



# Human Systems Community of Interest (HS Col) Newsletter



Summer 2024



**Senior Leader Perspective:** As the inaugural Principal Director (PD) for our Critical Technology Area (CTA), my role is to facilitate and implement our Department’s Vision, Strategy and Roadmaps for Human-Machine Interfaces (HMI). While HON Shyu established the focus of the CTA; the equities, approaches, and challenges must derive from Service priorities. HMI is an extremely broad area of work, as nearly every system in the DoD has an HMI component. As such, the CTA addresses specific challenges and opportunities laid out by HON Shyu, and the necessary adjacencies to deliver (like strong Human Sciences and building a stronger Community of Action). The priorities laid out in the CTA will provide focus areas for our S&T Community, Technology Developers (USG and Industry), Academia and Human Sciences. The HSI community will be key to developing these priorities and plans appropriately.

The use of augmented, mixed and virtual (AR, XR, VR) reality technologies and simplified, more natural means of controlling systems (e.g., Voice Control) are core technologies for the CTA. These technologies are not a solution for every problem, but there are a lot of mission areas where they must be used to achieve our Strategic objectives. We must meet the technology where it is and drive it towards the future operational gaps. The implementation of these technologies relies on strong human sciences to realize their potential, and appropriately nested operational contexts to deliver true capability. Human Sciences is a key pillar to the CTA and its ability to explore, exploit, experiment and deliver Decision/Action Advantage from a radically Human perspective. I look forward to working with and supporting the HSI community where it intersects with the CTA priorities and adjacencies over the next few years while leading this Critical Technology Area for our Department.

*Dr. Christopher Palmer (ST), Principal Director,  
Human-Machine Interfaces CTA, OASD(CT), USD R&E*

## HUMAN SYSTEMS Col

**Vision:** Develop/deliver technologies to enable, sustain, enhance and quantify human performance

**Mission:** Enhance the warfighter through:

- 1) *Integrated sims for mission training & experimentation*
- 2) *Human-machine designs for warfighters,*
- 3) *Assessment of operator effectiveness*
- 4) *Operating through battlespace stresses, and*
- 5) *Mastering the PMESII battle space.*

**Key Products:** Integrated service roadmaps; Col taxonomy; budget & programs; Seedling and ARAP proposals.



### Key Personnel:

**Col Chair:** Dr. Gaurav Sharma, Air Force Research Laboratory

**OSD:** CDR Wilfred Wells, OUSD (R&E)

**Navy:** Dr. Patrick Mason, Office of Naval Research

**Army:** Dr. Jeremy Gaston, Army Research Laboratory

**Army:** Dr. Robb Wilcox, Soldier Center (CCDCSC)

**Army:** Dr. Scott Shadrick, Army Research Institute

**SOCOM:** Ms. Lisa Sanders, Special Operations Command

**DIU:** Dr. Christian Witchurch, Defense Innovation Unit

**ExecSec:** Dr. Jill McQuade, Air Force Research Laboratory

**PAE&T Lead:** Dr. Elizabeth Uhl, Army Research Institute

**SICP Lead:** Dr. Mark Draper, Air Force Research Laboratory

**PSWP Lead:** Dr. Logan Williams, Air Force Research Laboratory

Questions, feedback or need to reach the POC? Please contact our Col’s email at [hscoi-contact@sainc.com](mailto:hscoi-contact@sainc.com). Thanks!

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## Col Highlights - Past Events

### Communities of Interest (Col) Information Exchange

All Cols participated in this Information Exchange to OUSD (R&E) during June 3-5 in Arlington VA. Our COI was successfully briefed by a Steering Committee member, Dr. Robb Wilcox, US Army Combat Capabilities Development Command Soldier Center. He provided valuable information on the state of our technology investment portfolio capabilities and identified future technology opportunities to inform resource decisions to the S&T Executive Committee (EXCOM).

POC: Katie Smith Stilling, Strategic Analysis, Inc

**Col Annual Meeting.** This year’s meeting was led by our Chair, Dr. Gaurav Sharma, Air Force Research Laboratory as a hybrid event. We successfully met our objectives to review FY24 accomplishments and next year’s strategy, provide guidance, and most importantly to engage in discussion between the services and our vital partners and stakeholders to hopefully find new collaboration opportunities. Key agenda items were a Steering Committee Panel, Service Portfolio Updates, Subarea Updates, and briefings from other key organizations in the Human Systems arena. We’re looking to improve our event next year by shifting the focus to take better advantage of being together in the future, have fewer presentations and more discussion — in particular from Principal Investigators sharing information on their successes!

POC: Katie Smith Stilling, Strategic Analysis, Inc

Major Events/Activities 2024	
Roadmap Review w/OUSD (R&E)	Jan
NDIA Human Systems Conference	Mar
Human Factors Engineering TAG	May
Col Information Exchange w/OSD	Jun
COI Annual Meeting	Aug
ARAP Data Call	Oct
I/ITSEC in Orlando FL	Nov/Dec

### Inaugural Emerging Research Opportunities (ERO) Program

OUSD(R&E) recently sent out a call for seedling papers under a new program called ERO, which is funded via Applied Research for the Advancement of S&T Priorities (ARAP) Program Element. It will provide funding in the amount of \$500K - \$1M per year over a 1 to 2 year Period of Performance. The program’s vision is to advance emerging research areas that can benefit DoD’s capability to meet joint war-fighter needs in multi-domain operations that are in alignment with Reliance 21 S&T Roadmaps or OSD Critical Technology Areas. It was emphasized that ERO isn’t a Mini ARAP, nor necessarily an ARAP Precursor.

Each COI can submit a candidate and there may be multiple award winners. We had several excellent internal nominations and selected a tri-service led candidate titled “DOMINATE: Distributed Ontology-Driven Mission Information Network for Adaptive Teaming and Execution”. Unfortunately, we didn’t win this time; however, Dr. Sharma would like to thank everyone for their efforts responding to a short notice call this year!

POC: Katie Smith Stilling, Strategic Analysis, Inc

## Col Highlights - “ Next Up “

### HS Col and Defense Innovation Unit (DIU) Exchange.

In the recent past, our Col held several visits at key service laboratories to highlight important capabilities. Following a Covid-driven interruption in this flow, we’re hoping to reinstate these visits annually. Our next is scheduled for early October at DIU’s Headquarters in Mountain View, CA. This engagement is designed to assist and inform the HS Col Steering Committee members and adjacent defense partners on how DIU is approaching the accelerated identification and adoption of commercial technology into the Department. Key objectives include discussing DIU’s portfolio of activities relevant to the HS COI, discussing ways to expand DIU and lab partnerships in support of mission requirements, and brokering engagements with local vendors, investors, and incubator/accelerator partners to discuss deeptech trends.

POC: Katie Smith Stilling, Strategic Analysis, Inc



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## From Our Partners and Stakeholders

**Joint Human Systems Integration Steering Committee Fall meeting.** The Joint Human Systems Integration Steering Committee (JHSISC) met in August with Mr. Thomas Simms, Principal Deputy Executive Director, Systems Engineering and Architecture of the Office of the Undersecretary of Defense for Research and Engineering as host along with thirty members of the JHSISC in attendance for the virtual meeting. Mr. Napoleon Gaither (Army) provided an update about the Capabilities-Based Reassessment and the status of four of five workstream activities that have moved to sustainment by the Joint HSI Working Group (JHSIWG). Dr Gordon Gattie (Navy) was introduced as the incoming JHSIWG Chair, and provided an update on items of interest to the JHSISC: 1) the establishment of Armed Service HSI Centers of Excellence, 2) the resolution of Naval Postgraduate School HSI academic sponsorship by the Army and the Navy, 3) the initiation of a Disruptive Technology Working Group within the JHSIWG, 4) the path forward approach for adoption of Human Readiness Levels as a tool for the Department of Defense, and 5) the creation of a POM cycle funding request for HSI within the department. Dr Christopher Palmer provided an update on the latest Human-Machine Interfaces Critical Technology Area strategy and roadmap.

Content for this meeting can be viewed at: <https://sites.apan.org/osd/HSI-BOKM/>

POC: Mr. Mitchell Woods, (OUSD R&E)/ED

**NDIA Human Systems Division.** The NDIA Human Systems Division is actively planning its 2025 Human Systems Conference which will return to George Mason University in Arlington on March 11-12. The theme is “Optimizing Total System Performance through Innovative Human Integration”, and will contain presentations that will both emphasize the value of Human Systems Integration in the DoD and highlight thoughtful integration techniques. Attendees can expect to hear from and network with program managers, academia, small businesses, representatives from major primes, and policy makers. Conference planners are finalizing public announcement details and a call for abstracts will follow imminently. Please visit <https://www.ndia.org/divisions/human-systems> to access event details as they become available.

*Other Business:* The NDIA Human Systems Division is looking forward to furthering its advocacy for Human Systems Integration resources for DoD stakeholders/program managers to enhance the impact of this important cost-saving technical and management strategy. Over the next quarter, the NDIA Human Systems Division will continue to foster relationships across other NDIA divisions and is pursuing a prominent presence at a variety of DoD-oriented gatherings throughout the year to raise awareness about DoDI 5000.95 and Human Systems Integration at large. The leadership of the NDIA Human Systems Division is excited to continue to work closely with the Human Systems COI into 2025 and beyond.

POCs: Stuart Michelson, GTRI, Chair of NDIA HSD, and Erik Sikorski, MITRE, Deputy Chair of NDIA HSD

## Col Accomplishments

**Army Research Institute Learning Environment Optimization.** The Army must find ways to effectively modernize training within the available time and resources. Science can help optimize professional military education (PME) and address this challenge through finding means to quickly and effectively develop instructor expertise, developing knowledge management tools, evaluating the effectiveness of virtual and distance learning modules, and testing new methods to collect and make revisions based on student feedback.

*Impact:* The research provides the Army with: 1) research-based instructor certification approaches and tools for virtual and in-person instruction, 2) definitions and a model for Army instructor expertise, 3) an example knowledge management system and development process, and 4) research-based parameters necessary to implement effective DL to support future modernization efforts.

*Accomplishments and Transitions:* ARI developed and implemented a cognitive apprenticeship-based approach to instructor certification, created a Learning Ecosystem to support instructors and maintain expert knowledge, assessed the impact of distributed learning on PME outcomes, created an instructor job aid that was transitioned across the Army Learning Enterprise, and assessed the impact of distributed learning on PME outcomes impacting Army policy.

POC: Dr. Richard Hoffman, Army Research Institute



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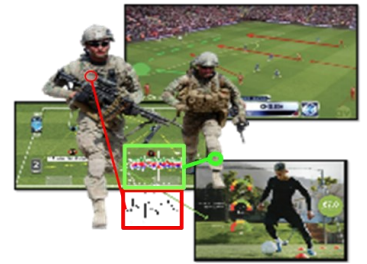


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## Col Accomplishments (Continued)

### Optimizing the Human Weapon System (OHWS) Expands to Support Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense (JPEO-CBRND)

Researchers at the 711 Human Performance Wing (HPW) and the Army Development Command (DEVCOM) developed and delivered a new OHWS package in collaboration with JPEO-CBRND focused on in-garrison readiness as a prototype for future support of AMC. JPEO-CBRND received a wearables physiological monitoring package for 143 soldiers in an Army regiment. JPEO approached AFRL and DEVCOM because the joint OHWS package (also used to support the Space Force's Continuous Fitness Assessment (CFA)) has the highest technology readiness level across the DoD and is easily modifiable to meet future customer needs for combining readiness and risk assessment from wearables. The monitoring package was able to capture aggregated sleep and activity data daily to inform operational leadership regarding workload (measured activity) and recovery (measured sleep) of the overall companies in real time. This data strengthened the relationship between AFRL, DEVCOM and JPEO, created a technical package that extends beyond the current OHWS applications used for the Space Force's CFA, and will allow us to be better prepared to support the impending Urgent Operational Need from AMC.



POC: Dr. Logan Williams, 711 Human Performance Wing

### 711 Human Performance Wing Update on "Holding Algorithms Accountable: Detecting Implicit Bias in Machine Learning Human Annotators"

Artificial intelligence (AI) systems and machine learning (ML) algorithms have streamlined decision making in our daily lives, such as when we browse media on a streaming platform or apply for instant approval on a credit site. On a national level, AI is now embedded in cognitive warfare tactics as nations attempt to influence the sixth operational, or the Human (Cognitive/Brain) domain. However, there can be negative long-term consequences when we assume that AI systems are synonymous with "unbiased", or if we fail to study possible vulnerabilities in these systems. All algorithms must be designed by humans, and the choices designers make can introduce bias into the system. Developers are beginning to note how human annotators, or the manpower behind ML algorithms, are likely to rely on systematic/cultural biases, such as gender and race stereotypes, while categorizing data. While much research has gone into developing AI systems, less is known about how human biases become embedded during the development process.

*Effort:* The project examines how human annotators may rely on their own implicit and explicit biases as they categorize the textual training data for a ML algorithm. Implicit bias is defined as attitudes that are relatively more unintentional and uncontrollable compare to more explicit (self-reported) bias, which is more controlled and intentional. People may not be fully aware of when implicit biases are activated and may even hold bias against their own in-group. Thus, we are examining bias with differing methods (e.g., self report measures for explicit; timed responses for implicit) to capture the full impact of bias on algorithm development. We are also investigating whether providing training to annotators about implicit bias affects how they annotate the text data.

In summary, the Air Force is battling for information superiority in the cyber battlespace, which often involves quickly organizing multi-source raw data into meaningful intelligence. Studying and addressing how bias affects AI systems will ensure warfighters have the most accurate and trustworthy algorithmic output, which will enable adversary intent identification and rapid decision-making against threats.

POCs: Dr. Christine Vitiello and Dr. Kathleen Larson, 711 Human Performance Wing



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## Col Accomplishments (Continued)

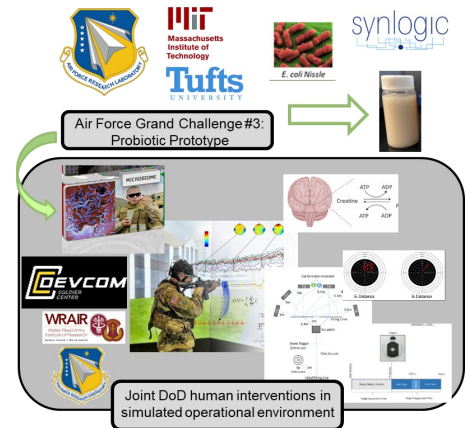
### Engineered Probiotics for Optimized Warfighter Performance.

Warfighters must maintain focus and performance during acute stress-induced fatigue to complete their mission and survive. Orally-administered fatigue mitigation compounds, specifically creatine, are rapidly degraded by the body and frequent oral doses are impractical for operational use. By harnessing power of synthetic biology and our gut microbiome, targeted probiotic intervention can be realized to mitigate cognitive fatigue and provide a critical performance edge in battle.

#### Accomplishments and Transitions:

- Air Force Grand Challenge #3 designed, prototyped and validated in vitro, an engineered probiotic to mitigate effects of sleep fatigue on cognition
- Air Force FY24 funding is scaling up manufacture of the engineered probiotic
- Air Force (FY24) and Army (FY24-26) funded programs are validating the engineered probiotic via human trials in simulated environment to statistically improve operational performance (marksmanship) under sleep-deprived states
- Planned future work: Expanding human studies evaluating the engineered probiotic intervention in a Field Training environ

POCs: Dr Michael Goodson, Air Force 711th Human Performance Wing and Jason Soares, Army DEVCOM Soldier Center



**ARL Researchers Win Award at International Conference on Applied Human Factors and Ergonomics.** DEVCOM ARL researchers received a Best Paper Award at the International Conference on Applied Human Factors and Ergonomics in Nice, France, 2024. The manuscript, titled "Using Multi-Modal Physiological Markers and Latent States to Understand Team Performance and Collaboration," presents findings from data collected under the Strengthening Teams in Robust Operations in Novel Groups (STRONG) Collaborative Research Alliance (CRA). The research investigates the use of physiological synchrony as a performance predictor within team dynamics. By analyzing facial expressions and other physiological markers during a virtual mission, the team uncovered promising results that further our understanding of team performance.

**Winning Abstract:** Squads of the future battlefield will include a mixture of technically savvy humans and artificially intelligent teammates. Contextually aware AI teammates will be essential for war fighter overmatch. To understand how multimodal physiology can impact mixed team performance, we looked at how physiological team properties emerge in a naturalistic and collaborative environment. We examined internal states and team outcomes based on these states within the context of a complex bomb defusal task in a simulated, but naturalistic environment. This overarching research integrates eye gaze behavior, neural activity, speech, heart rate variability, and facial expressions to unravel the intricate relationship between individual and team performance. We focused on the facial expression data. Using a novel testbed, we aimed to uncover how these physiological processes evolve and interact with environmental changes and human interactions to influence team dynamics and task performance. Compared to traditional highly controlled lab tasks, this novel and naturalistic testbed enables peripheral measurement of multimodal physiology during naturalistic team formation and collaboration. We reported differences between individual and teaming task work in global expressivity result and correlations between facial expression synchrony and team task performance. We argued the measurement of non-invasive cognitive states as a dynamic, causal process will enhance predictions of future states and team performance, and that including interactions and naturalistic environment factors will enhance prediction model accuracy for human AI teaming.

⇒ Ultimately, this research aims to shed light on the complex interplay between individual latent states, team dynamics, and task performance, contributing to the development of more effective autonomous systems capable of seamless collaboration with human counterparts.

POC: Dr. Catherine Neubauer, DEVCOM ARL



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## Col Accomplishments (Continued)

**Effective readiness tools and fatigue risk management are critical to meet agile Warfighter mission needs.**

Authors: Fisher, C.; Morris, M. B.; Stevens, C. A.; and Swan, G.

*Abstract:* 711 Human Performance Wing researchers share findings from an effort focused on developing a new hybrid framework of fatigue with broader military, practitioner, and academic communities. This effort integrates three independent accounts of time-on-task fatigue into a novel hybrid framework. Specifically, it unites a motivational system balancing goal and comfort drives as described by an influential cognitive-energetic theory with accumulating microlapses from a recent computational model of fatigue, and frontal gamma oscillations indexing fluctuations in motivation control.

Analyses and computational models from the effort suggested compelling support for this framework which resolves dissociations between psychological theory, computational mechanisms, and neural behavior to establish a comprehensive account of time-on-task effects. These findings can be used to advanced predictive models of fatigue by integrating neural metrics into cognitive models of operational performance.

*Read More:* "Hybrid framework of fatigue: Connecting motivational control and computational moderators to gamma oscillations". *Frontiers in Neuroergonomics*, section Cognitive Neuroergonomics, 5, 1375913. <https://doi.org/10.3389/fnrgo.2024.1375913>

POC: Dr. Lorraine Borghetti and Dr. Megan Morris, 711 Human Performance Wing



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## Col Contact Information

Human Systems Col – STEERING COMMITTEE		
Agency	Position/Organization	Name
AF (Chair)	Chief Scientist, 711 <sup>th</sup> Human Performance Wing (711 HPW), Air Force Research Laboratory (AFRL)	Dr. Gaurav Sharma
Navy	Dept Head, Warfighter Performance, Code 34, ONR	Dr. Patrick Mason
Army	Chief, Humans in Complex Systems (HCxS) Division—Army Research Lab (ARL)	Dr. Jeremy Gaston
Army	Acting Director, Army Research Institute (ARI)	Dr. Scott Shadrick
SOCOM	Director, SOF AT&L Science & Technology	Ms. Lisa Sanders
Army	Chief Scientist, Soldier Performance and Optimization, US Army Combat Capabilities Development Command Soldier Center (CCDCSC)	Dr. Robb Wilcox
OUSDR&E	Director of Emerging Technologies, Human Systems	CDR Wilfred Wells
DIU	Director, Human Systems Portfolio	Dr. Christian Whitchurch
DARPA	Special Assistant to Director for Strategic Engagement	Dr. John Kamp
Human Systems Col – OUSDR&E Support		
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OUSDR&E	Contractor Support (Strategic Analysis)	Dr. Richard Potember
Human Systems Col – Executive Secretariat Members		
AF (chair)	711 HPW, Air Force Research Laboratory	Dr. Jill McQuade
Army	Army Research Institute	Dr. Richard Hoffman
Air Force	711 HPW, Air Force Research Laboratory	Dr. Glenn Gunzelmann
Navy	Office of Naval Research	Dr. Mike LaFiandra
Army	Senior Research Scientist (ST) for Soldier Performance in Socio-Technical Systems	Dr. Jessie Chen
Army	Army Research Lab	Ms. Rachel Weatherless
Army	CCDC Soldier Center	Ms. Karen Gregorczyk
DIU	Human Systems Portfolio	CDR Niels Olson
SOCOM	SOF AT&L Science & Technology	CDR Brennan Cox
Human Systems Col – Contractor Support		
OUSDR&E	Contractor Support (Strategic Analysis)	Ms. Katie Stilling
Air Force	Contractor Support (JYG Innovations Inc)	Mr. Al Livada



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<b>Human Systems Col – SUB-AREA LEADS &amp; MEMBERS</b>		
<b>Personalized Assessment, Education, and Training (PAE&amp;T)</b>		
Army	Army Research Institute (ARI)	Dr. Elizabeth Uhl
Navy	ASN, Manpower and Reserve Affairs (M&RA)	Dr. Kendy Vierling
Army	Army Research Lab	Dr. Benjamin Goldberg
Army	Army Research Lab	Dr. Greg Ruark
Navy	Naval Research Laboratory	Dr. Mark Livingston
ADL	Director, Advanced Distributive Learning Initiative	Dr. Laura Milham
DLNSEO	Defense Language, Nat'l Security Education	Dr. Michael Nugent
Navy	Office of Naval Research (ONR code 34)	Dr. Natalie Steinhauser
Navy	JAIC—Joint Artificial Intelligence Center	LCDR Pete Walker
Navy	Naval Air Warfare Command, Training Systems	Dr. Jim Pharmer
Navy	Naval Air Warfare Command, Training Systems	Dr. Melissa Walwanis
Army	Army Research Lab (ARL)	Dr. Pete Khooshabeh
Army	Combat Capabilities Development Command	Dr. Kimberly Pollard
Navy	Nav Surface Warfare Center Crane	Dr. Siddharth Maini
Army	Army Research Institute (ARI)	Mr. Richard Hoffman
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Navy	NPS	Dr. Aditya Prasad
Army	US Army DEVCOM Soldier Center	Dr. Anne Sinatra
<b>Protection, Sustainment, &amp; Warfighter Performance (PSWP)</b>		
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AF	AFRL, 711 HPW	Dr. Craig Narasaki
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Navy	ONR Code 34	Dr. Sandra Chapman
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Navy	Nav Surface Warfare Center Dahlgren	Dr. Alex Kniffin
Navy	ONR Code 34	Dr. Tim Bentley
Navy	ONR Code 34	Lt Tracy Morgan





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Human Systems Col – SUB-AREA LEADS & MEMBERS		
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Air Force	AFRL, 711 HPW	Mr. Eric Hansen
Air Force	AFRL, 711 HPW	Dr. Chris Brill
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Army	ARO	Dr. Lisa Troyer
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Navy	ONR Global	Dr. Jessica Jones
Navy	Naval Surface Warfare Center	Dr. Alex Kniffin
Navy	COMPACFLT N5	Dr. Dale Russell
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Army	Research & Development Command (RDECOM)	Dr. David Scribner
Army	DEVCOM—Army Research Laboratory	Dr. Jeremy Gaston
Navy	Nav Surface Warfare Center Crane	Dr. Siddharth Maini