



SCIENCE AND TECHNOLOGY ORGANIZATION
HUMAN FACTORS AND MEDICINE PANEL
NATO MODELLING & SIMULATION GROUP



**HUMAN FACTORS AND MEDICINE (HFM) PANEL
&
NATO MODELLING AND SIMULATION GROUP (NMSG)**

CALL FOR ABSTRACTS

for the HFM-MSG-375-RSM Research Specialists' Meeting on

HUMAN DIGITAL TWIN IN THE MILITARY: FINDINGS AND PERSPECTIVE

**to be held in
Orlando, Florida USA
10th-13th December 2024**



**DEADLINE FOR RECEIPT OF ABSTRACTS:
26th April 2024**

This event is UNCLASSIFIED, open to participants from NATO Nations, EOP Nations, and Austria, Israel, Singapore, Switzerland, and New Zealand.

The NATO Science and Technology Organization

Science & Technology (S&T) in the NATO context 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, namely a 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, and secondly an 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 mission of the NATO Science & Technology Organization (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, and 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.

The total spectrum of this collaborative effort is addressed by six Technical Panels who manage a wide range of scientific research activities, a Group specialising in modelling and simulation, plus a committee dedicated to supporting the information management needs of the organization:

- AVT Applied Vehicle Technology Panel
- HFM Human Factors and Medicine Panel
- IST Information Systems Technology Panel
- NMSG NATO Modelling and Simulation Group
- SAS System Analysis and Studies Panel
- SCI Systems Concepts and Integration Panel
- SET Sensors and Electronics Technology Panel

These Panels and Groups are the powerhouse of the collaborative model and are made up of national representatives as well as recognised world-class scientists, engineers and information specialists. In addition to providing critical technical oversight, they also provide a communication link to military users and other NATO bodies.

The scientific and technological work is carried out by Technical Teams, created under one or more of these eight bodies, for specific research activities which have a defined duration. These research activities can take a variety of forms, including Task Groups, Workshops, Symposia, Specialists' Meetings, Lecture Series and Technical Courses.



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TECHNICAL PROGRAMME COMMITTEE

PROGRAMME CO-CHAIR

Michael MILLER

USAF, Air Force Institute of Technology
United States
Tel: +1 937 2656 4641
Email: Michael.Miller.185@us.af.mil

Casey PIRNSTILL

USAF, AFRL, Human Effectiveness Directorate
United States
Tel: +1 937 255 0159
Email: Casey.Pirnstill@us.af.mil

COMMITTEE MEMBERS

Fabio BISOGNI

FORMIT
Italy
Tel: +39 06 5165 0001
Email: f.bisogni@formit.org

Timothy DEWITT

USAF, AFRL, Human Effectiveness Directorate
United States
Tel: +1 937 255 2242
Email: timothy.dewitt.2@us.af.mil

Kathryn FELTMAN

US Army Aeromedical Research Lab (USAARL)
United States
Tel: +1 701 213 7346
Email: kathryn.a.feltman.civ@health.mil

Susanna FONTANA

FORMIT
Italy
Tel: +39 06 5165 0046
Email: s.fontana@formit.org

Kaj GIJSBERTSE

TNO
The Netherlands
Tel: +31 06 1560 2409
Email: kaj.gijsbertse@tno.nl

William GLASCOE

Tailored Access, LLC
United States
Tel: +1 240 354 2002
Email: woglasc@nsa.gov

Crystal MARAJ

University of Central Florida
United States
Tel: +1 407 882 1317
Email: crystal.maraj@ucf.edu

Olivia MCCORMICK

USAF, AFRL, 711th Human Performance Wing
United States
Tel: +1 937 716 4543
Email: olivia.mccormick@us.af.mil

Giles MOORE

UKMOD/DSTL
United Kingdom
Tel: +44 1980 952843
Email: gmmoore@dstl.gov.uk

Dan NICOLELLA

Southwest Research Institute (SwRI)
United States
Tel: +1 210 522 3222
Email: daniel.nicolella@swri.org

Bharatkumar PATEL

UKMOD/DSTL
United Kingdom
Tel: +44 1980 955706
Email: bmpatel@dstl.gov.uk

Marius PEDERSEN

Norwegian Defence Research Establishment (FF)
Norway
Tel: +47 9547 4918
Email: marius-nyquist.pedersen@ffi.no

Paolo PROIETTI (Mentor)

Leonardo Spa
Italy
Tel: +39 06 4150 4180
Email: paolo.proietti@leonardo.com

Pinata SESSOMS

US Navy, Naval Health Research Center
United States
Tel: +1 312 213 8036
Email: pinata.h.sessoms.civ@health.mil



SCIENCE AND TECHNOLOGY ORGANIZATION
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NATO MODELLING & SIMULATION GROUP



Valarie YERDON

THOR Solutions LLC.

United States

Tel: +1 352 988 4850

Email: valarie.a.yerdon@uscg.mil

MSG & HFM PANEL OFFICE AND POINTS OF CONTACT

HFM Panel Executive

LTC. Siebren WOLF

Tel: +33 1 55 61 22 60

Email: siebren.wolf@cso.nato.int

MSCO Executive

LCDR Alvaro HERRAIZ SOLLA

Tel: +33.1.55.61.22.90

Email: alvaro.herraiz-solla@cso.nato.int

HFM Panel Assistant

Ms. Marie LINET

Tel: +33 1 55 61 22 62

Email: marie.linnet@cso.nato.int

MSCO Assistant

Mrs. Renata JAPERTAITE

Tel: +33 1 55 61 22 94

Email: renata.japertaite@cso.nato.int

RATIONALE

A Human Digital Twin (HDT) is a digital representation of an individual, which captures, stores, and analyses data from multiple sources to determine and predict the individual's physical and mental state, potential health risks, personalized health care advice, or future performance. This technology is becoming increasingly popular in the medical and healthcare industries providing insights into behaviour and lifestyle patterns and providing tailored and individualized care. HDTs are also being applied in sports medicine and manufacturing environments to gain insight into injury risk and performance. Ultimately, the HDT can provide a powerful tool to help the military train, equip and deploy soldiers. Although powerful, existing legal and ethical frameworks may limit the use and utility of HDTs. For example, in the United States, the Health Insurance Portability and Accountability Act limits the sharing of sensitive patient information. Further, individuals may be opposed to sharing certain behavioural data that will be evaluated and used to inform the system.

HDTs can monitor and assess the physical and mental health of service members, providing insights into the capabilities, health, lifestyle, and behaviour of deployed individuals to understand their suitability for certain missions and tasks. Additionally, the technology may be used to provide alerts in case of an emergency or illness, allowing quick action to be taken. Training can be individualized by understanding the current readiness of the individual. By providing an accurate and comprehensive picture of an individual's health and behaviour, HDTs can help to optimize the health and well-being of military personnel and ultimately improve the performance and readiness of the armed forces.

The use of digital twins in the military domain is still in its early stages, but the concept is beginning to gain traction. For example, the U.S. Air Force is exploring the use of digital twins to better understand human performance in complex environments, such as for pilot training and mission planning. Additionally, the U.S. Army is exploring the use of digital twins to create and manage virtual training environments for soldiers. Finally, the U.S. Navy is exploring the use of digital twins to support predictive maintenance and enhance situation awareness of operators.

SPECIALISTS' MEETING TOPICS

The objective of this Specialists' Meeting is to examine the use of Human Digital Twins (HDTs) in the military. HDTs are digital counterparts of real-life individuals, which capture and simulate the physical, mental and social aspects of a human. They are used in a variety of applications, including simulation and training, robotics, biomedical research, decision support and others. This activity is not intended to create a HDT or collect data useful in a HDT but to understand activities with respect to military relevant application. If successful, the Research Specialist Meeting (RSM) will drive a common understanding of terminology, an inclusive set of use cases, and an understanding of current capabilities to drive a shared vision of HDTs and their applications. The specialist meeting will be conducted in themed panels to explore topics related to use of HDTs, including **but not limited** to the following **example topic areas**:

- A. Current and proposed future challenges and opportunities of military HDTs**
- B. The impact of HDTs on a wide range of military operations**
- C. Application of HDTs to decision support**
- D. Use of HDTs in military equipment design**
- E. The use of HDTs in biomedical research**
- F. The legal, ethical, and social implications of HDTs in the military**
- G. Selection or integration of real-world data sources**
- H. Robust Data Security**
- I. Usability and scalability of HDTs in military operations**
- J. HDT Visualization Displays**
- K. Potential to integrate with currently supported systems**

The RSM seeks to develop and define a broad set of military relevant use cases as indicated in the topic areas. While the committee is interested broadly in these topics, the following list of detailed topics with accompanying descriptions are provided to further illustrate some known areas of specific interest.

Individuals are encouraged to submit proposals that pertain to Human Digital Twins regardless of whether the proposal is relevant to either one or more of the topic areas. The following list includes **several example topics**:

1. **HDTs in simulation and training:** The use of individualized history and predictive modelling to support the selection and customization of training content to minimize training time and optimize soldier performance.
2. **Prediction of Human Behaviour:** The use of predictive modelling, statistical analysis, and machine learning techniques to anticipate and respond to the behaviour of enemy forces.
3. **Data Collection and Protection:** The use of low power, non-invasive sensors to collect soldier specific data as well as methods to securely transmit and store data necessary to support HDTs.
4. **Human-Centric Artificial Intelligence:** The use of Artificial Intelligence (AI) or other modelling techniques to create robust models of individuals or groups of humans and the prediction of future performance on the battlefield.
5. **Improved Human-Robot Interaction:** The development of intuitive user interfaces and natural language processing to allow humans and robots to collaborate more efficiently, specifically, robot or AI models which support improved interaction by constructing models of human teammates to support collaboration.
6. **Customized Decision Support Systems:** The use of AI algorithms and novel interface constructs to provide custom decision support based on current human capabilities as informed by the digital twin, as well as providing AI-supported analytics to commanders based on the health of individual soldiers in the battlespace.
7. **Legal, Ethical, and Social Limitations:** Analysis and discussion of existing international, ethical, and social frameworks applicable to Human Digital Twins. Papers should focus on aspects of current frameworks or gaps in these frameworks which may limit the adoption and use of human digital twins.
8. **Novel Applications of Human Digital Twins:** Frameworks for analysing or categorizing the application of Human Digital Twins in military applications, as well as novel applications for this technology.
9. **Case Studies:** Case studies which demonstrate both the successful implementation of HDTs in military applications and simultaneously expose unanticipated barriers arising from application of this technology.
10. **Improved Intervention Techniques:** The use of AI to identify timepoints when an individual's performance is waning and identify and implement optimal intervention strategy. Intervention strategy may range from biomedical (e.g., non-invasive stimulation), to pharmacological (e.g., use of Modafinil) to technology (e.g., use of cueing).

The RSM will facilitate the information exchange on Human Digital Twins for military applications and related modelling and data-requirement through presentations on most of the above topics from research and innovation points of view. The outcome of this RSM should improve current studies on the subject, suggest areas for further NATO research activities and re-enforce the links with military bodies in NATO.

The main exploitation envisioned could support digital twin technology to help military personnel, operations, and equipment to be better managed, monitored, and improved. This could involve technology to create a digital replica of a soldier to accurately simulate the physical and mental effects of battle, or a digital twin of human that can be integrated with the digital twin of a weapon system to predict performance and maintenance needs, digital twins of training and operational systems to support tailored training. Additionally, HDTs could enable advances in tactics and strategy, or to improve decision-making in the field.

Prominent leaders, contributors and representatives from the military, government, academia, and industry are expected to attend the meeting.

CALL FOR PAPERS

The Programme Committee invites the interested specialists to submit an **extended abstract** (2 to 4 pages) addressing one or more the above aforementioned topics.

The selected authors will be invited to submit a **full paper** (8 to 12 pages).

Please send an electronic copy of the extended abstract together with completed Questionnaire attached to Technical Programme Committee Co-Chairs (michael.miller.185@us.af.mil) and (casey.pirnstill@us.af.mil) with a courtesy copy to the MSCO & HFM Panel Assistant (MSG@cso.nato.int and HFM@cso.nato.int) early enough to reach them by **26th April 2024**. **US authors and non-US Citizen affiliated with a US organization must comply with US procedures.**

The extended abstract must include the following information, in the beginning:

- **HFM-MSG-375-RSM Specialists' Meeting on "Human Digital Twin in the Military: Findings and Perspective"**
- **Title of the Paper**
- **Name of the Primary Author, followed by the names of the Co-Author(s) if any, and then Company/Affiliation, complete mailing addresses, telephone, fax and e-mail addresses.**

It is the responsibility of each contributor to fulfil the publication release and clearance requirements of his/her organization/company and country to obtain **clearance of papers** as needed. An official clearance is mandatory in the United States and there may also be a requirement in other countries to obtain clearance for unclassified papers. For further information, authors may contact any of the Programme Committee Members listed in this document or their National STO Coordinator. Please allow sufficient time for the clearance to be issued before deadline. In this case, the NATO classification of the paper is "APPROVED FOR PUBLIC RELEASE".

The Programme Committee will select a number of papers that are considered suitable for presentation at the Specialists Meeting. Authors will be notified by the date indicated in the schedule whether or not their papers are selected. Authors of selected papers will also be provided with information in the Instructions for Authors, which contains detailed instructions for the final formatting, presentation, transmission, etc. of full papers.

The time allowed for each presenter of a paper is approximately 20 minutes. Equipment will be available for PowerPoint presentations. All papers accepted for presentation at the Specialists' Meeting will appear in the Meeting Proceedings and published electronically.

Please note that the authors of papers selected for presentation will not be financially supported by this organization. They are fully responsible for their own hotel and travel.

IMPORTANT DATES

- | | |
|--|---|
| 26th April 2024 | • Abstract submission deadline |
| 28th June 2024 | • Acceptance notification to the Speakers |
| | • Authors to receive full «Instructions to Authors» package from CSO |
| | • Authors to start national procedure to obtain the «Presentation/Publication Release and Clearance Certificate (<i>this document will be attached to the "Instructions to Authors" document</i>) |
| 23rd November 2024 | • Submission of full paper (electronic by e-mail: Word & PDF) |
| | • Submission of «Presentation/Publication Release and Clearance Certificate» to CSO |
| 23rd November 2024 | • Submission of the Power Point Presentation |
| 10th-13th December 2024 | • Specialists' Meeting Oral Presentation |

PAPERS AND PRESENTATIONS

Approximately 15/20 full papers will be presented at the plenary sessions, each author being allocated 25 minutes, with usually twenty minutes for the presentation of their paper and five minutes for discussion. All presented papers will be published. They should be written and presented in English.

GENERAL INFORMATION

Classification

All material and discussion in this Specialists' Meeting will be UNCLASSIFIED, Releasable to Public.

In the case of CLASSIFIED information are going to be presented, a dedicated **closed session** will be organised.

Participation and Enrolment

You can attend and participate in the meeting even if you do not present a paper. Whether you present a paper or not, it is mandatory for all individuals to enrol online on the link mentioned below. The link is <https://events.sto.nato.int>. The enrolment process will be open approximately two months in advance the meeting date.

Language

Presentations and discussions will be in English.

Specialists' Meeting site and lodging

The meeting will be held at the University of Central Florida IST, School of Modelling Simulation and Training, Orlando, Florida USA, following the I/ITSEC conference 2024.

There is no meeting registration fee.

Attendees and accompanying persons will be responsible for their own accommodation arrangements and any travel expenses.

Any questions on the technical aspects of the scientific programme or the participation process should be addressed to the Specialists Meeting Co-Chairs.

PUBLICATION OF MEETING PROCEEDINGS

Complete instructions will be sent by the MSCO and HFM Panel Assistant to the lead authors of the selected papers who will be providing a full paper. The Guidelines for Authors will detail all requirements and deadlines for the preparation of the final manuscripts and presentations.

All authors will need to provide CSO with a final version of their Paper (PDF and source document in Word), in accordance with the aforementioned schedule, together with the Presentation/Publication Release and Clearance Certificate. Please be reminded that all papers must be written and presented in English.

A week before the event, CSO will pre-release the papers on the STO website under the "Pre-Released" section of the "Reports" pages and will remain as such until officially published. The final publication (Meeting Proceedings) will be at a URL address which will be given later. This will represent the official reference of the Meeting Proceedings of this Specialists Meeting including the presentations, papers, posters (if any), demonstration videos (if any), an Executive Summary, abstract and the TER (Technical Evaluation Report). Please take note that CSO reserves the right to print in the Proceedings any paper or material presented at the meeting.

Any questions on the technical aspects of the scientific programme, or the participation process should be addressed to the Specialists Meeting Co-Chairs.

Questions on the administrative aspects or requests for further information on STO activities should be addressed to the NMSG and HFM Panel Offices:



MSCO Executive LCDR Alvaro HERRAIZ SOLLA Tel: +33.1.55.61.22.90 Email: alvaro.herraiz-solla@cso.nato.int	HFM Panel Executive LTC. Siebren WOLF Tel: +33 1 55 61 22 60 Email: siebren.wolf@cso.nato.int
MSCO Assistant Mrs. Renata JAPERTAITE Tel: +33.1.55.61.22.94 Email: renata.japertaite@cso.nato.int	HFM Panel Assistant Ms. Marie LINET Tel: +33 1 55 61 22 62 Email: marie.linnet@cso.nato.int

SECURITY LEVEL AND CLEARANCE FOR PRESENTATIONS AND PAPERS

This meeting is UNCLASSIFIED. However, it is the responsibility of each contributor to fulfil the publication release and clearance requirements of his/her organization/company and country to obtain clearance of abstracts and papers as needed. An official clearance is mandatory in the United States and there may also be a requirement in other countries to obtain clearance for unclassified as well as classified papers. For further information, authors should contact the appropriate Programme Committee Member listed in this document or their National STO Coordinator.

Thank you for your contributions which are very much appreciated by the NATO community.



ATTACHMENT

SPECIAL NOTICE FOR US AUTHORS AND NON-US CITIZENS AFFILIATED WITH US ORGANIZATIONS

Abstracts of Papers from the U.S.A. must be sent **ONLY** to the following P.O.C.:

NATO STO U.S. National Coordinator

OASD (R&E)/International Technology Programs

4800 Mark Center Drive, Suite 17D08

Alexandria, VA 22350-3600

E-mail: osd.pentagon.ousd-atl.mbx.usnatcor@mail.mil

Tel: +1 571 372 6538 / 6539

Fax: +1 571 372 6548

Please Note the Following:

All U.S. Authors must submit one electronic copy to this P.O.C. by **26th April 2024**

All US Authors must include the following statement in a covering letter:

- The work described in this paper is cleared for presentation to NATO audiences (i.e., Approved for public release)
- The paper is technically correct
- If work is sponsored by a government agency, identify the organization and attest that the organization is aware of submission
- The paper is Approved for Public Release and
- The paper does not violate any proprietary rights.

Note:

1. Only complete packages (paper plus all items listed above) will be accepted by the US P.O.C.
2. After review and approval, the US POC will forward all US papers with the Details of Authors Form to the Panel Assistant. All US papers must be received directly from the US POC. US papers will not be accepted directly from authors.
3. In the event there are any questions or concerns with these requirements, U.S. authors are encouraged to contact the US POC as early as possible. Delays in meeting POC deadlines will impact the timely submission of your paper.

ANNEX A

Questionnaire

For consideration of a paper submitted for the NMSG and HFM Panels Specialists Meeting on:
HUMAN DIGITAL TWIN IN THE MILITARY: FINDINGS AND PERSPECTIVE (HFM-MSG-375-RSM)
Orlando, Florida USA, 10th – 13th December 2024

Please attach a copy of this Questionnaire to each copy of an abstract.

On each Abstract, authors should be listed in the order they will appear on the programme. Unless specified otherwise, the first author will be presumed to be the LEAD AUTHOR having the major responsibility regarding the content of the paper.

Title of Paper:

What is the Nature of Work Reported in the Paper? (Indicate with X)

Basic Research	
Applied Research	
Concept Study or Analysis	
Experimentation	
System Development	
System Trial	
Other:	

Specialists Meeting Topic Area Addressed by Paper (Indicate all that apply with X)

1) HDTs in simulation and training	
2) Prediction of Human Behaviour	
3) Data Collection and Protection	
4) Human-Centric Artificial Intelligence	
5) Improved Human-Robot Interaction	
6) Customized Decision Support Systems	
7) Legal, Ethical, and Social Limitations	
8) Novel Applications of Human Digital Twins	
9) Case Studies	
10) Improved Intervention Techniques	
11) Other	



DETAILS OF AUTHORS

Authorship:

Lead Author (*Is author having the major responsibility regarding the content of the paper and contact person for correspondence with the HFM-MSG-375-RSM Programme Committee and MSG & HFM Panel Offices*)

Full Name (title, first, last)	
Organisation	
Business Mailing Address	
Email	
Telephone	
Citizenship	

Co-Authors (*Each Co-Author should be listed in the order they will appear on the programme*)

Full Name (title, first, last)	
Organisation	
Business Mailing Address	
Email	
Telephone	
Citizenship	

Full Name (title, first, last)	
Organisation	
Business Mailing Address	
Email	
Telephone	
Citizenship	

(Add as necessary)