Royal Aeronautical Society
Flight Simulation Conference 2025

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Conference abstracts

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RAeS Flight Simulation Conference 2025

SESSION: Regulatory Session

ICAO, the Personnel Training & Licensing Panel, the future

- **Stephane Clement** - Director of Regulatory Affairs, Civil Aviation, CAE

The International Civil Aviation Organization (ICAO) is a United Nations agency helping 193 States to cooperate and share their skies to their mutual benefit, with a vision to sustainably grow our global civil aviation system. ICAO develops policies, Standards and guidance, undertakes compliance audits, performs studies and analyses, and assists its Member States and other stakeholders. ICAO focuses on aviation safety, air navigation capacity and efficiency, security and facilitation, economic development of air transport, and environmental protection.

In 2021, ICAO established the Personnel Training and Licensing Panel (PTLP) to enable the review and development of relevant requirements for disciplines like pilots, air traffic controllers and aircraft maintainers. The PLTP aims at developing and maintaining ICAO Standards and guidance for personnel licensing and training (CBTA and traditional training), approved training organizations, Flight Simulation Training Devices (FSTDs), STDs and new aircraft categories.

The PLTP is composed of ten workgroups. Workgroup 3 (WG3) focuses on FSTDs for pilots and STDs for air traffic controllers and aircraft maintainers. For FSTDs, the qualification criteria included in ICAO Document 9625 are not aligned with the latest simulation and aircraft technologies, training methodologies and best regulatory oversight practices.
For example, FSTDs using virtual reality and mixed reality, and FSTDs for powered-lift aircraft (also called VTOL aircraft) are not included in this ICAO document.
Moreover, the technical evolution of FSTDs has improved their reliability and consistency. Consequently, per the aircraft certification and continued airworthiness domains, assigning more responsibilities to OEMs, FSTD manufacturers and FSTD operators should be considered. Also, the modernization and standardization of FSTD regulatory oversight activities done by States should be considered, mostly to promote stronger international cooperation, harmonization and recognition of FSTD qualifications and approvals for use between States.

This presentation will elaborate on the FSTD activities of WG3 within the ICAO PLTP.

RAeS Flight Simulation Conference 2025

SESSION: Regulatory Session

New and Emerging Simulation Technologies in FSTDs – ICAO Doc. 9625

- **Larry McDonald** - Senior Technical Specialist, Flight Simulation Systems, FAA
- **Eric Fuilla-Weishaupt** - Aircraft Simulation (GO5) & Training Solutions – STO, Commercial Aircraft, Airbus

Since the mid-1990's, ICAO has published several versions of Doc. 9625 with the stated purpose of establishing common test criteria for simulation that would be recognized internationally. While ICAO 9625 has been used with mixed success over the years to establish national standards to support FSTD qualification, it is recognized that the current update processes for national FSTD standards and ICAO Doc. 9625 are not agile enough to address the rapid pace of technological advancements in the simulation industry. Where advancements in simulation technology are shown to improve training outcomes and aviation safety, regulators should have the flexibility to enable the industry to implement positive change.

As part of the ICAO Personnel Training and Licensing Panel (PTLP), a subgroup for new and emerging simulation technologies (NEST) was established within the FSTD working group to examine how emerging technologies could be addressed within ICAO Doc. 9625. While the initial work of NEST has been focused on addressing the more immediate needs of industry and CAAs regarding the qualification of FSTDs with extended reality (XR) technologies, a broader look at FSTD standards will be necessary to address simulation technologies that cross the lines between traditional simulator standards and simulation tools that enhance training. The presenter will discuss some of the work within the scope of the NEST subgroup and considerations on how more agility and flexibility can be incorporated into the FSTD standards and qualification process.

RAeS Flight Simulation Conference 2025

SESSION: Regulatory Session

Competence of personnel still guaranteed with new regulations on hand?

- **Marco Brandes MRAeS** - Managing Director, Clément Aviation Company
- **Ilse Lamens** - Operations Manager, Clément Aviation Company

Regulation changes from the European Union have never been more “radical” than the proposed Opinion 01/2025. Surprisingly never was the industry more happy about new regulation than with this proposal. A changing landscape of the FSTD world allowing more flexibility for training organisations and airlines to train on devices considered suitable for their training needs. The main change is considered the introduction of the FSTD Capability Signatures.

But the ‘devil is in the detail’. We have always known the twelve main processes for operating an FSTD organisation. How many of these processes are going to be affected? Which new tasks are performed by the personnel of an FSTD operator? How will the competent authority perform its oversight? Do we all understand what is expected from each other?

These challenges ask for standardisation to ensure equal playing field for all FSTD operators within EU mandate area and far beyond. This presentation will give you sufficient fuel to consider multiple solutions for enhancing competences of all personnel.

RAeS Flight Simulation Conference 2025

SESSION: Regulatory Session

EASA feeding ICAO - updating ICAO 9625

- **Mark Dransfield FRAeS** - FSTD Regulatory Consultant, SIM OPS Solutions
- **Olli Hänninen** - Senior Inspector, Flight Simulators FSTD; Coordinator, Finnish Transport and Communications Agency (Traficom)

ICAO 9625 Manual of Criteria for the Qualification of Flight Simulation Training Devices was last updated by industry and ICAO in 2015 for Volume 1 (aeroplanes) and 2012 for Volume 2 (helicopters).

As part of the ICAO PTLP initiative, ICAO has decided to update Document 9625 to better support global harmonization of FSTD qualifications and reflect advances in simulation and aircraft technologies, and training practices. The revised document will combine the current volumes for aeroplanes and helicopters into a single, unified standard—an essential step to accommodate emerging aircraft types such as tiltrotors and VTOLs. Through this revision, ICAO aims to ensure training devices remain relevant and effective across a rapidly evolving aviation landscape.

The presentation will explain how the proposed update will draw heavily from the work recently published by EASA RMT.0196 rulemaking group (Opinion 01/2025 Update of the flight simulation training device requirements) and examines how the content will be reorganized into two separate documents: one focused on training requirements and the other on FSTD technical criteria.

Finally, the opportunity for this revised ICAO Doc 9625 to truly form an accepted global technical standard for FSTD qualification criteria will be discussed.

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SESSION: Regulatory Session

A Novel Framework for VTOL-capable Flight Training Device Standards

- **Arnab Lahiri FRAeS** - Chairman of the G35B Subcommittee, Independent (Ex FAA)

Flight Simulation Training Devices (FSTDs), especially those of high fidelity, are qualified to strict technical standards that have tried to keep pace with emerging technology. The new breed of emerging technology flying vehicles has created challenges for FSTD qualifications- with new propulsive methods, energy usage, radical aerodynamic design concepts, use of novel fabrication techniques, along with cutting edge computational technology and operational environments.

The technical standards have been based on conventional fixed or rotary wing aircraft with allied fidelity definitions that were borrowed heavily from them and, they have stood the test of time. The advent of innovations in vehicle and propulsion control, unconventional designs, high degrees of augmentation and automation have now made it problematic, and often impossible, to apply the legacy prescriptive standards to the qualification of training devices for the current diverse range. Testing methods and parameters suddenly may no longer be applicable. Precision levels in autonomy and operation present new implications to stability and handling impacting traditional tolerances. Controlling takes a whole new meaning. Current regulations that allude to 'performance based' are still prescriptive with their well-defined requirements. Forum discussions have led to conclude that one viable option would be a Performance based Standard (PBS) approach to encompass the multitude of designs for which training devices will be required.

This paper discusses the rationales behind an attempt to develop a consensus-based PBS and presents the evolution and considerations of its development. The standard would allow training devices qualifications and apply to the gamut of the emerging technology flying vehicles requiring training to operate them.

RAeS Flight Simulation Conference 2025

SESSION: Cleared for Takeoff: Innovation Meets Regulation

A new approach to the uses of simulation

- **John Frearson FRAeS** - Consultant and Former Team Leader, Flight Simulation Certification and Innovation, Australian Civil Aviation Safety Authority

We face the perennial problem that NAA regulatory capabilities lag, and often hinder, opportunities offered by new FSTD capabilities and emerging training practices.

Aviation is an inherently conservative business where regulatory change happens linearly (often glacially!). Whereas simulation and training opportunities (e.g. SATCE, VR, AR) emerge exponentially. Hence the ever-growing gap between training needs and NAA enabling rules and guidance.

With the approach of “next generation” standards (EASA and ICAO) come long-awaited opportunities for paradigm shifts taking us beyond the traditional QTG-driven device-by-device certification and deeper into new arenas (including GA) where finite NAA oversight resources (regulatory, certification, guidance, user approvals) need a greater focus on training outcomes and less on the minutia of device fidelity.

If NAAs continue to lag, as is almost their nature, then industry (OEMs and training providers) must grasp a greater role, taking care not to lead in piecemeal ways that could undermine standardisation and training outcomes.

This industry-led future will need two enabling strands:
The first strand should be the development of an industry consensus standard ‘How to use FSTDs” Advisory Circular where practical tools and recommendations can be incorporated as AMC material and used by reference.

This new AC (however named) would rest on EASA and ICAO technical standards in the same manner that the globally accepted IATA Dangerous Goods Manual rests on the technical instructions in Annex 18 and Doc 9824. Such an AC would be an ideal repository of material concerning the critical roles of instructors.

The second strand is the development of globally accepted “special conditions” for trials of new technologies and training concepts. This will ensure no hindrance to trials of new ideas.

A few exceptions aside, the basic purpose of simulation is to support flight safety through training. Having an easy-to-use ready reference work is an idea whose time has well and truly come.

RAeS Flight Simulation Conference 2025

SESSION: Cleared for Takeoff: Innovation Meets Regulation

Reclaiming Transformative Technologies and the Future of Pilot Training

- **Itash Samani FRAeS** - EVP Public Affairs, Loft Dynamics Inc.

The aviation training landscape is undergoing a pivotal shift. Emerging technologies, such as extended reality and intelligent simulation are fundamentally redefining how we approach pilot readiness. These tools allow for immersive, high fidelity training environments that mirror the dynamic complexity of real-world operations, enabling a deeper focus on decision-making, systems thinking, and human performance under pressure.

However, current simulation standards, while labeled performance-based, often remain overly prescriptive and task focused. They reward compliance with checklists rather than the authentic operational competence. As a result, critical training opportunities, especially those involving rare or compound failure scenarios, remain underutilized, or excluded altogether.

This presentation will explore how transformative technologies are creating a viable path to reclaim core flying skills, enhance scenario realism, and personalize pilot development.

More importantly, it will challenge us to align regulatory frameworks with these capabilities, to ensure that training standards are not only met, but meaningfully redefined for the complexity of tomorrow's flight environment.

RAeS Flight Simulation Conference 2025

SESSION: Cleared for Takeoff: Innovation Meets Regulation

Bridging the Gap: Certification Standards for sUAS Flight Simulators

- **Eric T Bird MRAeS** - Chief Engineer, Autonomy Research Institute, Texas A&M University

The small Unmanned Aircraft Systems (sUAS) field is rapidly growing, and while flight simulators could be used to help train the pilots that will be needed to operate these aircraft, the current lack of standards for sUAS flight simulators makes it challenging to ensure that the training that pilots receive will be accurate, realistic, or useful. Flight simulators and training devices have long played a pivotal role in pilot familiarization, training, and certification for both manned and unmanned aircraft.

In the United States, the Title 14 Code of Federal Regulations Part 60 (Part 60) outlines stringent certification standards for Full Flight Simulators (FFS) and Flight Training Devices (FTD) for manned aviation. In addition, in 2005, the Royal Aeronautical Society published the Aeroplane Flight Simulator Evaluation Handbook, which detailed the “International Standards For The Qualification Of Aeroplane Flight Simulators”. However, there is a notable gap for sUAS flight simulator standards, which demands immediate attention.

Research will focus on the implementation of an extended reality (XR) full-mission flight simulator, customized for sUAS operation, and the planned methodology that will be used to align its fidelity levels using existing Part 60 standards as a guide. The research will also outline the process used to determine the fidelity level of the sUAS flight simulator and assess its suitability for pilot training. The results will be validated through expert pilot evaluations and fidelity benchmarking against existing Part 60 standards, providing empirical evidence to inform the development of a standards framework for adoption by ASTM International, International Civil Aviation Organization (ICAO), and civil aviation authorities (CAA).

Detailing the XR sUAS flight simulator capabilities and certification process will offer insights into the broader discussion of sUAS training, certification, and regulatory framework development. Ultimately, this research intends to advance the dialogue on integrating unmanned aircraft systems into aviation training.

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SESSION: Cleared for Takeoff: Innovation Meets Regulation

Reducing Latency In Helicopter Simulators

- **Adrian Alford MRAeS** - Associate Technical Fellow in Modelling and Simulation, Leonardo Helicopters

For both training and engineering aircraft simulators, it has always been the intention that the handling qualities of the simulated vehicle match those of the real aircraft. For rotorcraft, handling qualities can be objectively estimated using MIL-DTL-32742 (formerly ADS33). This document can be used to ensure that the flight model has theoretical handling qualities which match flight test data. One of the key handling quality metrics relates to short-term response to control inputs and this in turn is characterised by the parameters bandwidth and phase delay.

A major problem occurs when a “good” flight model is integrated into a simulator. The simulator will introduce additional latency between the pilot inputs and the visually perceived motion of the aircraft. Simulator additional latency is typically of the order of 50ms. This in turn increases pilot perceived short-term response phase delay by 50ms and this unfortunately can have a profound negative impact on perceived handling qualities. The traditional approach to restoring handling qualities is to add extra angular velocity damping or inertia to the flight model. This traditional approach has a number of serious drawbacks:

- The flight model is no longer “good” when compared with flight test data (which could invalidate it for engineering use).
- The flight model’s response to turbulence will be significantly attenuated.

This presentation proposes a number of ways that a simulator’s additional latency can be reduced and compensated for – this is evidenced by the results of a recent simulation trial. This approach removes the need to make changes to a “good” flight model. This presentation also concludes that certification and qualification specifications for simulators should be changed to:

- Insist upon flight models having the correct values of bandwidth and phase delay.
- Insist upon simulators using latency compensation techniques to effectively reduce additional latency to below 10ms.

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SESSION: Cleared for Takeoff: Innovation Meets Regulation

Expanding the Capabilities of Lower-Level Flight Training Devices and Implications of Extended Reality in Flight Simulation

- **Nigel Sargent** - Director Flight Simulator Operation, Alaska Airlines

This presentation provides an overview of expanding utilization of lower-level training devices and the challenges of adopting XR technology within the current and future regulatory requirements.

The presentation will delve into the minimum requirements and enhanced features of modern FTDs, highlighting how Alaska Airlines implemented these enhancements into its Level 5 MAX9 FTD training program. Specifically, utilizing current regulatory requirements within FAA Part 60 as well as exploring the EASA RMT.0196 and the FSTD Capability Signature, examining its impact on FSTD qualification and potential future directions for flight simulation training.

Furthermore, the presentation will outline the integration and evaluation process of Simulated Air Traffic Control (ATC) Environment within the MAX9 Full Flight Simulator (FFS), with the potential providing a more realistic platform for runway incursion training.

Explore how future XR technology could be adopted leveraging tactile and synthetic imagery within simulation technology discussing the regulatory drivers and practical flight training benefits of extended and mixed reality solutions.

RAeS Flight Simulation Conference 2025

SESSION: Cleared for Takeoff: Innovation Meets Regulation

Revolution in Training: Disruptive Solutions for a Competency-Based Era

- **Mike Varney FRAeS** - CEO, Salient
- **Scott Boughton** - Director, Salient

This builds on our 2024 presentation and addresses a persistent challenge in aviation training: ensuring that training devices are designed and selected based on operational challenges and specific training needs, rather than outdated classifications.

First formalised in the revised ICAO Doc 9625 and advanced by the 2006–2008 IWG convened by the Society, this training-led philosophy is now reflected in European regulation—marking a significant shift toward device qualification based on training relevance.

Meanwhile, the growing adoption of Evidence-Based Training (EBT) and Competency-Based Training and Assessment (CBTA) offers a unique opportunity to move beyond legacy approaches and align training with real-world performance and risk profiles.

In this context, we are pleased to collaborate with a leading training device manufacturer (TDM), who will co-present the outcomes of a shared initiative. Together, we will outline the rationale behind this innovation, the safety challenges it addresses, and how it applies CBTA and EBT principles to deliver adaptive, competency-focused training using next-generation simulation technology.

This is a true game-changer—and a bold step toward the future of aviation training.

RAeS Flight Simulation Conference 2025

SESSION: Cleared for Takeoff: Innovation Meets Regulation

Adaptive Training: AI's Role in Evolving CBTA and Qualification Standards

- **Adolfo Klassen** - Business Leader, AI Training Solutions, PACE Aerospace

As aviation regulators and stakeholders converge around updates to EASA's CS-FSTD and the forthcoming ICAO "new 9625," artificial intelligence offers a timely and transformative capability. By embedding AI-driven adaptive learning into flight simulation training devices (FSTDs), training systems can dynamically assess pilot competencies and tailor scenarios in real time—enhancing both fidelity and pedagogical value. This approach not only supports more efficient, competency-based training but also aligns with evolving standards for simulator qualification and performance evaluation, ensuring training technologies advance in step with regulatory and operational needs.

RAeS Flight Simulation Conference 2025

RAeS Edwin A Link Named Lecture 2025

"Aviate, Navigate, Communicate" — Reclaiming the Missing Dimension of Pilot Training

- **Neil Waterman** - Commercial Aviation Director, ASTi
- **Dr Jeremy Goodman MRAeS** - Industry Consultant (SATCE), ASTi

PART A: How did we get here?

The Missing Piece - Neil will set out to describe the long-standing fidelity gap we have even in state-of-the-art modern flight simulators. In a look back to the "Link Trainer", the first mass-produced flight simulator invented by Edwin Albert Link, we can see some elements (anyone guess?) looking... unchanged! He'll then take a look at the emergence of "Simulated ATC" starting many years ago with ICAO and IATA recommendations he first heard discussed at the RAeS at No 4 Hamilton Place, London.

For those new to Simulated ATC Environment (SATCE), Neil will describe what it is and why it deserves the attention it's now receiving. Over the last (just over) 40 years, flight simulators became "stuck" - while many elements advanced, enabled by new technology, the operational environment simulation remained unrealistically sterile.

More recently, the nature of flight training has also changed - moving from 1980s-era aircraft malfunction scenarios to simulating modern operational threats from outside the aircraft. Simulation technology needs to support this shift, to reflect evidence-based observations that match today's threats, and SATCE is positioned to provide the full complexity of the operational environment pilots face daily.

PART B: Where are we now?

Industry Adoption - Despite limited regulatory requirements for SATCE, Neil will report on industry momentum - there are now more than 350 SATCE installations globally, primarily military, but commercial aviation is rapidly adopting the technology. SATCE is now mature and proven, no longer experimental.It is past the tipping point, and, major economic shocks aside, we believe it's now inevitable.

Driven by Flight Safety - Multiple carriers are now integrating and implementing SATCE in LOFT/LOS scenario-based training, with runway incursion training being the initial driver.

"We simply cannot sit around waiting for the regulators to react to an accident. Safety is the reason we train and it's obvious we are missing something in our simulators. SATCE fixes this." [Director of Training Operations - US Airline]

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The MPL - For the first time, a Multi-Crew Pilot License (MPL) training programme has incorporated SATCE with demand now following from other training providers, where some countries have adopted ICAO Doc 9869 PANS TRG where SATCE is required for MPL programmes.

Technology Demonstration - A short video demonstration will show an approach in a Level D Full Flight Simulator (FFS) using SATCE technology with a complex runway incursion simulation - a scenario impossible to replicate with traditional methods.

Research - Jeremy will provide an overview of an ongoing FAA funded research project into the efficacy of SATCE focused on airline implementation, and supported by ASTi’s team and technology.

Regulatory - The regulatory framework is evolving: SATCE technical requirements have recently been added to EASA's draft CS-FSTD document. The industry consensus standard for SATCE, ARINC Specification 439, is being revised to provide a unified reference that can be iterated to keep pace with technology advances.

PART C: What does the future look like?

Looking Ahead - None of us can know, of course, but Jeremy will be doing his best to “look forward” to tomorrow's flight training using SATCE.

SATCE represents not just a technology upgrade, but a fundamental tool to support how we better prepare pilots for the complexities of modern flight. There are three training areas he’ll focus on: enhanced runway safety, air proximity (ACAS) and ground collisions - all globally recognised key risk areas, and all impacted by the instruction of SATCE.

Far-reaching - SATCE affects many areas - including Human Factors (HF), the instructor's role, and pilot assessment - while also generating contextual training data. Jeremy will attempt to cover these topics, and ask: what could be the unindented consequences of its introduction? How do we best mitigate these?

The Ultimate Goal - Flight safety is our North Star. A shared goal that unites us in all of our activities. Jeremy will finish by looking at the relationship between SATCE and safer flight. While the direct link between SATCE in training and reduced accidents requires long-term validation, the logic is sound and the approach well-tested.

RAeS Flight Simulation Conference 2025

SESSION: Accelerating Aircraft Development by Simulation

Digital threads and automation to enable credible, model-based, decision making in aircraft development and operation

- **Robert Hällqvist** - Technical Fellow, M&S of Vehicle Systems, Saab Aeronautics

A wide range of different activities, and their outcomes, influence model and simulator credibility. This presentation aims to provide an overview on the history, present, and future concerning research and implementation of credibility assessment techniques and enablers, concerning modeling and simulation, at Saab Aeronautics. The presented approach to establishing and communicating results from an automated, independent, and traceable credibility Modeling and Simulation (M&S) assessment process relies on multiple technological needs. Many of these needs are addressed through the combination of interoperability standards such as the Functional Mock-up Interface (FMI) and System Structure and Parameterization (SSP) maintained and developed by the Modelica Association. This presentation summarizes how models can be treated as information assets that are continuously updated and carry their own, up to date, meta-data capturing credibility information. This enables a model to be used for multiple purposes throughout the aircraft life-cycle.

RAeS Flight Simulation Conference 2025

SESSION: Accelerating Aircraft Development by Simulation

The Use of Modelling and Simulation for Ship Air Integration Certification

- **Professor Mark White FRAeS** - The University of Liverpool
- **John Goodby** - Ship Air Integration Modelling and Simulation Systems Integrator, Leonardo Helicopters

The University of Liverpool's Flight Science and Technology (FS&T) research group is part of a consortium led by Leonardo Helicopters that was awarded a contract under Dstl's "Rotorcraft Concepts & Tactical Aviation Research" (RCAT) Project, for Work Package 2 (WP2), titled "Improved operational efficiency and capability through digital engineering". The main problem statement for RCAT2 "is a need to develop tools and metrics that enable consistent and convincing compliance with RA5812" [1], a Ministry of Defense (MoD) regulatory article governing use of digital modelling and simulation in airworthiness decision making as detailed in NASA-STD-7009B [2]. Of particular interest in this respect is the topic of Ship Air Integration (SAI) Modelling and Simulation (M&S). SAI M&S has long been a topic of research for FS&T but is yet to see wide-scale adoption, though it stands to significantly reduce cost and risk associated with performing ship-helicopter qualification testing.

FS&T proposed a new certification framework for SAI M&S based on the findings of a previous RCAT Task for AW159 Wildcat to Type 23 Frigate. The certification framework, shown in Figure 1, is structured to create a 70:20:10 approach; 70% of effort in AS/SS qualification task is applied to 'offline' modelling, simulation analysis, 20% of effort is used on piloted simulation testing, and 10% is used on at-sea testing.

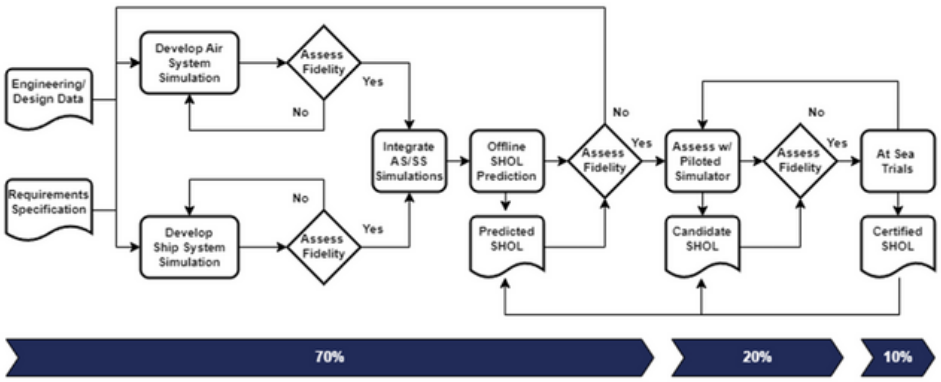

Figure 1. Proposed SAI certification framework

The proposed framework would allow for compliance with RA5812 [1] and will be explained at the conference detailing its exploitation for future UK aircraft/ship pairings, with a particular focus on future uncrewed platforms.

[1] MoD, and MAA, "Digital Models and Simulations Supporting Airworthiness-Related Decision-Making," RA5812, Ministry of Defence, December 2021.
[2] NASA, "Standard for Models and Simulations," NASA-STD-7009B, National Aeronautics and Space Administration, March 2024.

RAeS Flight Simulation Conference 2025

SESSION: Applications of Simulation

Motion Cueing in Formula 1: Lessons for Aerospace?

- **Dr Craig Brown** - Director, BrownSim

In the pressured world of Formula 1 and motorsport, every millisecond counts. Cost caps and fierce competition have led to an arms race in high fidelity simulator technology. Not just for driver preparation and training but also vehicle development.

Whereas the conventional Stewart-Gough platform is a popular choice in aerospace, the demands of motorsport, especially in the translational and yaw axes, has prompted the development of alternative topologies. Moreover, higher bandwidth requirements necessitate smaller simulators which, combined with the violent accelerations of Formula 1, makes providing useful motion cues challenging.

Careful experiment management is needed to accommodate rapidly changing requirements - changes often provoked by live driver feedback. Data-driven revision of cueing parameters is mandatory.

In this talk, we will elucidate these challenges and review how this relates to the existing body of literature, as well as real-world practice of teams in operation today. Finally, we will attempt to identify where insights from motorsport can benefit aerospace, and vice versa.

RAeS Flight Simulation Conference 2025

SESSION: Applications of Simulation

Project 'Turbulation': Measuring the Impact of Turbulence on Touchscreen Operations in a Motion Simulator

- **Chris Friel MRAeS** - Senior Human Factors Engineer, BAE Systems

The use of touchscreens in combat aircraft is becoming more common, as current and future generations of fast-jet cockpit designs move away from traditional Multi-Function Head Down Displays (MFHDDs) and physical data-entry controls, in favour of Large Area Displays (LAD) with touchscreen capabilities.

Adoption of LAD technology, as a key part of the Human Machine Interface (HMI), has the potential to provide pilots with greater display flexibility, enhanced situational awareness, and faster more intuitive data-entry.

However, much of the development of such HMIs has focused on using touchscreens in static, fixed-base simulators, or cockpit development rigs. On the contrary, real fighter cockpit environments are highly dynamic and subject to vibrations and disturbances due to the operational conditions and atmospheric turbulence. Therefore, the current study used a representative fast-jet cockpit, with a fighter aircraft flight model, mounted on a six-axis electric motion system, to investigate the influence of various dynamic environments on pilot performance during a simple data-entry task.

Three levels of disturbance (none, moderate and severe), two keypad screen positions (top and centre), and two data-entry techniques (unanchored and anchored) were investigated, where 'anchored' means that subjects were allowed to stabilise their hand, by bracing multiple fingers around the bezel of the touchscreen display. Eighteen participants, that included both volunteers and test pilots, took part in the experiment and the results showed that all three variables had some impact on data-entry error rates and subjective ratings, with unanchored interactions with the top keypad, under severe disturbance conditions, giving the worst performance and greatest fatigue. The presentation will provide an overview of the experimental setup and a summary of the results; and explore what the findings might mean for future cockpit designs.

RAeS Flight Simulation Conference 2025

SESSION: Pushing the Horizon: Transformative Tech Session

Evaluation of Virtual Reality and Motion for Upset Prevention & Recovery Training (UPRT)

- **Professor Mike Bromfield FRAeS** - Associate Professor in Aerospace, University of Birmingham

This study investigates the effectiveness of Virtual Reality (VR) and motion in Upset Prevention and Recovery Training (UPRT) for general aviation pilots. In commercial aviation UPRT is mandatory using full flight simulators and aerobatic aircraft (Europe only). This approach is beyond the reach of most general aviation pilots given cost and limited access.

Although unusual attitude training is included in the PPL(A) syllabus, full spin recovery is not. In the case of three-axis microlight aircraft - not approved for spinning - neither incipient nor full spin recovery can be practised. It is likely that the first time that a pilot encounters these scenarios will be in the real world and this may lead to startle and/or surprise, followed by delayed recognition and recovery.

Technological advancement in simulation and has led to affordable, immersive (VR) visual systems and motion systems. This preliminary research evaluates the use of VR and limited motion simulators for UPRT by measuring recognition (situation awareness), response, recovery performance and workload. A between-groups experimental study was used with two groups. Both groups received aircraft pre-flight briefing including emergency procedures combined with simulator familiarisation. The Control Group received no UPRT. The experimental group experienced pre-recorded upset scenarios in VR with motion. Pilot performance was assessed for upset recognition, recovery reaction time, adherence to procedure and physiological response.

Preliminary results showed that the experimental group achieved faster reaction times during a spin upset (0.5s, 62.5%) and lower altitude loss (850ft, 40%) compared to the control group. The experimental group had better spin upset recognition (80%) compared to the control group (40%). Confidence levels for spin recovery were also greater for the experimental group (92%) compared to the control group (60%).

These preliminary findings suggest that VR in combination with limited motion has potential to enhance the general aviation safety by improving a pilot's ability to recognise and attempt upset recovery in selected upsets.

RAeS Flight Simulation Conference 2025

SESSION: Pushing the Horizon: Transformative Tech Session

XR in Flight Simulation – keeping the man in the loop

- **Retired Maj. Michael Rosenqvist MRAeS** - Aviation Specialist, Defense & Security - Ex Swedish Air Force

Flight Training is today partly conducted in a virtual environment, and this virtual part will grow. A growing virtual part is inevitable and desirable as it opens possibilities to direct Flight Training in a more cost and time effective way. The gaming market is (right now) in the lead to develop and field both hard- and software that the Flight Training community, both military and civilian, will benefit of.

Shall we go “all in” in the Virtual/Mixed/Augmented Reality? I say yes, but we must not forget the human part in the equation. The human brain is capable of amazing things, and it will perfectly adapt to Flight Training mainly conducted in an Extended Reality. Though, to make this transition possible and smooth we must train the brain and the mindset parallel to developing and introducing the Extended Reality training tools. Technolog ical development and learning capability must be parallel processes.

Having spent 17 years in the Military Flight Training arena, starting as QFI and retiring as Head of SwAF Flight Training Capabilities, I have seen too many initiatives that have been too “bold” or too innovative to be able to realize.

Presentation will focus on difficulties and opportunities to identify, and how to handle these while moving Flight Training more into the Extended Reality.