SCIENCE AND TECHNOLOGY ORGANIZATION

APPLIED VEHICLE TECHNOLOGY PANEL

Science & Technology Organization
Collaboration Support Office
Applied Vehicle Technology Panel

AVT-369 Research Symposium on

Digital Twin Technology Development and Application for Tri-Service Platforms and Systems

Båstad, Sweden

10-12 October 2023

This Symposium is open to NATO Nations, Australia, Finland, Japan and Sweden

Theme and Topics

The theme of this symposium is to explore innovative/revolutionary digital twin technology for military fleet sustainment and product development to:

1. ensure platform safety by providing the warfighter with better information on the condition of each asset;
2. reduce maintenance costs by reducing both unnecessary maintenance and unplanned maintenance; and
3. increase platform availability by enabling better maintenance planning and reducing the occurrence of unanticipated damage findings;
4. improve product development and reduce lead time for the new military systems.

The general topics of the AVT-369 Research Symposium are:

- reviews of the state-of-the-art of digital twin technology development and the benefits of various digital twin outputs; and
- digital twin applications on product/system design, manufacturing, and sustainment for tri-service platforms and systems.

It is expected to identify the core enabling S&T methodologies for near and long term digital twin technology development and application. The proceedings and technical evaluation report will summarize the state-of-the-art on digital twin technologies and applications, technology readiness, business case and gaps for adopting the technology to fleet applications.

Background

There have been increasing R&D activities on digital twin technology development in North American and European NATO countries recently. Some OEMs have used digital twin/digital thread technologies for new product or weapon systems development. There is a need to look at the state-of-the-art of digital twin technology development, benefits of various digital twin outputs, and discuss digital twin applications on product development and sustainment.

In 2020, AVT-ET-211 assessed NATO members' interest to jointly review the state-of-the-art of digital twin technology development, review the benefits of various digital twin outputs, and discuss digital twin applications in product development and sustainment. ET-211 confirmed a strong interest in digital twin technology development, application, and paths to adoption for tri-service platforms and systems; ET-211 concluded with an agreement to hold a Research Symposium on digital twin technology development and application for tri-service Platforms and Systems, for both near- and long-term application and paths to adoption.

Registration

Online registration for this event AVT-369 is mandatory for all symposium delegates, programme committee members, authors, presenters and external guests. Participation is free of charge. Due to security restrictions only duly registered and re-confirmed AVT-369 participants will have access to the General Information Package (GIP) with detailed information on conference location and logistics.

For online registration please go to this website:
https://events.sto.nato.int/index.php/upcoming-events
Registration will close 4 weeks before the event. Thank you for your cooperation.

AVT Executive Office, Collaboration Support Office (CSO), Paris – Points of Contact:

Ms Erin BOLDI
AVT Executive Officer
Tel: +33 (0)1 55 61 22 93
Erin.Boldi@cso.nato.int

Ms Ezgi YAZICIOGLU
AVT Panel Assistant
Tel: +33 (0)1 55 61 22 12
Ezgi.Yazicioglu@cso.nato.int

Programme Committee

CO-CHAIRS

Dr. Min Liao (Canada)
National Research Council Canada
Email: Min.Liao@nrc-cnrc.gc.ca

Marcel Bos (Netherlands)
Royal Netherlands Aerospace Center (NLR)
Email: Marcel.Bos@nlr.nl

Dr. John Russell (United States)
U.S. Air Force Research Laboratory
Email: John.Russell.23@us.af.mil

Dr. Benjamin Grisso
U.S. Naval Surface Warfare Center Carderock
Email: Benjamin.L.Grisso.civ@us.navy.mil

MEMBERS

AUSTRALIA

John Vine
Defence Science and Technology Group
Email: john.vine@defence.gov.au

CANADA

Dr. Prakash Patnaik
National Research Council Canada
Email: Prakash.Patnaik@nrc-cnrc.gc.ca

Neil Pegg
Defence Research and Development Canada
Email: Neil.Pegg@forces.gc.ca

FINLAND
Ilpo Paukkeri
Finnish Defence Forces
Email: Ilpo.Paukkeri@mil.fi

GERMANY
Richard Roedler
German Aerospace Center (DLR)
Email: Richard.Roedler@dlr.de

ITALY
Dr. Matteo Diez
CNR-INM, National Research Council-
Institute of Marine Engineering
Email: Matteo.Diez@cnr.it

NETHERLANDS
Henk Jan ten Hoeve
Netherlands Aerospace Center (NLR)
Email: Henk.Jan.ten.Hoeve@nlr.nl

UNITED KINGDOM
David Hallam
Defence Science and Technology Laboratory
Email: DHallam@mail.dstl.gov.uk

UNITED STATES
Dr. Woei-Min Lin
Office of Naval Research, USN
Email: Woei-Min.Lin@navy.mil

PANEL MENTOR
Henk Jan ten Hoeve
Royal Netherlands Aerospace Center (NLR)
Email: Henk.Jan.ten.Hoeve@nlr.nl

TECHNICAL EVALUATOR
Dr. Eric J. Tuegel
(United States)
Email: etuegel7556@gmail.com

AVT-369 Research Symposium on Digital Twin Technology Development and Application for Tri-Service Platforms and Systems

Programme

Tuesday, 10 October 2023

Registration

08:00		Registration

Session 1 – Digital Twin and Systems Engineering

Chairs:

08:30		AVT-369 Opening Remarks M. Liao, National Research Council Canada, Canada M. Bos, NLR, Netherlands J. Russell, U.S. Air Force Research Laboratory, United States B. Grisso, NSWC Carderock, United States
08:45	1	KEYNOTE Model-based Systems Engineering for Future Digital Flight Lines M. Kelly, Lockheed-Martin Aeronautics, United States
09:30	2	System of Systems Virtual Twin Experience G. Fanmuy, Dassault Système, France
10:00	3	The Virtual Twin Experience – Shaping the Future of Systems Engineering G. Wang, Dassault Système, United States / France / Canada
10:30		COFFEE BREAK

Session 2 – Digital Twin Architecture

Chairs:

11:00	4	JADC2 in a Contested Logistics Environment – The Role of Digital Twins G. Schlichting, Georgia Institute of Technology, United States
11:30	5	Linking digital twins to use time series for predictive maintenance at component level H. Meyer, German Aerospace Center, Germany
12:00		Open Discussion
12:30		LUNCH

Session 3 – Digital Twin for Aircraft

Chairs:

14:00	6	A-10 the path to the Digital Twin for legacy defense systems M. Raming, Southwest Research Institute, United States
14:30	7	ASIP Data Collection as a Critical Step Towards a Realistic Digital Twin B. Kuramoto, Leidos, United States
15:00	8	Life Tracking System keeps RM12 and the JAS 39 Gripen fighter safely in the air with a reduced cost of operation F. Wänman, GKN Aerospace Engine Systems, Sweden
15:30		COFFEE BREAK

Session 4 – Digital Twin Developments for Aerospace

Chairs:

16:00	9	Variable amplitude fatigue life methodology for a structural digital twin E. Amsterdam, Royal Netherlands Aerospace Center (NLR), Netherlands
16:30	10	Probabilistic Damage Tolerance in support of Digital Twin Technology Development J. Ocampo, St. Mary's University, United States

17:00	11	Development and Demonstration of a Digital Twin Analysis Framework for Airframe Life Extension G. Renaud, National Research Council Canada, Canada
17:30		ADJOURN for the DAY

Wednesday, 11 October 2023

Session 5 – Digital Twin for Maritime Applications I
Chairs:

08:45	12	KEYNOTE CBM, Digital Twins, and Data Threading for Complex Systems -- Pragmatic Approaches Manuel Terranova, PEAXY
09:30	13	Ship Hull Monitoring System applied as a Real Time Decision Support System on Fast Ferries C. Wines, FiReCo AS, Norway
10:00	14	On the Application of Structural Digital Twins for Surface Ships for Operational Guidance Support A. Mondoro, Naval Surface Warfare Center Carderock, United States
10:30		COFFEE BREAK

Session 6 – Digital Twin for Maritime Applications II
Chairs:

11:00	15	Examining the Requirements for a Digital Twin Supporting Naval Platform Management and Operations A. Woolley, Defence Science and Technology Group, Australia
11:30	16	Digital Twin in naval environment A. Zini, Fincantieri S.p.A., Italy
12:00	17	Maritime digital twins to support tri-service campaign operations J. de Marchi, Royal Netherlands Aerospace Center (NLR), Netherlands
12:30		LUNCH

Session 7 – Digital Twin for NDE and Experiments
Chairs:

14:00	18	Approaches to Realize Materials / Damage State Characterization for the Digital Twin E. Lindgren, U.S. Air Force Research Laboratory, United States
14:30	19	Model Assisted Probability of Detection – study on aircraft parts V. Dhanisetty, Royal Netherlands Aerospace Center (NLR), Netherlands
15:00	20	A Shared Vision for Smart Aerodynamic Testing A. Peace, Aircraft Research Association, United Kingdom
15:30		COFFEE BREAK

Session 8 – Digital Twin for Materials
Chairs:

16:00	21	AI-based Design and Manufacturing of Architectured Ceramics for Extreme Environments H. Yazdani Sarvestani, National Research Council Canada, Canada
16:30	22	Multi-physics modeling and optimization towards a digital twin of quenching processes of large-scale metallic structures

J. Yan, University of Illinois at Urbana-Champaign, United States

17:00	23	Probabilistic Analysis of Cold Expanded Holes D. Wieland, Southwest Research Institute, United States
17:30		ADJOURN for the DAY

Thursday, 12 October 2023

Session 9 – Digital Twin for Manufacturing
Chairs:

09:00	24	Digital Twin in the Context of the Digital Transformation Process C. Richardson, Spirit Aerosystems, Inc., United States
09:30	25	On the potentials of digital twinning for tri-service platforms and systems – Lessons learned from digital twinning in aircraft component fabrication E. Baalbergen, Royal Netherlands Aerospace Center (NLR), Netherlands
10:00	26	High Fidelity Digital Twin Autoclave Tool for Quality Informed Composite Fabrication J. Lua, Global Engineering and Materials, Inc., United States
10:30		COFFEE BREAK

Session 10 – Miscellaneous Use Cases
Chairs:

11:00	27	Hybrid Neural Network and Physics-based Digital Twins for Condition-based Maintenance (a shock absorber) A. Lammas, Flinders University – Tonsley Campus, Australia
11:30	28	Digital Twin for underwater systems based on meta learning (a battery) M.M.A. Rantanen Modéer, Saab Dynamics, Sweden
12:00	29	Predictive Battery Health Management of Unmanned Air Vehicles M. Altun, HAVELSAN Inc., Turkey
12:30		LUNCH

Session 11 – Math Algorithms / Modeling & Simulation
Chairs:

14:00	30	Digital Twins and their Mathematical Souls L. Mainini, Politecnico di Torino, Italy
14:30	31	NATO Modeling and Simulation Group presentation on MSG-205 S. Skinner, NATO Modeling and Simulation Group
15:00	32	MSG-205 Open Discussion S. Skinner, NATO Modeling and Simulation Group
15:30		COFFEE BREAK
16:00		Technical Evaluator Comments E. Tuegel
16:30		Open Discussion
17:00		Closing Remarks and Future Plans M. Liao, M. Bos, J. Russell, and B. Grisso
17:30		SYMPOSIUM ADJOURNS

Science and Technology Organization in NATO

In NATO, Science & Technology (S&T) is defined as the selective and rigorous generation and application of state-of-the-art, validated knowledge for defence and security purposes. S&T activities embrace scientific research, technology development, transition, application and field-testing, experimentation and a range of related scientific activities that include systems engineering, operational research and analysis, synthesis, integration and validation of knowledge derived through the scientific method.

In NATO, S&T is addressed using different business models:

- The Collaborative business model where NATO provides a forum where NATO Nations and partner Nations elect to use their national resources to define, conduct and promote cooperative research and information exchange.
- The In-House delivery business model where S&T activities are conducted in a NATO dedicated executive body, having its own personnel, capabilities and infrastructure.

The Science and Technology Organization - STO

The mission of the NATO STO is to help position the Nations' and NATO's S&T investments as a strategic enabler of the knowledge and technology advantage for the defence and security posture of NATO Nations and partner Nations, by:

- Conducting and promoting S&T activities that augment and leverage the capabilities and programmes of the Alliance, of the NATO Nations and the partner Nations, in support of NATO's objectives;
- Contributing to NATO's ability to enable and influence security - and defence-related capability development and threat mitigation in NATO Nations and partner Nations, in accordance with NATO policies;
- Supporting decision-making in the NATO Nations and NATO.

Acknowledgement

The Applied Vehicle Technology Panel expresses its thanks to Sweden
for the invitation to hold this meeting in Bastad and for the facilities and personnel,
which make this meeting possible.