

Graphics by 711 HPW/RHW

RHW AT I/ITSEC 2021

INTRODUCTION & CONFERENCE FOCUS EVENTS

The 711 HPW/RHW team led two Interservice/Industry Training, Simulation and Education Conference (I/ITSEC) 2021 Focus Events with thought leaders from around the world as panelists. These two events were well attended, logging over 250 attendees combined!

The first event was titled “Digital Twin/Digital Engineering: Multinational Perspectives on Digital Engineering and the M&S Enterprise” and played host to subject matter experts actively involved in their country’s digital engineering enterprises. Each of them discussed their successes, challenges, and ambitions for today’s digital engineering fields, as well as the (near) future’s. The participating panelists were Wim Huiskamp (TNO Defence Research, NLD), Simon Skinner (Thales Training and Simulation), Agatino Mursia (Investments & Technology Plan Governance CTIO Leonardo Electronics Division, ITA), and Dr. Christopher Stevens (Research Psychologist, Multi-Scale Models Line of Effort (LOE) Lead, AFRL) who presented on behalf of himself and his co-author, Roxanne Constable (Bioeffects Division Senior Engineer/Product Line Lead, Airman Systems Directorate, AFRL).

The second of the Focus Events was a panel centered on “Research Foundations and Findings Supporting Augmented and Virtual Reality (AR/VR) Implementation in the Wild.” Each panelist discussed their organization/agency’s selection, implementation, and assessments of the technologies in terms of their successes, challenges, and potential needs and tools for improving our technology implementations today and in the future. The panelists included Mayowa Olonilua (Defence Science and Technology Laboratory (DSTL)), Wim Huiskamp (TNO), Dr. Kay Stanney (Design Interactive, Inc., Prof Jelte Bos (TNO)), Dr. Jonathan Allsop (R&D Psychologist, SBA, CFS, Royal Air Force), and Dr. Jim Belanich, (The Institute for Defense Analyses (IDA), US OSD).

Dr. Winston “Wink” Bennett, Readiness Product Line Lead, 711 HPW/RHW

MISSION READINESS APP

The Fatigue & Sustained Attention Performance Impacts Team demonstrated the Mission Readiness App, a prototype mobile app that assesses and predicts performance effectiveness (i.e., fatigue) by tracking sleep, consumption of stimulants (e.g., caffeine) and depressants (e.g., sleep aids), and individual performance over time. The resulting software provides individualized assessments of current functioning and forward-looking predictions to inform both fatigue risk assessments and countermeasure strategies. The team is currently preparing the app for testing and validation in multiple operational communities and training exercises. The Mission Readiness App is a key capability in the Fatigue Optimized Cognition Under Stress (FOCUS) product from the Sensing and Assessment Product Line which is lead by Dr. James Christensen (RHB).

Dr. Megan Morris, Cognitive Models CRA Lead, 711 HPW/RHW

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IRON DEV COMPETITION '21

The GRILL® participated for the third consecutive year in the Iron Dev competition at I/ITSEC. In the competition, developers are challenged to rapidly create a prototype AR/VR training, education, or operational solution. Using an open-source Distributed Interactive Simulation (openDIS) that is maintained by the Naval Post Graduate School, the GRILL® created an openDIS plugin that allows military simulation systems to interoperate with Epic Game's Unreal Engine®. Whole-Earth terrain and satellite imagery streaming were enabled by Cesium Ion®, and Project Anywhere XR® permitted augmented and virtual reality interactions. The prototype successfully united the game engine, geospatial, and modeling & simulation communities into one powerful solution. The GRILL® team will refine, publish, and make all of their work open source for the benefit of the modeling & simulation communities.

Mr. Tim Rodabaugh, Principal Software Engineer, Ball Aerospace

THE GRILL® DEMO BOOTH

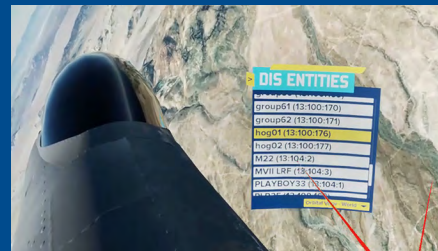
The GRILL® brought out three prototype simulations for display: a VR Joint Terminal Attack Controller training system, parachute simulator, and Traumatic Brain Injury treatment facility. All of the prototypes were built using commercial gaming hardware and software, demonstrating how existing tech can be leveraged to build tools for a range of purposes, from training and rehearsing military operations to medical scenarios and patient rehabilitation.

Lt Kyle Bucklew, Program Manager, 711 HPW/RHWM

THE NEXT BIG THING

Finally, Dr. Wink Bennett was a part of I/ITSEC's new TED-Talk-like event called "The Next Big Thing" which was a series of 3 separate events focused on advancing novel technologies in Extended Reality. The events included a Senior Leader panel on the policy and implications supporting the transitions of these technologies into operational contexts; an event with industry thought leaders from game engine and technology development companies speaking on where they see the "Metaverse" taking education and training in the future; and finally, hearing from innovators in relevant areas of work and the capabilities they are pursuing with current and future clients and customers. ★

Dr. Winston "Wink" Bennett, Readiness Product Line Lead, 711 HPW/RHW



The openDIS plugin provides a highly-interactive interface for simulations and training.

Screenshots by 711 HPW/RHW

UNDERSTANDING IS A PROCESS

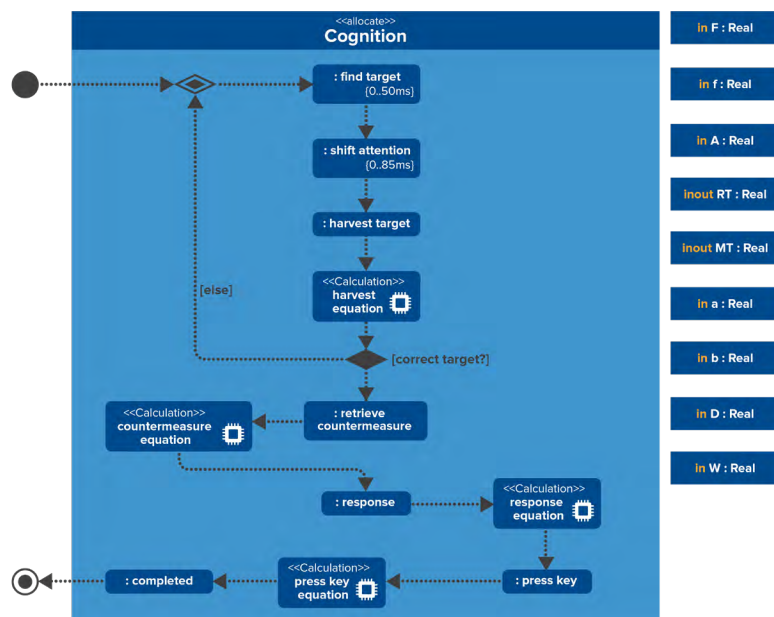
For humans, robots, and other intelligent machines to be able to effectively work and train together, they need the ability to understand each other. In teams, understanding requires team members (intelligent machine or human) to understand their tasks and goals, along with their own and their teammates' knowledge, skills, and capabilities. A critical measurement methodology is needed to address the question: *How can we systematically assess the understanding of both humans and machines in consistent ways?*

The Science of Understanding (SoU) research team recently published a theoretical perspective paper that leverages an extensive cross-disciplinary review of the concept and measurement of understanding and introduces a new framework that uses natural language probes to gauge an agent's depth of understanding. The SoU team argues that for humans and machines to demonstrate their abilities of understanding to each other, they must have a common symbolic representation system. For humans, the most prevalent and easiest system to use is language; therefore, language will also be the most natural symbolic system for machines to use that humans will understand. From there, the scientific claim is that only through the lens of natural language can humans and machines demonstrate understanding to each other. The general framework proposed in this paper provides a way to structure evaluations that can be adapted to specific domains, tasks, and teams through further research.

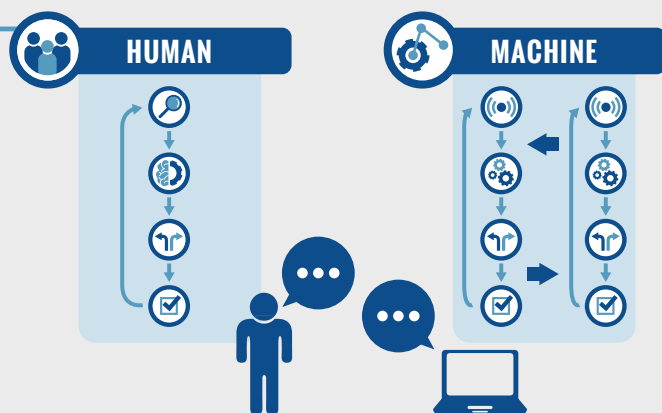
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INTEGRATING HUMAN COGNITIVE MODELS WITH SYSTEMS ENGINEERING – RADAR OPERATION AS A USE CASE

Maintaining situation awareness and completing complex tasks in denied environments is a crucial challenge faced by Warfighters. Electronic warfare attacks are becoming increasingly sophisticated, forcing Warfighters to adapt, think, and act while accounting for partial or misleading information. Human models that can account for the effects of these critical threats on performance and help identify mitigation opportunities are needed. In this project, we are designing models that simulate the performance of human radar operators under a variety of operational pressures, such as fatigue, perceptual/cognitive load, and information uncertainty. We have partnered with a team at Naval Sea System Command (NAVSEA) who is building a simulated Aegis surface-warfare system using a Model-Based Systems Engineering (MBSE) model at its core. MBSE is a powerful unifying framework for models at various levels of analysis because it offers a clear representation of information flow



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Graphic by Ms. Shania Horner, Multimedia Designer, Cubic

The SoU research team is a tri-service team comprised of researchers from AFRL's Warfighter Interactions and Readiness Division, Army Research Lab's Combat Capabilities Development Command, and the Naval Research Lab's Center for Applied Research in AI. Their research was supported by a seedling grant from the Office of the Secretary of Defense's Applied Research for Advancement of S&T Priorities (ARAP) Program. ☆

Dr. Leslie Blaha, Senior Research Psychologist and CMU Operating Location Lead, 711 HPW/RHWM at Carnegie Mellon University

A System Modeling Language (SysML) diagram of the central perceptual/cognitive/motor loop of our model. This diagram simultaneously lays out the information dynamics in our model and allows for simulating performance by using SysML (Cameo) software.

between complex systems. We are supporting the team's effort by building a library of human models in MBSE and external languages that interface with MBSE that can simulate human performance under mission-relevant circumstances, including visual marking of tracks, various display densities, and display blackouts.

We have recently validated the first version of our human model against the published benchmark data and delivered the model to NAVSEA. To expand the range of situations captured by the models, we are conducting novel laboratory research to better understand how fatigue, cognitive load, and electronic warfare interact to affect radar operator performance. Our aim is to create a set of robust and reliable simulation capabilities that will provide insight for mission planning, war-gaming, and system design. ☆

Dr. Christopher Stevens, Research Psychologist, 711 HPW/RHWM

<https://www.frontiersin.org/articles/10.3389/fnsys.2022.800280/abstract>

Blaha, L. M., Abrams, M., Bibyk, S. A., Bonial, C., Hartzler, B., Hsu, C. D., Khemlani, S., King, J., St. Amant, R., Trafton, J. G., & Wong, R. (in press). Understanding is a process. *Frontiers in Systems Neuroscience (Special Topic on Understanding in the Human and the Machine)*.

RECOGNITIONS

2021 ANNUAL AWARDS

AFRL

Administrative Excellence (Individual):
Mr. Jack Brown

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Innovation Award (Individual):
Dr. Kristen Liggett

Technology Transition:
Dr. Jerred Holt

Company Grade Officer of the Year:
Capt Jonathan Powers

IMA Field Grade Officer of the Year:
Maj Geoffrey Dobson

Scientific/Technical Achievement (Team):
Joint All-Domain Integrated ISR Team

RH

Commander's Cup (Senior Individual):
Dr. John "Chris" Brill

Collaboration Team Award:
Human-Machine Interface Skyborg Team

RHW

2021 AFRL Early Career Award:
Dr. Alan Wall

2021 AFRL Fellows:
Dr. Joseph Lyons

40 Years of Service:
Dr. David Williamson

Commander's Cup (Junior Individual): Ms. Jessica Bartik

Commander's Cup (Team):
Space Team

Scientific/Technical Management Award: Ms. Kristen Barrera

Daniel Repperger Mentor of the Year Award:
Dr. Kathleen Larson

Supervisory Award (Individual):
Dr. Vincent Schmidt

Thomas S. Wells Senior Leadership Award (Individual): Dr. Joseph Lyons

James W. Brinkley Leadership Award (Individual): Dr. Taylor Murphy

International Award (Team):
Lakenheath HAS Team

Harry G. Armstrong Scientific Achievement (Individual): Dr. Christopher Stevens

Civilian-Category II: Mr. Brandon Nolan

Civilian-Category III: Dr. Christopher Myers

Senior Non-Commissioned Officer (E7 to E8): MSgt Jeffery Held

Field Grade Officer (O4-O5):
Maj Kyle Knight

2021 3rd QUARTER AWARDS

RH

Civilian-Category II:
Ms. Emily Conway

Company Grade Officer (CGO):
1Lt Alexander Ciolek

Senior Non-Commissioned Officer:
MSgt Scott Kincaid

2021 4th QUARTER AWARDS

711 HPW

IMA Field Grade Officer:
Maj Geoffrey Dobson

Civilian-Category III:
Ms. Theresa Penn

Company Grade Officer:
1 Lt Phitina Tran

RH

Senior Non-Commissioned Officer:
MSgt Paul DuCharme

PUBLISHED CONTENT

JOURNAL ARTICLES AND ABSTRACTS

Bajaj, G., Current, S., Schmidt, D., Bandyopadhyay, B., Myers, C. W., & Parthasarathy, S. (2022). Knowledge gaps: A challenge for agent-based task completion. *Topics in Cognitive Science*.

Demir, M., McNeese, N. J., Gorman, J. C., Cooke, N. J., Myers, C. W., & Grimm, D. A. (2022). Exploration of team trust and interaction dynamics in Human-Autonomy Teaming. *IEEE Transactions on Human-Machine Systems*.

Hough, A. R., O'Neill, K., & Juvina, I. (2021). Counterfactual-based nudging and signaling promote more efficient coordination during group tasks. *Comprehensive Results in Social Psychology*, 1-27.

Morris, M. B., Veksler, B. Z., Krusmark, M. A., Gaines, A. R., Jantscher, H. L., & Gunzelmann, G. (2021). Aircrew actual vs. prescriptive sleep schedules and resulting fatigue estimates. *Aerospace Medicine and Human Performance*, 92(10), 806-814. <https://doi.org/10.3357/AMHP.5820.2021>

Oermann, M., Krusmark, M., Jastrzembski, T., Kardong-Edgren, S., & Gluck, K. (2021). Personalized training schedules for retention and sustainment of CPR skills. *Simulation in Healthcare*.

Sense, F., Wood, R., Fiechter, J., Collins, M., Jastrzembski, T., Krusmark, M., Wood, A., & Myers, C. (2021). Integrating cognitive and machine learning models to enhance predictive validity. Special Issue, Cognition-Inspired Artificial Intelligence, *Topics in Cognitive Science*.

Tryhorn D, Dill R, Hodson DD, Grimaila MR, Myers CW. (2021). Modeling fog of war effects in AFSIM. *The Journal of Defense Modeling and Simulation*. doi:10.1177/15485129211041963

BOOKS, BOOK CHAPTERS, AND REPORTS

Chelette, Tamara L. (2021) Human Response to Acceleration, Chapter 18 in *Fundamentals of Aerospace Medicine*, Jeff Davis Editor, published by Wolters Kluwer Health, Jul 2021. ISBN/ISSN 9781975143855.

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711 HPW/RHW Core Research Areas:

- Cognitive Models
- Personalized Learning and Readiness Sciences
- Systems Analytics
- Collaborative Interfaces and Teaming
- Multisensory Perception and Communication