Operations.

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Title: A Variety of Specific Perspectives on the Use of AI in Military Simulations a Panel Discussion

Author: Mark Pfeiffer, Sophia Klewer and Mate Koch

Abstract:

This paper provides an outline for the panel discussion to be held at the NATO CAX Forum in Rome in 2024. Similar to the previous year, the intention is to provide insights into the challenges and opportunities that the use of artificial intelligence (AI) entails. The panel is composed of a diverse group of experts involved in the military simulation industry.

In the evolving landscape of AI and its applications, integrating diverse perspectives and technological advancements is critical for enhancing capabilities across various domains. This paper explores the multifaceted perspectives on AI from my background as an expert in hybrid warfare, aerospace research, modeling and simulation, and as a member of NATO. Specifically, it examines the implementation of AI in agent-based models (ABMs) for improving course of action (COA) analysis. This approach leverages AI to simulate complex scenarios, providing military strategists with robust decision-making tools.

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Title: Advanced Techniques in Space Battle Management: Enhancing Military Operations through Simulation and Domain Awareness,

Author: Jacopo Diamanti and Valerio Amodeo

Abstract:

In an era where space is recognized as a vital domain for military operations, the ability to manage and protect space assets is crucial. This presentation, titled "Advanced Techniques in Space Battle Management: Enhancing Military Operations through Simulation and Domain Awareness" will explore the sophisticated methodologies and tools that are shaping the future of space operations. Attendees will gain a deep understanding of the role of Space Situational Awareness (SSA), the application of advanced software tools for orbit analysis and satellite management, and the importance of developing realistic scenarios to improve decision-making and operational readiness. The session will also examine future trends and the significance of international collaboration in ensuring space security. Join us to discover how these advanced techniques are enhancing military capabilities and shaping the strategic landscape of space operations.

Title: Boosting multi-domain operations with MSaaS based simulations on HPC

Author: Pierpaolo Rosin

Abstract:

Multi-Domain Operations represent a fundamental shift in the current approach for Defense activities. This presentation describes how Leonardo Modeling & Simulation products and capabilities can actively support Partners and Customers in a wide range of multi-domain operations spanning from CONOPS validation trough simulation, Product Development, Test & Integration and Training.

Leonardo extensive experience in the field of simulation and the vast expertise and knowledge acquired through years of development and use of simulations in various sectors allowed to develop a set of specific simulation capabilities that cover different important aspects of the M&S domain.

In the following some of these capabilities (in particular for the Electronics Division):

• State of the art Synthetic Environment, a computer generated simulation of the real world (the natural environment - including atmosphere, space, ocean, terrain etc. - and natural phenomena), within which any combination of players defined by accurate behavioral models interact in a distributed scenario.

• Suite of simulated sensors, implemented by real-time and physically accurate sensor models. Using rehosted code or simulated models, a wide range of sensors (including radar, FLIR, IRST, IFF, SONAR, DASS and EW Systems) are implemented; an extensive data generation suite (for GIS and EW data) completes the sensor simulation solution.

• Interactive radio and sound simulation system, capable of implementing radio, intercom, sounds considering effects due to line of sight, distance, noise disturbance and weather attenuation.

• High-fidelity real-time 3D engine designed to create a highly detailed, realistic and immersive representation of the simulated scenario. Advanced rendering techniques, detailed texture and models, dynamic lighting and shadows are coupled with an unprecedented simplicity and speed in geographical database preparation.

All these M&S capabilities are made available as services through a modern integrated approach that, according to the NATO MSaaS paradigm, allows for selecting, orchestrating and executing them in any combination easily and intuitively.

The above-mentioned M&S capabilities are hosted in a private cloud supported by a common Leonardo infrastructure and boosted by the Leonardo High Performance Computer platform, DaVinci-1.

The approach chosen from Leonardo is then very well suitable to address in the proper way the complexity of Multi-Domain Operations requested by the actual operational scenarios.

The Leonardo presentation will show how this MSaaS environment (based on OCEAN), capable of providing a wide range of Simulation services also from the other Leonardo Divisions, can support such a complexity.

Title: Overview of the EDF project FEDERATES

Author: Agatino Mursia

Abstract:

The FEDERATES (FEDerated Ecosystem of euRopean simulation Assets for Training and dEcision Support) project proposes the study, design, prototyping and testing of a unique and unified EU capability aiming to develop a European Modelling and Simulation as a Service (MSaaS) Ecosystem to support Distributed Synthetic Training (DST) and decision-making.

A close cooperation between major defence industries, research organisations and innovative small and medium enterprises from 14 MS and Norway will ensure the availability of M&S applications and services across EU in the FEDERAT&S Ecosystem Prototype. European Member States and Norway will be able to operate national simulation environments connected with other Member State' assets and services to compose multi-national simulation events. FEDERATES will also be able to interoperate with non-European systems using compatible International and NATO standards. At an operational level, the FEDERAT&S Ecosystem vision is the interconnection of national M&S clouds and national training centres to allow the composition of EU-wide simulation systems to support concurrent multi-domain training and decision support activities.

From a functional perspective, the FEDERATES Ecosystem consists of three major elements: 1) a Portal to get access, 2) a Foundation and 3) Content consisting of Services and User Applications. The FEDERATES Foundation includes core services and applications to discover, compose and execute simulation environments and is based on common standards and processes, including business models.

FEDERATES' most significant technological contribution is the first operational implementation of the MSaaS conceptual framework. The FEDERATES Ecosystem Prototype aims for TRL 6-7. It includes the application of commercial cloud and virtualisation technology, including readily available open-source developments, representing a substantial evolution in the field of military M&S applications.

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Title: Mission Combat Architecture (MCA): How to Empower Airmobile Assets with a Powerful, Innovative, and Cost Effective Architecture.

Author: Paolo Trotta

Abstract:

Missions can be successful with no or reduced collateral damages, when plan and rehearsal are detailed, achievable anytime, anywhere, and crystal clear within the mind of operators. The Mission Combat Architecture has been designed as an integrated Training, Planning, Rehearsal, Execution, AAR architecture to serve war fighters within complex symmetric and asymmetric multi domain scenarios. The key technological development are based on it powerful rehearsal engine and flexible battlefield management system.

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Title: CAX & WARGAME a methodology to use them together

Author: Ivan Vianello

Abstract:

The brief is about JWC attempt and experience to run a Wargame supported by CAX

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Title: Addressing current and emerging Challenges and Enhancing Operational Readiness through Advanced M&S Education and Training

Author: Dino Daniele Tropea

Abstract:

In the rapidly evolving landscape of military operations, the integration of advanced Modelling and Simulation (M&S) technologies into education and training programs is crucial for maintaining operational readiness and addressing emerging challenges. This presentation explores the current & future of military training through the lens of M&S, focusing on the integration of Joint Theater Level Simulation - Global Operations (JTLS-GO), Joint Conflict and Tactical Simulation (JCATS), and Virtual Battlespace 4 (VBS4). These cutting-edge simulators enhance the realism and effectiveness of training scenarios, providing comprehensive support for wargaming exercises.

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Title: Revolutionizing Military Flight Training: LVC, AI, and AR Integration for Next-Generation Training

Author: Francesco Ollosu

Abstract:

Military flight training is introducing more and more new technologies such as augmented reality (AR) and embedded simulation technologies to Live, Virtual, and Constructive (LVC) environments. These advancements aim to reduce the overall costs of tactical exercises leveraging on simulation technologies and to enhance the training effectiveness and permitting to widen the exercises spectrum across multiple domains including air, land and sea towards a full MDO (Multi Domain Operations) capability.

Restricting the field on military flight training, the traditional LVC exercises included Live Aircraft (L), Virtual entities (V, simulators operated by human pilots) and Synthetic entities (C, Constructive entities managed by a Synthetic Environment). Often tactical training has been conducted in a LV or LC manner, having however the limitation, on board of the real Aircraft, to not see any Virtual or Constructive entities as soon as they are Within Visual Range (WVR).

The aforementioned new technologies in particular AR, permits to cope and avoid this limitation and the combination of LVC with AR and embedded simulation represents a significant leap forward in military flight training, offering more effective, efficient and safe training solutions for pilots.

In addition, considering the training for the next generation of fighter aircrafts and last events within the international theater, the application of LVC, AR and embedded simulation on Multi Domain tactical exercises can bring benefits to the trainees' training.

Today, digitalization and artificial intelligence are the enablers of a further evolution that affects both the aircraft and the ground segment, and which will materialize in the new Block 20 configuration of the M-346, in the two Fighter and Trainer versions, target platforms for next-generation training.

In a Multi Domain military context, LVC can be used to improve the readiness and resilience of forces by providing a realistic and adaptable training environment. It allows for the testing and validation of new tactics, techniques, and procedures in a controlled setting, reducing the risks associated with live training exercises. Additionally, LVC facilitates joint and coalition training, enabling interoperability and coordination among different branches and allied forces.

In this context, LEONARDO's presentation will illustrate its activities in this sector, in particular it will cover:

• The state of the art of the LVC application, in particular the application to the training syllabus of the Italian Air Force at IFTS and the new developments in terms of transmission technologies and embedded simulations

• The state of the art of Augmented Reality in particular the application to the training syllabus of an advanced Air Force

• Multi domain application of LVC, broadening its scope, including Leonardo OCEAN MSaaS technology

• Medium/Long Term evolutions, in particular artificial intelligence algorithms applications with substantial benefits in terms of operational availability of the fleet and integrated services

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Title: The identification, recruitment, and development of talent in Professional Defence Wargaming: An Analysis of Women, Gen Z, and Gen Alpha Wargaming practices

Author: Tess Butler

Abstract:

Aim or major research question:

This study investigates the approaches to, and execution of, serious games by women, Gen Z, and Gen Alpha participants, focusing on the influence of gender and generational perspectives within defence and wargaming environments.

The goal is to deliver knowledge and outcomes that will directly benefit defence immediately, as well as provide a programme of action to address challenges or exploit any identified potential.

The research is proposed to be structured in three phases: a narrative exploration of the challenges faced by women and young people in defence and wargaming, an empirical study through a series of wargames, and an analysis of the future implications of digitisation in wargaming.

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Title: Multi-Domain Operations - The Cubic experience

Author: Agostini Stefano

Abstract:

Experience and solutions of Cubic on MDO.

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Title: Strategic Engineering to support Decision Makers in Complex Systems: Innovative Models for Cognitive Warfare Simulation

Author: Agostino Bruzzone, Antonio Giovannetti, Marco Gotelli, Marina Massei, Filippo Ghisi, Xhulia Sina, Paolo Di Bella, Roberto Ferrari, Giovanni Ferraris, Marina Cardelli and Massimo Pedemonte

Abstract:

The proposed Solution DRYAS4 (Dynamic Reactive solution for opponent Yielding based on Artificial intelligent Systems, Simulation and Strategic engineering for Success) by Simulation Team, uses Modeling & Simulation (M&S), Artificial Intelligence (AI) and Data Analytics, leveraging the Strategic Engineering approach to support Decision Making in a comprehensive PMESII-PT (Political, Military, Economic, Social, Information, Infrastructure, Physical environment, and Time) Scenario and evaluating the Impacts of DIMEFIL (Diplomatic, Intelligence, Military, Economic, Financial, Information, Law Enforcement) Actions.

DRYAS4 goal is to Simulate, Analyze and support Strategic Decisions respect Global Scenarios including several Nations and their respective Populations, Capitals and Coalitions by a multi-dimensional approach capable of addressing the Physical, Virtual and Cognitive Dimensions, as well as Multi Domain military initiatives.

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Title: Tactical Level Land Centric Computer Assisted Wargaming at JFTC

Author: Olaf WERNER

Abstract:

NATO Joint Force Training Centre (JFTC) follows the NATO agreed general definition of a wargame as representation of a conflict or competition in which people make decisions and respond to the consequences of those decisions and actively supports the implementation of a new NATO training environment with 2024 and 2025 as transition years. This includes new opportunities to test and validate elements of the newly developed Regional Plans Land Tactical Plans (RP LTP) in a "safe-to-fail-environment" through computer-assisted wargaming. Therefore, JFTC developed a concept for Tactical Level Land Centric Computer Assisted Wargame (TLCAW) and prepares a TLCAW Trial together with Multinational Corps Southeast (MNC-SE) as sponsor to be conducted in November 2024 at JFTC.

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Title: Nov Wargame plan

Author: Scott Roach

Abstract:

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Title: Defence Universities Workshop (closed workshop)

Author: Bernd Weissenberger

Abstract:

Workshop, in support of an academic military simulation community.