NAVAL AIR WARFARE CENTER TRAINING SYSTEMS DIVISION

2020

RESEARCH COMPENDIUM

Training • Human Performance • Modeling & Simulation

NAWCTSD

Research Mission

- Plan and perform a full range of **research and development,** in support of **Naval training systems** for **all warfare areas** and **platforms**
- Continue to expand the **Naval technology base**
- **Transition results** to the **Fleet** and other customers

RESEARCH COMPENDIUM

2020 EDITION

NAVAL AIR WARFARE CENTER TRAINING SYSTEMS DIVISON

The Naval Air Warfare Center Training Systems Division (Photo Credit: Doug Schaub)

Training ● Human Performance ● Modeling & Simulation

Research & Development to Enable Fleet Success

S&T R&D Where the Mission Begins

A Message from Our NAWCTSD Leaders: Science & Technology to Enable Fleet Success

Captain Timothy Hill USN
Commanding Officer

John Meyers
Executive Director

At NAWCTSD, we conduct research to understand and **improve individual, team, and multi-team learning** and performance. We develop education, training methods, and tools to **reduce training time and maximize transfer of knowledge**, utilizing emerging findings in the **"Science of Learning"** to enable Fleet success.

OUR MISSION

To be the principal Navy center for research, development, test and evaluation, acquisition and product support of training systems, to provide Inter-service coordination and training systems support for the Army, Marine Corps and Air Force, and to perform such other functions and tasks as directed by higher authority.

Near-term Fleet Science & Technology focus areas includes: distributed, Live, Virtual and Constructive (LVC) training; adaptive training; human performance modeling; measurement & assessment; virtual reality and augmented reality training technologies; cyberwarfare and electronic maneuver warfare training; and, rapid prototyping of training technologies.

Our research efforts focus on where the mission begins—where the body of knowledge of human performance and training is expanded, where innovations are developed, concepts are established, and prototypes are demonstrated.

We promote experimentation and creativity, and we encourage our people to challenge basic assumptions. We are open to reinventing ourselves based on new knowledge and understanding. To do this, we work to consistently seek Fleet input and feedback on our projects.

Our ultimate goal is that our training solution innovations are transitioned to the Fleet as quickly as possible to improve warfighter readiness. As part of this process, we lean forward to deliver Fleet prototypes for selected projects that show the greatest promise for transition and Fleet impact.

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

Robert Seltzer, Director
Research & Technology Programs Office
Robert.seltzer@navy.mil

NAWCTSD is a key warfare center laboratory for training systems and human performance. The primary goal of our researchers is to explore and develop advanced technologies and methodologies to ensure that the Fleet of tomorrow has the skills, training, and equipment it needs to enable success against current and future threats.

OUR VISION:
To merge behavioral, cognitive and engineering sciences to produce effective training solutions and systems, exploiting technology to improve performance, reduce risk, and reduce cost

OUR STRATEGY:
Partnering with and leveraging work at universities, industry, and other government laboratories, to provide advanced technologies that transition into operational use

Our research focus areas align to our CORE CAPABILITIES:

1. Human Systems Engineering, Integration, and Acquisition
2. Optimized Human Performance and Decision Support
3. Advanced Training Systems Technology
4. Human Systems Analysis, Design, and Evaluation
5. Warfighter Protection, Performance, and Survivability

The Naval Air Warfare Center Training Systems Division (NAWCTSD) is the Navy's source for a full range of innovative products and services that provide complete training solutions. This includes research and development in human performance, learning, advanced technologies through training system acquisition and life cycle support.

NAWCTSD's research mission is to plan and perform a full range of directed Research and Development (R&D) in support of naval training systems for all warfare areas and platforms, to maintain an expanding naval-critical technology base, and to transition research results to the Fleet and other customers.

Melissa Walwanis
Deputy Director
S&T Program Manager
Melissa.walwanis@navy.mil

The Department of the Navy's (DON) Science and Technology (S&T) program, includes Basic and Applied Research (BA1 and BA2), and Advanced Technology Development (ATD) (BA3) that is funded and managed by the Office of Naval Research (ONR). The Naval S&T Strategic plan describes how ONR will enable the future operational concepts of the Navy and Marine Corps.

NAWCTSD's S&T Program primarily focuses on supporting the NAE's Naval Warrior Performance Science and Technology Objectives (STO) that are detailed in the NAE STO document dated April 2014. The NAE STOs directly align to support the Naval S&T focus area called, Naval Warfighter Performance. Other NAE STOs addressed by the S&T project portfolio include: Strike Operations, Undersea Warfare, Information Dominance, and Enterprise and Platform Enablers.

"We revitalize the workforce and enable technical excellence through a focus on research and development."

The Naval Innovative Science and Engineering (NISE) Program was created under Section 219 of the Duncan Hunter National Defense Act for Fiscal Year 2009. It is intended to promote and maintain the scientific vitality of Naval laboratories by funding innovative in-house research in support of military missions, the transition of technology development programs into operational use, and workforce development activities. There are three categories of NISE projects.

The Basic and Applied Research category consists of in-house research projects to explore the fundamental aspects of military relevant phenomena and determine ways in which those phenomena can best be used by the military.

The Workforce Development category of projects is intended more explicitly to build the capability of Naval labs through personnel training and laboratory capability development.

Finally, the **Transition category** provides funding for pre-Milestone A bread board or brass board demonstrations and prototyping efforts to demonstrate critical performance parameters of key technologies.

CDR Wilfred Wells
Military Deputy
NISE Program Manager
Wilfred.wells@navy.mil

Small Business Research Program Manager

The Small Business Innovation Research (SBIR) & Small Business Technology Transition Research (STTR) programs differ only in the fact that small companies perform exploratory R&D in partnership with universities and larger nonprofit research institutions in the latter program and by themselves in the former.

John Hodak
john.hodak@navy.mil

Technology Transfer Program Manager

The NAWCTSD Technology Transfer Program operates under the Federal Technology Transfer Act, related laws, executive orders, directives and guidance. The anticipated benefits of sharing the results of Navy research and development (R&D) with public and private research organizations are: improved national, state and local training and education, new commercial products and additional national employment opportunities, access to federal government subject matter experts and resources, and feedback on R&D products that can be used to improve future government systems.

Lisa Ouakil
lisa.ouakil@navy.mil

Human Research Protection Program Chair

The Human Research Protection Program (HRPP) implements NAWCTSD's policies and procedures to protect human subjects involved in research conducted by, for, or through NAWCTSD. Our Institutional Review Board (IRB) was established in 2000 and has the responsibility to protect the rights and welfare of human subjects at potential risk in research projects. NAWCTSD maintains a DoD-Navy Assurance to conduct research.

Dr. Jim Pharmer
James.pharmer@navy.mil


RESEARCH
PROJECT
SUMMARIES

CORE CAPABILITY 1:
HUMAN SYSTEMS ENGINEERING, INTEGRATION, AND ACQUISITION

The successful acquisition of training and crew system solutions is highly dependent upon the tailored application of Human Factors, Systems Engineering, and Human Systems Integration (HSI) strategies and processes throughout the acquisition life-cycle. The Department of Defense's (DoD) acquisition policy goal is to optimize total system performance while minimizing the cost of ownership through the development and acquisition management by applying HSI elements to acquisition systems.

HSI establishes the technical framework for delivering crew and training system capabilities to the warfighter. It ensures the effective development and delivery of capabilities through the implementation of a balanced approach with respect to cost, schedule, performance, and risk using integrated, disciplined, and consistent systems engineering activities and processes throughout the acquisition life-cycle to guide knowledge-based product development that demonstrates high levels of performance, protection, and sustainment before significant commitments are made.

The following Technology area comprises this Core Capability: Research, Design and Development of Integrated Human System products.

MULTI-INTEGRATED DOMAIN ADMINISTRATIVE SUPPORT SOLUTION (N182-104)

OBJECTIVE

Design and develop a cross-domain solution (CDS) technology that allows a centrally located system administrator to disseminate network configuration information to multiple associated networks.

The Department of Defense effort to enhance and combine its computer networks to improve capability and reliability

PROJECT DURATION

SEP 2018 - JAN 2021

SPONSORS

Naval Air Systems Command (NAVAIR)
Small Business Innovative Research (SBIR)

POINTS OF CONTACT

John Killilea (TPOC)
john.killilea@navy.mil

Javier Spear (Co-TPOC)
javier.spear@navy.mil

John Hodak (PM)
john.hodak@navy.mil

DESCRIPTION

One of the core security features of distinct information networks is that they are separate from other computer networks. This is primarily implemented to ensure that if one is compromised, the other remains unaffected as access to the network is limited and restricted by an administrator. This effort focuses on designing, developing, and demonstrating the feasibility of a proof-of-concept cross-domain administrative solution and network communication between trusted and untrusted networks.

NEED

Although the cyber security benefits of individual networks are clear, there is a desire for a secure CDS to allow a central system administrator to manage multiple networks. Cross-domain solutions provide the ability to transfer information between two domains with different security levels that are isolated from each other. Currently, each network administrator must set up separate instances for their own respective domains, which poses software-related concurrency challenges. The desired solution is envisioned as a standalone solution, or a technology that can be added to an existing cross-domain solution for network communication between trusted and untrusted networks. Key factors of an envisioned solution include the scalability of architecture and the supportability of the device.

BENEFITS

Having the ability to manage all domains with a single cyber security solution (through a specialized guard) would significantly lessen both the initial acquisition and sustainment costs of any procurement that had the requirement for multiple classification levels. or design solution tradeoffs of comparative technologies.

STATUS

NAWCTSD personnel conducted an evaluation of the Phase 1 effort at the end of November in 2018. The cross-code project team determined that the contractor should be awarded the Phase 1 option period, and be invited to submit a full Phase 2 proposal for additional work. During an anticipated Phase 2, the contractor and Navy will work close together to modify and implement CDS solutions deemed feasible from Phase 1 work.

MILESTONES

- Phase I:
  - A single contractor was selected for Phase 1 award
  - Cross-code project team comprising research psychologists and interoperability engineers monitoring was completed via bi-monthly progress reports and periodic status updates
  - A closeout meeting was held in late November of 2018 at NAWCTSD in Orlando
- Phase I option:
  - The contractor is currently working on the Phase 1 option period, with a full phase 2 proposal submitted and under review

NEXT GENERATION TRAINING SYSTEMS DEVELOPMENT FOR MANNED & UNMANNED CONCEPTS

OBJECTIVE

Develop workforce skills in individual & team level training concepts that apply to future concepts for manned-unmanned team training environments including implementation of artificial intelligence, development of trust in automation in training & applications for data science for performance assessment/effectiveness analyses.

The JMR-TD is demonstrating platform and mission systems technologies to help the Army make decisions about FVL capabilities, which could look like this hypothetical rendering. The demonstrator effort is managed jointly by a team led by the U.S. Army Aviation and Missile Research, Development and Engineering Center (AMRDEC). (U.S. Army graphic by AMRDEC VizLab)

PROJECT DURATION

AUG 2018 - SEP 2020

SPONSORS

Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: WFD

POINTS OF CONTACT

James Pharmer, Ph.D. (PI)
james.pharmer@navy.mil

Beth Atkinson (Co-PI)
beth.atkinson@navy.mil

CDR Wilfred Wells (PM)
wilfred.wells@navy.mil

DESCRIPTION

This effort seeks to develop workforce skills in individual & team level training concepts that apply to future concepts for manned-unmanned team training environments including implementation of artificial intelligence, development of trust in automation in training, & applications for data science for performance assessment/ effectiveness analyses. Additionally, the team is refining a methodology to identify the transitional Knowledge, Skills & Abilities (KSAs) that will impact the selection of training technologies for future training solutions.

NEED

As the Navy adopts novel aviation platforms such as Future Vertical Lift, which strives to maximize automation and manned-unmanned teaming solutions, there is a need to address training strategies and technologies required for training. Specifically, expanding on existing instructional strategies, modalities, and training technologies to advance individual and team training will be necessary to address the emerging needs of future concepts for manned-unmanned team training environments.

BENEFITS

Through the early involvement of instructional system designers and research psychologists, this effort seeks to identify capability and technology gaps that can be pursued via science and technology development efforts ahead of platform fielding. Further, the team is defining a methodology for early identification (pre-milestone A) of training requirements for human machine performance issues introduced by increase automation and advanced technologies.

STATUS

Quarterly joint working group meetings were held to discuss Army technology development and concepts to date, and general capabilities under consideration by the Navy for Manned-Unmanned Teaming solutions within the Future Vertical Lift program to serve as a use case. A research and development roadmap that highlights Joint service science and technology efforts for platform development and training solutions is under development.

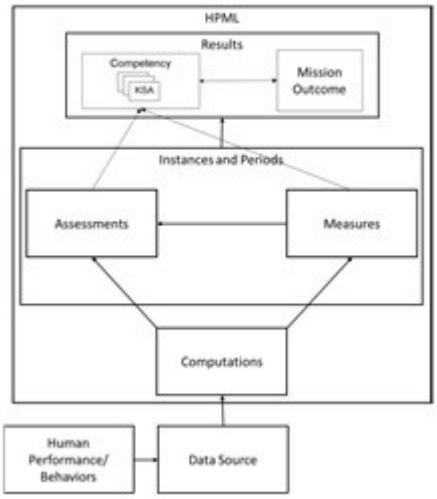
MILESTONES

- Manuscripts/Publications:
  - Anania, Killilea, Atkinson, (2018, November 27). The Application of Automation Systems for Training - Implications of Trust. Interservice/ Industry Training, Simulation, and Education Conference (I/ITSEC) Proceedings.
  - Frick, Anania, (2019, April 18). Early Definition of Training: Enhancing Speed to the Fleet. HFE TAG-Aberdeen Proving Ground, MD.
  - Anania, Killilea, (2019, July 27). Advances in Navy training research and applications: The development of manned-unmanned teaming training. 10th International Conference on Applied Human Factors & Ergonomics.
- Workforce Development: Mentored junior teammates on future Navy platforms, training systems needs analysis, advancing science & technology solutions for training, and method development for initial front end analyses when pre-Milestone A.
- Planned Transitions (FY20): Product transitions to Naval Air Warfare Center / Fleet Readiness Center Strategic S&T roadmap; Initial individual & team training concepts as input to program office training planning & capability development documents (CDDs).
- Collaborative Mechanisms/Agreements: Quarterly working group meetings with joint service representation to discuss manned-unmanned acquisition concepts and training implications; site visit to Navy and Army training and operational research and development labs and fleet units.

SIMULATION STANDARDS FOR INTEROPERABILITY OF HUMAN PERFORMANCE AND DEBRIEF DATA IN TRAINING

OBJECTIVE

This project aims to provide a multi-disciplinary team with a Navy Standards and Human-in-the-loop voice in the process of developing an overall standard that Navy, Joint, coalition partners, and industry will comply with to enable training systems across the spectrum to be interoperable through participation in Simulation Interoperability Standards Organization (SISO).



The Human Performance Markup Language (HPML) standard provides schemas for organizing information relevant to performance including: Computations, Measures, Assessments, Results, and Instances and Periods.

PROJECT DURATION

OCT 2017 - SEP 2019

SPONSORS

Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: WFD

POINTS OF CONTACT

Beth Atkinson (PI)
beth.atkinson@navy.mil

CDR Wilfred Wells (PM)
wilfred.wells@navy.mil

DESCRIPTION

Product Development Groups (PDG) are collaborative opportunities for organizations (e.g., Department of Defense, North Atlantic Treaty Organization, industry, academia) to build consensus among members and refine standards that result in formal adoption by the Simulation Interoperability Standards Organization (SISO). This effort seeks to provide resources for a multi-disciplinary team of engineers and human factors professionals to actively participate in the Human Performance Markup Language (HPML) and Distributed Debrief Control Architecture (DDCA) PDGs.

NEED

Developers are currently challenged with finding ways to implement technology in environments that lack the right type of data. The technology challenge that exists is defining a means for implementing performance measures and an architecture for debriefing that increases their successful integration, and ensuring that Navy requirements are articulated and advocated for, during the industry standards development process.

BENEFITS

Interoperability is essential to supporting training in an integrated, interactive environment. Early participation in standards development ensures that the Navy's requirements are represented and that we maintain awareness of novel developments by other SISO members that may benefit our Science and Technology, Research and Development, and/or acquisition. Further, calls for quantitative data and big data analytics to understand proficiency requires access to the right data. Therefore, it is imperative to ensure that distributed training environments support assessment of performance and provides an architecture that facilitates distributed debriefs.

STATUS

Teammates reviewed the status of current PDG products, and participated in the 2017 Simulation Innovation Workshop held in January 2018, as well as the 2018 Simulation Innovation Workshop held in September 2018. In FY19, the team attended additional meetings and quarterly meetings to inform and vote in the HPML PDG. Currently recruiting additional PDG members to fulfill voting requirements of a final HPML standard.

MILESTONES

- Manuscripts/Publications:
  - Atkinson, Tindall, Killilea, Tolland, & Dean. (2017). Standardizing human performance measurement for ease of data analytics. Proceedings of the I/ITSEC. Paper received honorable mention for 2017 IITSEC Best Paper.
  - Atkinson, Tindall & Entinger (2019). End user autonomy in the generation of automated performance measures. *SISO Simulation Innovation Workshop.*
  - Tindall & Atkinson. (2019). Standardizing performance measurement while ensuring psychometric validity . Proceedings of the I/ITSEC.
- Workforce Development: Mentored junior teammates on simulation interoperability and automated performance measurement.
- Transitions: The proposed HPML is the underlying code base for efforts such as the PMATT-TA Performance Dashboard, providing a use case and testing standard as part of the transition of technologies to PMA-290 and PMA-205.
- Collaborative Mechanisms/Agreements: Coordination across research psychologists and interoperability engineers supports a multi-disciplinary perspective on standards under development. Collaboration amongst industry, government and academia has been achieved through participation in HPML PDG meetings.

CORE CAPABILITY 2:
OPTIMIZED HUMAN PERFORMANCE AND DECISION SUPPORT

Current and future Naval systems are not only dependent on the qualities of the systems and the performance of their operators, but are also highly dependent upon the interaction between the human and the system. Failure to effectively integrate the human and the system invites mission failure. It is routinely reported that 70-80% of all aviation and other mishaps trace back to human error in some fashion.

The overwhelming majority of these errors are related to inaccurate decisions, judgments, and perceptions, attributable to inadequacies in the systems design or decision-support capabilities. The extent to which those same design and/or decision support inadequacies contribute to operational inefficiencies or outright decrements is not as clearly quantified, but is expected to be profound.

Human Performance refers to the range of perceptions, decisions, and actions that an individual or team carries out in the context of performing a task. The underlying detail in each of these actions traces back to the design of systems and the training of operators. Human Performance Assessment (HPA) focuses on the ability to accurately measure and analyze task performance at different levels which include individuals, teams, multi-teams, and organizations. HPA can be conducted across multiple domains and tasks, ranging from simple procedural skills to complex cognitive skills, such as tactical decision-making, and is an integral part of Human Performance Modeling (HPM). Measurement technologies encompass neurocognitive, as well as other physiological measures or indices. Better understanding of such measures in the context of training or operational tasks will serve both to expand this technical area and to enhance warfighter performance and effectiveness.

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While there is already a clear adverse impact resulting from the lack of/flawed human systems design and decision support, there is also a significant concern that this will be rapidly exacerbated due to the overwhelming amount of data being collected and available in a timely fashion. For human decision-makers to be effective in these information-rich environments, "they must be able to access the data necessary to make a decision when, where and in a manner that addresses the need. The data must be integrated and organized so that they become useful information to the user" (Morrison et al., 1998, p. 375). The challenge of integrating the human and system can be parsed into four separate pieces: 1) human factors engineering—which is required for the system to be used effectively by the human operator, 2) HMIs specifically developed to supplement the human's ability to process, infer, and decide in real time actions based on system-provided information, 3) developing the requisite training materials of modes of presentation to optimally use the information to make and implement better, faster decisions, and 4) automation to perform functions without direct human intercession.

The following Technology areas comprise this Core Capability:

- Human-Machine Interfaces
- Human Performance Measurement and Assessment
- Training Methodologies for Distributed Team Competencies
- Advanced Instructional Techniques
- Applied Human Behavior Modeling

ADAPTIVE TRAINING SYSTEM FOR MAINTAINING ATTENTION DURING UNMANNED AERIAL SYSTEMS (UAS) OPERATIONS (N162-090)

OBJECTIVE

The purpose of this effort is to develop an innovative and adaptive training system for Unmanned Aerial Systems (UAS) operators to maintain attentiveness during the long shiftwork associated with extended UAS missions. The initial call (for proposals) was made for cost-effective, computer-based, simulation training solutions that are able to adapt to the 1) learning characteristics of different individuals, 2) affordances inherent in UAS, and 3) specific details involved with different missions.

The MQ-4C Triton unmanned aircraft system prepares to land at Naval Air Station Patuxent River, Md., after completing an approximately 11-hour flight from Northrop Grumman's California facility. (U.S. Navy photo by Kelly Schindler/Released)

PROJECT DURATION

OCT 2016 - SEP 2021

SPONSORS

Naval Air Systems Command (NAVAIR)
Small Business Innovative Research (SBIR)

POINTS OF CONTACT

Laticia Bowens, Ph.D. (TPOC)
laticia.bowens@navy.mil

John Hodak (PM)
john.hodak@navy.mil

DESCRIPTION

As UAS are being used with increasing frequency, it is becoming more critical for UAS operators to maintain attention for long periods of time during lengthy missions. Operators' shifts can sometimes approach 12 hours in length, and shiftwork is associated with higher fatigue levels, degraded task performance, and higher error rates. Still, there are currently no training systems that focus on attention. This research aims to develop tailored adaptive training techniques to minimize the issue of channelized attention.

NEED

Channelized attention occurs when all of an individual's cognitive resources are focused on one aspect of the environment, causing other equally important cues to be missed. Investigations of UAS mishaps have implicated channelized attention as a likely contributor to mishaps with larger (i.e., Group 4 & 5) UAS. Thus, it is critical to provide training for UAS operators on how to maintain attention over extended periods of time.

BENEFITS

Research on attentional training has indicated that it is possible to train attention *and* create effects that transfer to tasks after training. Moreover, attentional training may be more effective if it is adaptive. Adaptive training (AT) is broadly defined as any instruction that is tailored to an individual trainee's strengths and weaknesses, varying the training experience from one individual to another, based on task performance, aptitudes, or test scores. The goal of AT solutions is to provide the effectiveness of one-on-one tutoring through computer-based training that does not require an instructor in the loop. Thus, such training can possibly reduce the likelihood of UAS mishaps via a cost-effective method.

STATUS

In June 2018, two companies completed the Phase II Base period, during which time they refined their systems, developed mission scenarios, further defined system AT elements, and obtained Institutional Review Board (IRB) approval in preparation for experimental investigations of system effectiveness. Both companies were approved to proceed to the Phase II Option period for their systems–one for sensor operators and the other for air vehicle operators. During this period, the companies will develop individual test subject baselines and perform training effectiveness evaluations, in attempts to show the extent to which their systems can improve the attentional skills of UAS operators.

MILESTONES

- Phase I Base period: Four companies (from more than 25) were selected to design, develop, and demonstrate a proof of concept for a computer-based simulation, attentional trainer and adaptive training techniques.
- Two companies were then selected to proceed with the Phase I Option period & and abbreviated Phase II Base period.
- Both companies successfully completed the 2018/19 SBIR/STTR Transition Program (STP) in April 2019.

ADJUSTABLE CREWMEMBERS - ACCELERATING INSTRUCTOR MASTERY (AIM) N152-108

OBJECTIVE

This effort will design, develop, and demonstrate a suite of synthetic crew members, who operate in support of Tactical Coordinator (TACCO) training in the Anti-Submarine Warfare (ASW) domain, capable of dynamically adjusting their performance to better fit the needs of the trainee during part-task training activity.

A member of VP 5 plans radar search tactics onboard a P-8A Poseidon aircraft during a sea search and rescue operation off the coast of Argentina. (U.S. Navy photo by Mass Communications Specialist 2nd Class Sean R. Morton/Released)

PROJECT DURATION

MAR 2018 - APR 2020

SPONSORS

Naval Air Systems Command (NAVAIR)
Small Business Innovative Research (SBIR)

POINTS OF CONTACT

John Killilea (TPOC)
john.killilea@navy.mil

Beth Atkinson (Co-TPOC)
beth.atkinson@navy.mil

John Hodak (PM)
john.hodak@navy.mil

DESCRIPTION

The Adjustable Crew Members effort is focused on further augmenting the baseline Crew Role-Players Enabled by Automated Technology Enhancements (CREATE) technology suite that brings advanced speech recognition and intelligent agent behavioral modeling in to the P-8A part-task training. It will enable synthetic crew members to dynamically adjust their performance to better fit the needs of the trainee and instructor during TACCO-centered part-task training activity.

NEED

The successful transition of autonomous crewmembers technology seeks to solve a long-standing training challenge - how to train a single trainee in a task that requires a crew or group to execute it. Through a software solution for autonomous crewmembers that builds on recent technological advances in speech recognition, this technology capability has the potential to reduce operator workload and facilitate more robust and realistic training of skills such as crew coordination earlier in the training pipeline. The Adjustable Crew Member effort allows instructors to better tailor the intelligent agent's domain awareness and expertise to the individual TACCO trainee.

BENEFITS

Adjustable and customizable intelligent and autonomous crew member agents will allow for more realistic and robust early TACCO training. As much of the TACCO role focuses on being the nexus of information, building communication and coordination skills early during individual training is a key motivator. By leveraging realistic crew member agents, the instructors can focus on driving the scenario and providing timely and appropriate feedback to the trainee, rather than having to role-play the various sensor roles.

STATUS

This effort was selected for Phase 2 award as a FY18 new start. First year tasking focused on modifying three crew member models (acoustic operator, electronic operator, co-TACCO) so that they can adjust their performance and proficiency in response to internal or external stimuli. Current and future tasking will include modifying the agents to support automatic (or cued) performance degradation, as well as designing the instructor interface for these actions to be instantiated. A testbed environment is being developed and data collection will begin in late FY19.

MILESTONES

- Phase II:
  - NAVAIR awarded a Phase II contract to a single vendor based on progress made during an Office of Naval Research SBIR and maritime patrol program interest.
  - The Phase 2 kickoff will bring together P-8A Fleet Projects personnel, Fleet Training personnel, as well as members of the P-8A Innovation Council .
  - Future tasking in FY19 will include modifying the agents to support automatic (or cued) performance degradation, as well as designing the instructor interface for these actions to be instantiated.

AVIATION RECONFIGURABLE COCKPIT FOR HYPOXIA & HAZARD EXPOSURE & RECOGNITION (ARCH2ER) AF090-027

OBJECTIVE

To research, develop, and testing of a reconfigurable and modular cockpits and controls for aviation pilot training that are low-cost but moderate fidelity to support immersive training devices.

Aviation survival training seeks to advance mishap awareness training through interactive, immersive visualization techniques such as moderate fidelity training systems.

PROJECT DURATION

OCT 2018 - SEP 2020

SPONSORS

Naval Air Systems Command (NAVAIR)
Small Business Innovative Research (SBIR)
Naval Undergraduate Flight Training Systems, PMA-273

POINTS OF CONTACT

Beth Atkinson (PI)
beth.atkinson@navy.mil

John Hodak (PM)
john.hodak@navy.mil

DESCRIPTION

This effort seeks to evaluate the feasibility of a reconfigurable training system to provide higher fidelity emergency procedure training in aviation survival training centers, fleet synthetic or Live Virtual Constructive (LVC) training centers (configure to needed platforms for next training exercise), and deployed training sites with limited space and multiple T/M/S in the area.

NEED

As the Navy seeks to identify ways to provide low-cost, high fidelity training options with a family of training systems, novel solutions such as augmented reality are under investigation. One potential way to capitalize on the benefits of this flexible training medium for aviation training is the use of replica cockpits and controls to provide high physical fidelity during training. However, to maximize the benefit, low-cost equipment that is reconfigurable to different type/model/series (T/M/S) platforms would allow for flexibility for training multiple types of aircrews.

BENEFITS

Development of a reconfigurable cockpit training solution provides an opportunity to increase training fidelity at locations where aircrew from multiple platforms are trained while minimizing costs and footprint requirements when compared to platform specific training solutions. Additionally, by advancing the fidelity of hardware cockpits and controls, while seeking to minimize costs, this effort provides initial research into solutions that may increase the feasibility of augmented reality training.

STATUS

A Phase III contract was awarded in September 2018 to focus on the design and development of an initial reconfigurable cockpit, development of an intuitive instructor operator station, and the test and demonstration of resulting prototypes. An early developmental prototype was demonstrated in December 2018. The initial prototype was delivered to the Aviation Survival Training Center Pensacola, FL, for early evaluation and testing in June 2019. Incremental funding was awarded in June 2019 for further development.

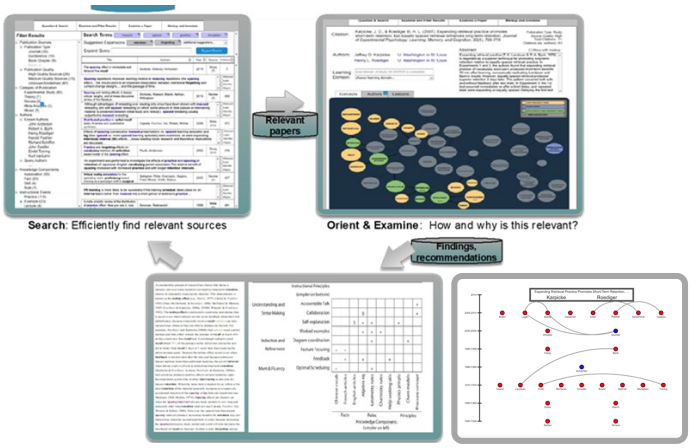
MILESTONES

- Workforce Development: Mentored junior teammates on program management and contract package development
- Presentations: Demonstration exhibit at IITSEC 2018; proposed presentation at the annual SAFE Symposium in October 2019.
- Transitions: Two copies of the initial prototype, which includes F-18, T-45 and F-35 configurations, were delivered to the Pensacola, FL, Aviation Survival Training Center (ASTC) in June 2019. The system is under preliminary evaluation and testing by the instructors and support staff at the ASTC to provide early feedback on the ease of reconfiguration and the reliability of the virtual simulation used to provide aviation specific tasking during mask on hypoxia training.

COMPLEX-KNOWLEDGE VISUALIZATION TOOL (N17A-T004)

OBJECTIVE

The objective of this project is to develop a tool that synthesizes learning and cognitive science literature and provides compelling, data-based information and visualizations to support training system acquisition decisions. For example, the tool would support analysts trying to answer questions such as: "What is the return on investment if a debriefing system is included with the training system?" and "What training system fidelity is needed to facilitate learning and transfer?"



Search results and visualizations facilitating synthesis and understanding of complex learning science literature

PROJECT DURATION

SEP 2018 - SEP 2020

SPONSORS

Naval Aviation Training Systems Program Office, PMA-205
Naval Air Systems Command (NAVAIR) Small Business Innovative Tech Transition Research (STTR)

POINTS OF CONTACT

Jennifer Fowlkes, Ph.D. (PI)
jennifer.fowlkes@navy.mil

Dawn Riddle, Ph.D. (PI)
dawn.riddle@navy.mil

LT Joseph Mercado, Ph.D.
joseph.mercado@navy.mil

CDR Wilfred Wells
wilfred.wells@navy.mil

DESCRIPTION

This Phase 2 STTR effort will result in a cloud based tool leveraging a learning science ontology to support intelligent literature search, analysis, synthesis and reporting of complex information. The tool provides users with:

- guided query formation and expansion supported by learning sciences ontology based visualizations.
- literature results review through intelligent paper markup and annotation.
- synthesis, characterization and visualization of data and relationships across multiple papers.
- acquisition oriented decision support visualizations.

NEED

The work performed for this effort supports the Advanced Instructional Techniques Technology Area.

BENEFITS

The tool will improve training system quality by assisting users in extracting, synthesizing and providing learning and cognitive science based evidence for acquisition related recommendations.

Users - analysts and decision makers - will gain a more comprehensive understanding of issues related to a query - not only theoretical and empirical evidence synthesized to support an 'answer' to the query, but also an understanding of, e.g., gaps in the research, who is performing related research and within which organizations, what trends are exhibited in research over time. Information of this type is especially relevant when dealing with cutting edge technologies.

STATUS

Two performers were selected to complete option tasks and continue to Phase 2. Performers are in year 1 of Phase 2.

MILESTONES

- Functional product demonstration (Minimal Viable Product; MVP) October 2019
- iCloud based user testing, 1st quarter FY20
- Tool delivery end of FY20

USER INTERFACE STRATEGIES FOR HUMAN-MACHINE TEAM TRAINING IN A SIMULATED SWARM TASK

OBJECTIVE

This project will compare the impact of multiple innovative display strategies on human-machine team training within a simulated multi-unmanned system scenario (i.e., swarm). Results will inform ongoing efforts to define user interface requirements for operator control of multiple, unmanned systems, as well as empirical evaluation of state diagrams and task-based interfaces to facilitate human-machine team training for swarm-based tasks.

Drone Swarm Illustration

PROJECT DURATION

OCT 2017 - SEP 2019

SPONSORS

Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: BAR

POINTS OF CONTACT

Mike Guest, Ph.D. (PI)
michael.guest@navy.mil

CDR Wilfred Wells
wilfred.wells@navy.mil

DESCRIPTION

Through a continued collaboration with the Robotics and Intelligent Systems Engineering (RISE) Lab (Lakehurst) and NAWCTSD (Orlando), we will develop a simulated environment (i.e., prototype) whereby one operator will coordinate with multiple unmanned (ground and/or air) systems to execute ISR tasks. In a mixed factorial design, we will compare state-based diagrams and task-based interfaces to a default condition, in terms of human-machine team performance, operator mental workload and situation awareness.

NEED

This proposal aligns with multiple 4.6 Core Capabilities as outlined in the “Core Capabilities and Future Directions: Human Systems Department (AIR-4.6)” document. AIR-4.6 emphasizes “research, design, and development of human systems products.” Specific capability development will be realized through "functional allocation and integration of advanced interaction technologies such as automation, decision aiding and data fusion."

BENEFITS

Autonomous systems are expected to produce extensive benefits to manpower, military capabilities, and mission success in future years, with the Department of Defense placing a high priority on continued research and development of these technologies (DOD Unmanned Systems Roadmap: 2013-2038).

STATUS

This project was started in October 2017. During FY19, we are currently completing final prototype development and pilot testing, and planning for experimental testing and analysis/reporting activities during FY19 Q4.

MILESTONES

- Completed initial prototype development for pilot testing
- Completed detailed experimental plans
- Complete final prototype development by FY19 Q3
- Conduct experiment and analyze/report findings by end of FY19 Q4

VARIABLE ACCOMODATION HEAD-MOUNTED DISPLAY

OBJECTIVE

The primary objective of this program is to overcome the vergence-accommodation conflict and fatigue in head worn displays.

Screenshot of the proposed virtual test environment.

PROJECT DURATION

DEC 2017- DEC 2020

SPONSORS

Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: TT

POINTS OF CONTACT

Benito Graniela (TPOC)
benito.graniela@navy.mil

Bruce Riner (TPOC)
bruce.riner@navy.mil

CDR Wilfred Wells
wilfred.wells@navy.mil

DESCRIPTION

The proposed technology incorporates variable accommodation into the HMD to eliminate the conflicting cues and decrease fusion time of binocular imagery and accuracy. The project will leverage the Variable Collimation Display (VCD) technology developed under the current NAVAIR SBIR topic N121-041 Phase II program. Specifically, the VCD's Variable Adaptive Lens (VAL) technology, control electronics and software will be adapted to fit in a thin, wide field-of view format conformal with the shape of current head worn displays. The VAL will be integrated in a head worn displays in order to stimulate accommodation-vergence response in the user, thus improving an enhanced immersive experience.

NEED

Virtual reality deployable trainers employ head worn displays technology to reduce the trainer footprint and provide a fully immersed training experience. However, accommodation depth cues (i.e., focus) are currently not replicated in current head worn displays. Instead, the eye is forced to focus on a fixed image plane regardless of the object location, resulting in a vergence-accommodation conflict. This limitation hinders the user's ability to accurately judge distances, reduces the user's sense of immersion and can cause or exacerbate virtual reality sickness (eye strain, dizziness, etc.).

BENEFITS

The anticipated benefits and potential commercial applications of the research and development into high-resolution wide-field-of-view head worn displays with variable accommodation include: (i) improvement in users' immersion; (ii) reduction in Virtual Reality (VR) sickness (eye strain, dizziness, etc.); and (iii) improve spatial awareness and more accurate judgement of depth and image distance.

STATUS

The two two-year program is partitioned into four 6-month phases, or "Spirals". Each Spiral results in an iteration of the prototype. These prototypes are delivered for testing. Spiral one and two have been completed. A list of recommendations have been generated and will be included in the spiral 3 headset.

MILESTONES

- Manuscripts/Publications: Batchko, R., Robinson, S., Schmidt, J., & Graniela, B. (2014, March). A variable-collimation display system. In Proc. SPIE (Vol. 9011, p. 901109).
- Presentations: Spiral 2 (Month 6) Design Review 8/21/18
- Spiral 2 HMD delivered March 7, 2019
- Spiral 3 HMD planned delivery Dec 2019
- Spiral 4 HMD planned delivery April 2020

VIRTUAL REALITY FOR TRAINING: EXAMINING THE BENEFITS OF HAPTIC FEEDBACK AND NATURAL GESTURES ON LEARNING

OBJECTIVE

To evaluate virtual reality (VR) technology by systematically examining the effects of providing haptic feedback and supporting natural gestures on learning outcomes and other factors such as feelings of presence, usability, and cognitive load while training in VR.

Example student completing a training exercise in VR.

PROJECT DURATION

OCT 2019 - SEP 2022

SPONSORS

Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: BAR

POINTS OF CONTACT

Cheryl I. Johnson, Ph.D. (PI)
cheryl.i.johnson@navy.mil

CDR Wilfred Wells (PM)
wilfred.wells@navy.mil

DESCRIPTION

There has been a recent flurry of interest by Fleet customers and stakeholders to provide virtual reality (VR)-based training across a variety of platforms and tasks. VR offers the potential to train tasks that may not be feasible to practice in the real world, but care must be taken to consider when and how to incorporate VR technologies within the training pipeline to ensure it is the right solution to achieve training goals. Therefore, the goal of this effort is to conduct research to explore different tasks and different methods of interaction between the trainee and the environment in a VR-based training environment to determine how these variables affect learning and other factors such as feelings of presence, usability, and cognitive load. Specifically, we aim to explore the impacts of more high-fidelity interactions within the environment, such as natural gestures and haptic feedback across different task types.

NEED

VR training solutions have the potential to reduce training cost, increase training impact, and maximize transfer of knowledge from the classroom to the operational environment. Knowing the capabilities and limitations of the technology and when to apply it as a training solution will allow the Navy to build more effective and efficient training. Furthermore, this research will enable the NAE to remain at the front of applied S&T understanding on how best to make use of these technologies to support Fleet readiness.

BENEFITS

This research is critical to provide timely evidence-based recommendations to Fleet customers on the benefits and risks of using VR for training and will culminate in a research testbed with integrated haptic gloves, several published conference proceedings papers, and journal articles to address significant gaps in the science of learning literature.

STATUS

In FY20, the research team will develop a research testbed and design and conduct Experiment 1, which focuses on exploring the impact of natural gestures on learning outcomes in a procedural task. Once the experiment is completed, the research team will analyze results and document them in publications.

MILESTONES

FY20:

- Complete research testbed development, incorporating natural gestures to support trainee's interactions with the virtual environment
- Design Experiment 1 and submit Institutional Review Board (IRB) Protocol
- Conduct Experiment 1 and write up results for publication

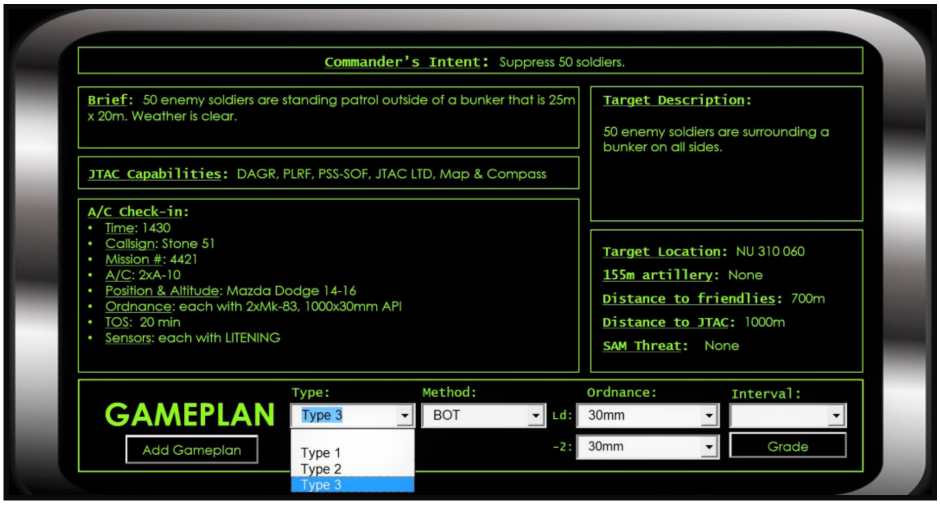
FY21-22:

- Develop testbed to support Experiment 2 incorporating haptic feedback
- Design and conduct Experiment 2
- Document results for publication

ADAPTIVE TRAINING FOR USMC CLOSE AIR SUPPORT TACTICS AND DECISION-MAKING

OBJECTIVE

The goal of this effort is to perform systematic research on the efficacy of adaptive training (AT) for a complex decision-making task centered on the Joint Terminal Attack Controller (JTAC). Specifically, the AT testbed focuses on game plan development, a critical planning task that sets the stage for the execution of a Close Air Support mission and a challenging topic for JTAC trainees to master.



PROJECT DURATION

DEC 2016 - DEC 2019

SPONSORS

Office of Naval Research, ONR-34

POINTS OF CONTACT

Cheryl I. Johnson, Ph.D. (PI)
cheryl.i.johnson@navy.mil

Melissa Walwanis (PM)
melissa.walwanis@navy.mil

DESCRIPTION

Adaptive training (AT) is training that is tailored to an individual's strengths and weaknesses, and it has led to higher learning gains and decreased training time when compared to traditional training approaches in certain domains. However, more systematic research is needed to determine which AT techniques to employ, when to employ them, for what content to inform best practices, and when to invest in AT technologies.

This research will examine the benefits of AT techniques in a scenario-based Close Air Support (CAS) decision-making task (e.g., game plan development) for Joint Terminal Attack Controllers (JTAC). Specifically, the AT prototype adjusts the type of feedback and the difficulty of subsequent scenarios based on trainee performance during training in accordance with science of learning principles.

NEED

USMC Vision and Strategy 2025 and ONR's Science & Technology (S&T) Strategy for Warfighter Performance both highlight the need for tailored training that focuses on the individual learner. Adaptive training is well-suited to meet this demand.

BENEFITS

This research has the potential to optimize classroom training time by allowing students the opportunity to practice key CAS skills on an individual basis, freeing up instructor time to focus on more challenging topics with the class. Additionally, this research will inform the military training community on AT best practices.

STATUS

In FY19, the research team performed an experiment comparing learning outcomes of three training conditions: AT with ATTAC, non-AT with ATTAC, and a traditional training condition. Initial results show that AT with ATTAC led to significantly higher learning gains than the other two conditions, providing further evidence for the benefits of AT to support military training.

MILESTONES

- Developed *Adaptive Training for Terminal Attack Controllers* (ATTAC) prototype. ATTAC:
  - Displays scenarios and assesses performance
  - Contains a scenario difficulty algorithm that adjusts based on performance during training
  - Contains a feedback algorithm that provides feedback tailored to an individual trainee's response
- Created over 80 unique scenarios with input from subject matter experts
- Conducted experiment with 60+ students in a USMC course to evaluate the efficacy of AT to train complex decision-making task
- Conference presentations covering testbed development and experiment results at HCII 2019, HFES 2019, and I/ITSEC 2019

DATA-DRIVEN AFTER-ACTION REVIEW TOOL (DART) FOR STUDENT PILOT PERFORMANCE

OBJECTIVE

Prototype an advanced data-driven instructor support tool for assessing student pilot performance and delivering enhanced After Action Review (AAR) capability with 3D visualizations of flight data, automatic segmentation of the flight profile, and quantitative assessment of human performance parameters.

Two T-45C training jets prepare to perform flyover maneuvers. (U.S. Navy photo by 1st Lt. Andrew Straessle, via Navy.mil Images)

PROJECT DURATION

OCT 2019 - SEP 2021

SPONSORS

Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: TT

POINTS OF CONTACT

Sean Reedy (PI)
Sean.Reedy@navy.mil

CDR Wilfred Wells (PM)
wilfred.wells@navy.mil

DESCRIPTION

The Data-Driven After-Action Review Tool (DART) is an interactive mobile software tool for use in After Action reviews of training flights on the T-45 platform. Our goal is to enhance communication between the instructor and student, while providing quantitative measures of human performance to aid instructors in standardizing their evaluations. The envisioned solution is a software tool that provides visual and quantitative feedback on human performance during training flights.

NEED

After Action Review for T-45 instruction currently consists primarily of verbal communication between instructor pilots and student pilots. Student miscomprehension of error and resistance to correction have been reported by instructor pilots for CNATRA, and multiple re-flies of training flights are costly. Improvement in student comprehension leads naturally to improvement in student performance.

BENEFITS

With interactive visualization, instructors will be able to convey feedback more accurately to students. The quantitative assessment of maneuver performance made by DART will produce a numerical indicator of performance for each maneuver. This numerical indicator will aid instructors in standardizing their evaluation of student pilots. Additionally, a government-owned software solution provides flexibility and agility for future support and expansion to new platforms.

STATUS

Recent achievements in the automated characterization and visualization of aircraft flight data in support of the F/A-18 Physiological Episodes Action Team's investigations provide a baseline for both the visualization software solution and quantitative performance metric. By leveraging solutions already developed for the F/A-18 platform, this product can be rapidly developed and expanded for the T-45.

MILESTONES

- SEP 2020: First iteration of After-Action visualization software delivered to instructor pilots for evaluation period.
- JAN 2021: First iteration of the companion in-cockpit instructor tablet app delivered to instructor pilots or evaluation period.
- JUL 2021: Incorporate advanced segmentation capabilities component and human performance evaluation component
- SEP 2021: Deliver final software package based on feedback from evaluation periods

DATA SCIENCE DRIVEN AIRCREW PERFORMANCE MEASUREMENT AND PROFICIENCY SYSTEM (N181-026)

OBJECTIVE

Develop a software technology to pre-process, fuse, and store data from multiple sources for human performance assessment and proficiency tracking during training, with the capability to parse and synchronize disparate data from live, virtual, and constructive aviation training system sources to output automated performance metrics.

150903-N-SS390-266 FALLON, Nev. (Sept. 3, 2015) F-35C Lightning IIs, attached to the Grim Reapers of Strike Fighter Squadron (VFA) 101, and an F/A-18E/F Super Hornets attached to the Naval Aviation Warfighter Development Center (NAWDC) fly over Naval Air Station Fallon's (NASF) Range Training Complex. VFA 101, based out of Eglin Air Force Base, is conducting an F-35C cross-country visit to NASF. The purpose is to begin integration of F-35C with the Fallon Range Training Complex and work with NAWDC to refine tactics, techniques and procedures (TTP) of F-35C as it integrates into the carrier air wing. (U.S. Navy photo by Lt. Cmdr. Darin Russell/Released)

PROJECT DURATION

JUN 2018 - MAY 2021

SPONSORS

Naval Air Systems Command (NAVAIR)
Small Business Innovative Research (SBIR)

POINTS OF CONTACT

Dan King (TPOC)
daniel.j.king@navy.mil

Beth Atkinson (Co-TPOC)
beth.atkinson@navy.mil

John Hodak (PM)
john.hodak@navy.mil

DESCRIPTION

This effort seeks to design and develop an architecture and process for linking available data sources to tactical aircrew performance in warfighting capabilities based on fleet tactical recommendations and mission essential tasks references, that is flexible to incorporate future tactics and scalable to address individual to multi-team performance. The team will work to determine the feasibility of implementing a software-based solution to process, parse and fuse disparate data sources and types for a single platform, as well as design advanced data science approaches intelligence for automated and human-in-the-loop data output for performance assessment, facilitating feedback, and support longitudinal trend analysis computations.

NEED

The current state-of-the-practice for performance assessment relies heavily on subjective rating, which is hampered by a manually intensive and time-consuming process. A software tool that provides an automated mechanism to pre-process and fuse multiple data sources for human performance assessment and proficiency tracking in warfighting capabilities would alleviate this burden. Specifically, to develop computational methods that can assist with timely and continuous calculation of aircrew performance, proficiency and identify associated trends.

BENEFITS

Better feedback to aircrew will improve performance by identifying training gaps. Increased quantities of data on aircrew performance will enhance future mission capabilities by informing decisions on training resource requirements. This effort seeks to close debrief and reporting gap identified by recent analyses of existing large force exercises. This gap will be present in and increasingly relevant to the effectiveness of forthcoming distributed simulation and LVC training events.

STATUS

This SBIR has undergone competitive source selection resulting in multiple Phase I awards and Phase II selections. The team is continually reviewing progress of on-going efforts to support transition planning and provide technical guidance.

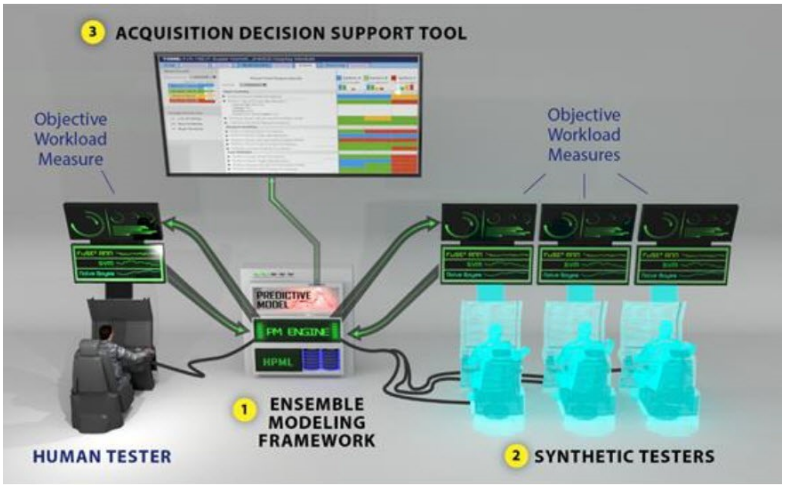
MILESTONES

- Phase I:
  - Kickoff meetings were held with each of the four Phase I contractors
  - Phase I status was monitored via bi-monthly progress reports, periodic status updates, and close out briefs
  - Phase I Option efforts end July 2019
- Phase II:
  - Phase II awards were made in July 2019 to three contractors based on Phase I effort and transition interest by PMA-281, PMA-264, PMA-290, PMA-205, and the Next Generation Threat System.

METHODS FOR ACTIONABLE MEASURES OF ABSOLUTE COGNITIVE WORKLOAD (N16A-T002)

OBJECTIVE

To develop an innovative and cost-effective capability that will provide an objective and measurable means of workload for determining impacts on individual operator, crew-level, and/or multi-team system level performance when life support or aircrew systems are added or modified.



Aptima's Tools for Objective Measurement and Evaluation applied to a notional T&E environment.

PROJECT DURATION

OCT 2014 - JULY 2020

SPONSORS

Naval Air Systems Command (NAVAIR)
Small Business Technology Transition (STTR)

POINTS OF CONTACT

Gabriella Severe-Valsaint (TPOC)
gabriella.severe-valsaint@navy.mil

Beth Atkinson (ATPOC)
beth.atkinson@navy.mil

John Hodak (PM)
john.hodak@navy.mil

DESCRIPTION

In the Naval community, improving affordability is one of the main focus areas. Specifically, standardized workload management systems have been deemed one essential component to gain increased affordability. It is critical to know human performance limitations when introducing complex/cognitive tasks, state-of-the-art technologies/equipment, and new environments to warfighters. Knowledge of these limitations can help researchers and developers understand and evaluate the potentially negative impacts on safety and the efficiency of operations. This effort develops a hybrid approach to objectively assess aircrew workload.

NEED

Current state-of-the-practice is to assess workload, either physical or cognitive, through a variety of assessment methods. The most commonly implemented are subjective measurement techniques; however, there is an increased desire for more objective data on which to base decisions. A variety of objective measurement techniques exist for cognitive workload including performance measures. New, cost-reducing methods are needed to support systems acquisition decisions, and these will need to improve on existing methods.

BENEFITS

This effort seeks to investigate a hybrid approach that would allow for the real-time measurement of physical and cognitive workload using results and modeling capabilities to understand how variations in the associated factors might impact operator safety and performance.

STATUS

In FY19, one of two vendors was award an additional 15 months (Option Period) to mature their prototype. During this time, multiple subjective and objective measures evaluating workload (e.g., NASA TLX, sensors, features, user interface) were upgraded and are being finalized. Workload data will be collected through a suite of tools using cloud capabilities to incorporate within the models. In FY20, the contractors will deploy a repeated measure design to validate the prototype's ability to provide and predict accurate measures of workload. Data collection is currently underway.

MILESTONES

- Phase I: Kickoff meetings were held with each of the Phase I contractors and project status was monitored via bi-monthly progress reports and periodic status updates. Closeout briefs were held with each of the contractors to discuss Phase I progress and Phase II plans. Phase I Options were awarded for two vendors and progress on product concepts were reviewed.
- Phase II: Phase II gated efforts were awarded for two vendors. Kickoff meetings and periodic reviews were held for the prototype toolkits being developed. Status was monitored via quarterly progress reports and monthly status call updates. Contractors submitted for Institutional Review Board (IRB) approval for data collection.
- Phase II Option I: Down selected to one vendor with potential for an additional option period. A kickoff meeting was held to provide plans for validation study. Monthly progress reviews were also held to go over prototype upgrades. Attended an in-person pilot study to explain experimental design, discuss data collection approach, and finalize both subjective and objective measure selections.

TECHNIQUES TO ADJUST COMPUTATIONAL TRENDS INVOLVING CHANGING DATA (TACTIC-D) N17B-T032)

OBJECTIVE

Develop technology based on statistical or computational methods to assist in the continued tracking of training performance and proficiency trends as underlying tactical data changes.

Racks containing Naval Integrated Tactical-Cloud Reference for Operational Superiority (NITROS) capabilities.

PROJECT DURATION

SEP 2017 - SEP 2020

SPONSORS

Naval Air Systems Command (NAVAIR)
Small Business Technology Transition (STTR)

POINTS OF CONTACT

Mitchell Tindall, Ph.D. (TPOC)
mitchell.tindall@navy.mil

John Hodak (PM)
john.hodak@navy.mil

DESCRIPTION

The continued push for integrated warfare will likely result in cross-platform, mission-based trends; however, there may be differences in constructs across platforms (e.g., one platform may rely on timeliness and another on accuracy) that if not accounted for in the analysis or development of common construct definitions would skew analysis results. This effort seeks to identify statistical or computational methods that can assist with these adjustments to statistical trends, and implement them in an automated tool that will allow for the timely and continued calculation of trends related to fleet performance and proficiency.

NEED

The DoD and USN seek to leverage the benefits of qualitative data analytics for tactical proficiency assessment to support decision making. Military domains for big data is unique in that the tactics, techniques and procedures used by the fleet shift over time due to changes in capabilities or the need to adapt, creating a unique challenge for the typical statistical processing to ensure that comparisons remain meaningful.

BENEFITS

Navy leadership has called for technologies that support analytics of big data sets such as avionics and human performance; however, as new systems or technologies are introduced and/or new tactics emerge to maintain superiority, underlying data sources may change. At this time, systems are built to support basic trends and statistical outputs, without accounting for this shift. Given the implications of decision makers relying on outputs to adapt training, modify resources or refine tactical approaches, a solution for understanding the implications or adjusting results based on these types of shifts is required. Advance statistical or novel modeling techniques are sought to address this unique challenge.

STATUS

This STTR has completed Phase I efforts by three vendors. After an extensive review of Phase I work by the three contractors, one was invited to propose a full Phase II. The award of Phase I option efforts has been completed, and Phase II contract was awarded in February FY19.

MILESTONES

- Manuscripts/Publications: Fegley, Carlin, Cheng, Tindall, Killilea, & Atkinson. (2019). Avoiding *Data Overload in an Adaptive Training Use Case.* Modsim.
- Phase I:
  - Kickoff meetings were held with each of the three Phase I contractors
  - Contractors status was monitored via bi-monthly progress reports and periodic status updates
  - Closeout briefs were held with each of the contractors to discuss Phase I progress and Phase II plans
  - Phase I Option was awarded for single vendor
- Phase II:
  - One contractor was invited to submit a Phase II proposal
  - Phase II contract awarded February FY19

TRANSITION OF CREW ROLE-PLAYER ENABLED BY AUTOMATED TECHNOLOGIES TO MARITIME PATROL TRAINING

OBJECTIVE

This effort will conduct the research and development necessary to refine the Crew Role-player Enabled by Automated Technology Enhancements (CREATE) technology to facilitate transition to PMA-205 and PMA-290, focusing on conducting human factors analyses, feasibility of automated performance measures for communication, and performance testing.

Aircrewmen assigned to Patrol Squadron (VP) 8 perform pre-flight procedures aboard a Boeing P-8A Poseidon maritime aircraft in preparation to support search and rescue efforts for the missing Republic of Korea cargo ship crew in the FOURTH Fleet Area of Operations

PROJECT DURATION

OCT 2017 - SEP 2020

SPONSORS

Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: TT

POINTS OF CONTACT

John Killilea (PI)
john.killilea@navy.mil

Gabriella Severe-Valsaint (PI)
gabriella.severe-valsaint@navy.mil

CDR Wilfred Wells (PM)
wilfred.wells@navy.mil

DESCRIPTION

The CREATE technology development has progressed significantly over the last two years, resulting in increased interest in harnessing the technology by platforms. However, work to date has focused on the challenges associated with the integration of speech and behavior modeling technologies. As platforms move forward with implementation of this this technology, greater attention is necessary to refine the instructional interface to ensure an appropriate amount of data is provided to facilitate human-machine trust without placing additional unnecessary workload on operators.

NEED

The successful transition of autonomous crewmembers technology seeks to solve a long-standing training challenge - how to train a single trainee in a task that requires a crew or group to execute it. Through a software solution for autonomous crewmembers that builds on recent technological advances in speech recognition, this technology transition effort has the potential to reduce operator workload and facilitate more robust and realistic training of skills such as crew coordination earlier in the training pipeline.

BENEFITS

SBIR work has focused on the challenges associated with the integration of speech and behavior modeling technologies. As platforms move forward with activities to implement this technology, greater attention is necessary to refine the instructional interface with the appropriate amount of data to facilitate training without placing unnecessary workload on operators. The lack of attention to these factors now, ahead of transitions, will result in schedule and financial impacts to programs to address usability issues identified after fielding. Additionally, increased usability at the on-set will increase fleet buy-in and increase the likelihood of successful fielding.

STATUS

Efforts in FY19 research opportunities for advanced performance assessment through communication capabilities and fleet testing of the component capabilities and integrated system performance. Interface mockups were developed based on user interface and automation transparency principles and submitted for subject matter expert review. Opportunities for automated communication performance measurement were identified and submitted for SME and Fleet review. Integration meetings are planned through FY19.

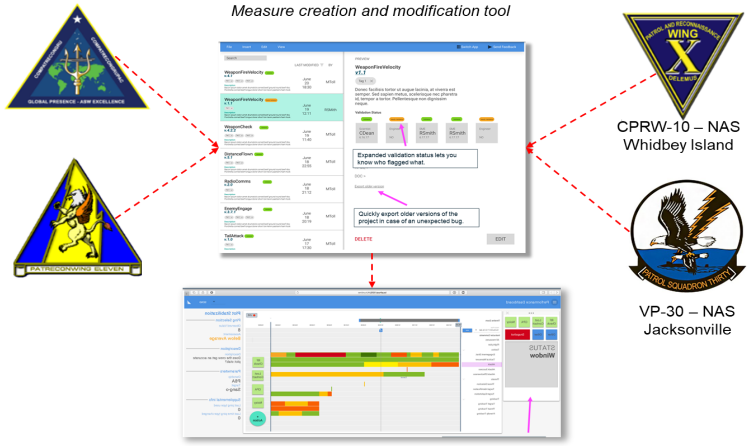
MILESTONES

- Manuscripts/Publications: Anania, E. C., Killilea, J., & Atkinson, B. F. W. (2018). *The application of automation systems for training - Implications of trust*. Proceedings of the Interservice/Industry Training Simulation & Education Conference, Orlando, FL.
- Information Exchanges:
  - CREATE demo and status briefing with Fleet representatives from VP-30 and Phase 3 performers (Soartech, ASEC, NAWCTSD). J. Killilea, (2019, February).
  - P-8 Technical Interchange Meeting at TACTIP in NAS Jacksonville with the MPRA community. J. Killilea, (2019, March).
  - Integration meetings with Boeing and the NAWCTSD IPT begin in August of 2019

TRANSITION OF END USER AUTOMATED PERFORMANCE MEASUREMENT TOOL (N18A-T003)

OBJECTIVE

Provide Fleet customers with an in-house capability for developing, modifying and implementing automated and observer-based performance measures within a broader performance measurement system.



Measure creation and modification tool.

PROJECT DURATION

APR 2019 - DEC 2021

SPONSORS

Maritime Patrol and Reconnaissance Aircraft Program Office, PMA-290

POINTS OF CONTACT

Mitchell Tindall, Ph.D. (TPOC)
mitchell.tindall@navy.mil

Beth Atkinson (Co-TPOC)
beth.atkinson@navy.mil

DESCRIPTION

Current solutions for developing and integrating automated performance measures into training systems require a lengthy contractual process to hard code modifications to existing measures or add new measures. An opportunity exists to empower the warfighter, in conjunction with leadership, to rapidly respond to changes in the environment by modifying existing measures or creating new ones to ensure TTPs and performance standards are current. This effort seeks to place the power of software system modification and development in the hands of the end-user.

NEED

In military contexts, where change is inevitable and rapid, it is crucial to ensure we are training to stay ahead of our adversaries, constantly challenge the status quo, and saving costs. The current effort seeks to address this fact, creating software which will allow end-users (e.g., Commanding Organizations, Wing and Squadron Instructors, Deployed Units) to easily create and implement automated and observer-based performance measures into training immediately, without the need for alternative contracts each time new performance measures are needed.

BENEFITS

Navy leadership has called for technologies that support analytics of big data sets such as avionic or human performance. This efforts seeks to provide a way for end-users to develop, modify, and implement automated and observer-based performance measures within a broader performance measurement system.

STATUS

This effort was first proposed in Q2 FY18. The effort was awarded in Q2 FY19 IRB protocol was submitted and accepted May 28 FY19. Data collection is set to begin July FY19.

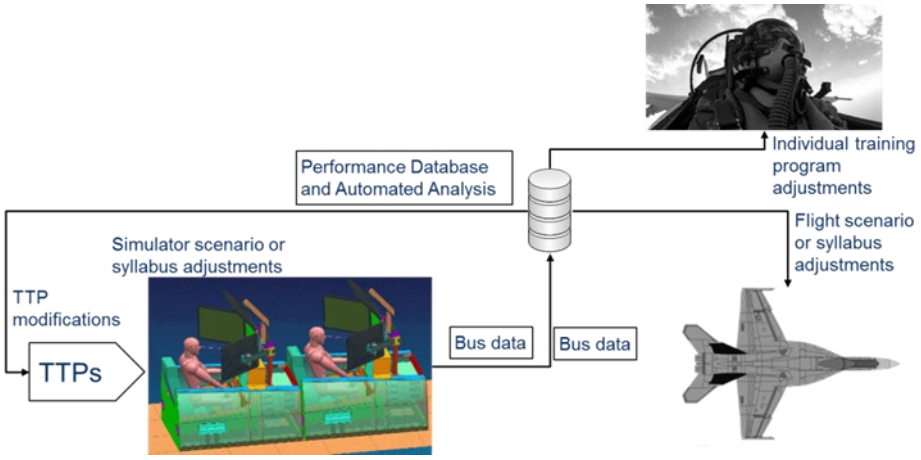
MILESTONES

- Effort awarded to Q2 FY19
- Request for approval and full IRB protocol submitted Q3FY19
- IRB protocol approved Q3FY19

OFFICE OF NAVAL RESEARCH (ONR) TECHNOLOGY CANDIDATE: NOTORIOUS

OBJECTIVE

Develop the underlying architecture for the Naval Air Warfare Development Center's Integrated Training Facility's (ITF) data collection/debriefing toolset.



Developing LVC multiteam performance measures

PROJECT DURATION

DEC 2017 - OCT 2019

SPONSORS

Office of Naval Research, ONR-34
Naval Aviation Training Systems Program Office, PMA-205

POINTS OF CONTACT

Jennifer Pagan (PI)
jennifer.pagan1@navy.mil

Heather Priest, Ph.D. (PI)
heather.priest@navy.mil

Melissa Walwanis (PM)
melissa.walwanis@navy.mil

DESCRIPTION

The science and technology of this Technology Candidate will focus on developing an assessment architecture that will automatically and adaptively collect, fuse, display, analyze, and archive training data (Live, Virtual, Constructive) from disparate systems. Competency-based, automated objective performance measures will be developed at the individual, unit, and carrier strike group level. These measures will be used for debrief and trend analysis to support decision making (currency, proficiency, acquisitions). Additionally, these measures will be enable comparison between live, virtual, and constructive (compare differential impact of simulation and live training opportunities). These data will be stored in a centralized system that will enable rapid development of post-mission and readiness reports.

NEED

Performance assessment of Carrier Airwings (CVW) during integrated training relies solely on qualitative instructor assessments presenting resource challenges with manpower, training time for instructors, standardization of metrics and feedback, and overall accuracy of recorded data. This practice requires instructors to pull data from multiple, disparate, often stove-piped systems and manually synthesize these data to conduct debrief and provide assessments which is time intensive.

BENEFITS

This capability will provide instructors with relevant data that is automatically fused to allow for increased for a reduction in manpower and time requirements for instructors. This will also reduce instructor workload focused on assessment and allow for increased quality of instruction and ultimately greater warfighter proficiency and readiness. Finally, this tool will allow for comparison between simulator and flight performance, assess the effect of simulator rehearsal on live flight proficiency, and enable development Concept of Operations and refinement of Tactics, Techniques, and Procedures (TTPs).

STATUS

This effort kicked off in FY18 and is currently in the process of identifying existing measures, gaps for further development, and baselining automation based on current manual practices.

MILESTONES

- Conducted observations during Strike Fighter Advanced Readiness Program training event
- Selected as full Future Naval Capability program with FY20 start
- Awarded Indefinite Delivery/Indefinite Quantity (IDIQ) contract to John Hopkins University Applied Physics Laboratory
- Awarded Phase 2.5 Small Business Innovative Research (SBIR) contract to BGI under topic N112-111
- Awarded Phase 2 SBIR contract to Soar Technology under topic OSD11-CR1
- Awarded Broad Area Announcement contract to BGI
- Completed individual platform measure data collections with F/A-18, E-2D, and Aegis communities
- Completed integrated platform measure data collection with F/A-18, E-2D, and Aegis communities

INTEGRATED CEC & OWNSHIP FOR NGTS—MISSION CAPABILITIES (ICON—MC)

OBJECTIVE

This effort seeks to improve CEC data link and AIM9X model fidelity and conduct effectiveness studies to better understand the impact these fidelity improvements have on training.

PROJECT DURATION

OCT 2019 - SEP 2022

SPONSORS

Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: TT

POINTS OF CONTACT

Jennifer Pagan (PI/TPOC)
jennifer.pagan1@navy.mil

Alyssa Mercado
Alyssa.mercado@navy.mil

CDR Will Wells (PM)
wilfred.wells@navy.mil

DESCRIPTION

This effort will conduct analyses to understand data messaging formats, parametric data, and other requirements to support the development of CEC and ownship weapons models as well as determining which measures are appropriate for assessing fidelity improvements. Iterative verification and validation test events with subject matter experts will be conducted to test the newly developed models and measures to ensure representative fidelity and capabilities exist and a training effectiveness evaluation will be conducted to determine the impact of the fidelity improvements on training.

NEED

To conduct experimentation and testing of Science and Technology (S&T) instructional training capabilities for complex Air Warfare missions and tactics, the simulation environment and ownship models in simulators must possess the appropriate fidelity and representative capabilities of the operational environment. Without these models complex integrated missions and tactics like Naval Integrated Fire Control - Counter Air tactic kill chains cannot be fully trained (i.e., From the Sea), modeled, nor relevant S&T products accurately tested.

BENEFITS

By developing/improving these models, the NAWCs (AD/TSD) will continue to advance the state-of-the-art in modeling, simulation, and training technologies for complex Air Warfare missions/tactics by providing a more robust simulation environment that more accurately represents the operational environment.

STATUS

This is an FY20 approved new start.

MILESTONES

- **FY20:** Conduct analysis to understand data messaging formats, parametric data, and other requirements to support development of CEC and ownship weapons model. Determine measures/testing criteria for assessing fidelity improvements.
- **FY21:** Develop models and measures based on year 1 requirements and conduct iterative verification and validation test events with subject matter experts to ensure representative fidelity and capabilities exist.
- **FY22:** Conduct training effectiveness evaluation to determine fidelity improvements impact on training. Analyze data and report findings.

INVESTIGATING CROSS-DOMAIN ADAPTIVE TRAINING

OBJECTIVE

The goal of this effort is to perform research on the generalizability of adaptive training (AT) techniques for self-paced, rapid knowledge acquisition tasks across different domains. Specifically, we are planning to conduct a series of experiments using a flashcard-like interface to determine if AT algorithms that are effective in one domain extend to other domains.

Example of feedback after a learning trial in the experimental testbed.

PROJECT DURATION

DEC 2018 - DEC 2021

SPONSORS

Office of Naval Research, ONR-31

POINTS OF CONTACT

Cheryl I. Johnson, Ph.D. (PI)
cheryl.i.johnson@navy.mil

Melissa Walwanis (PM)
melissa.walwanis@navy.mil

DESCRIPTION

Adaptive training (AT) is training that is tailored to an individual's strengths and weaknesses, and it has led to higher learning gains and decreased training time when compared to traditional training approaches in certain domains. However, developing effective AT systems can be time-intensive and costly, and they are typically developed as one-off systems to address a specific training need.

The goal of this research effort is to determine the most effective and efficient instructional strategies for rote learning tasks and explore the generalizability of a common set of AT algorithms across different training domains.

NEED

The U.S. Navy and Marine Corps are focused on modernizing training for the information age by providing learner-centered training available at the point of need. In addition, they seek to reduce bottlenecks in schoolhouse training and find training opportunities for students awaiting training. AT is well-suited to meet this demand.

BENEFITS

This research has the potential to optimize classroom training time by allowing students the opportunity to practice skills on an individual basis, freeing up instructor time to focus on more challenging topics with the class. Additionally, this research will inform the military training community with evidence-based research on the effectiveness of domain-general AT techniques across different domains.

STATUS

In FY19, the research team designed a series of experiments to explore adaptive spacing and card dropping criteria. Visual identification of armored vehicles is the first domain of study. Additionally, the team developed a flexible testbed to determine the effectiveness of AT algorithms across different task types as we continue experimentation. The testbed allows the research team to quickly implement new features, algorithms, and training content. Experimentation is planned for FY20-21 to explore the most effective and efficient AT algorithms across three separate domains.

MILESTONES

- Developed *Investigating Cross-Domain Adaptive Training* (ICDAT). ICDAT is a flashcard-like AT testbed where investigators can manipulate AT algorithms to identify the most effective and efficient techniques to produce learning gains across multiple domains. Trainees are presented with learning trials that are adaptively spaced based on their performance during the last presentation of that trial. Software algorithms assess students' responses and use their reaction times to determine when that card will re-appear.
- A series of experiments has been planned to test adaptive spacing algorithms across different domains for rote learning tasks. Suitable content for a second and third domain is being explored for follow-up experiments.
- IRB approval by NAWCTSD in FY19.

INVESTIGATION OF TRAINING FIDELITY FOR CARRIER QUALIFICATION AND PRECISION LANDING MODES

OBJECTIVE

This effort will research the level of flight simulation fidelity required for the carrier landing training using Precision Landing Mode (PLM) flight control laws. Deliverables include 1) data analytics reports that identify training gaps and performance issues for both pilots and LSOs, 2) simulated and live data that will be leveraged for the LSO virtual reality (VR) trainer and computational pilot models, and 3) empirical reports documenting solutions for training gaps and performance issues.

Landing Signal Officers (LSOs)

PROJECT DURATION

OCT 2017 - SEP 2020

SPONSORS

Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: BAR

POINTS OF CONTACT

Heather Priest, Ph.D. (PI)
heather.priest@navy.mil

CDR Wilfred Wells
wilfred.wells@navy.mil

DESCRIPTION

Precision Landing Mode (PLM) refers to a set of control laws that adds additional landing modes designed to improve pilot landing and recovery capabilities. These control laws decrease workload for pilots and improve aspects of recovery and landing performance (e.g., centralized landing patterns). However, the reaction of the aircraft to inputs from the pilot is different and the techniques of Landing Signal Officers (LSOs) waving pilots land at the ship may need to change. This will necessitate adjustments to pilot skills sets, disrupting long automated muscle memory and decision making for expert pilots and introduce more complex learning for novice pilots due to additional modes.

NEED

Originally planned for initial roll out early in FY18, integration started over a year early (Q4FY16) and is estimated to be fully integrated by the end of FY17. This early delivery of the PLM upgrade technology may result in pilots being undertrained as they struggle with either learning techniques for multiple modes or unlearning long held habits and muscle memory reactions under quick timelines and dangerous conditions (experts). This can present its own set of challenges such as negative impacts on muscle memory maintenance and mode confusion.

BENEFITS

First, the relationship between simulation fidelity and transfer/ learning area is generating significant attention in the Navy as we shift toward less live flight training and more simulation-based training, to save cost and increase safety. Thus, a need exists within the Navy to empirically evaluate theories of training transfer and fidelity in the environment when new technology is introduced and Fleet requirements change. Furthermore, this effort will provide a significant contribution to the scientific community in that it will provide an understanding of the relationship between fidelity and learning in highly complex, dynamic military environments.

STATUS

FY20 will look at T45 data and training pipeline for CNATRA with regards to CQ for CNATRA level undergrad pilots.

MILESTONES

- Planning and development of experimental protocol and timeline.
- Conducted data collection with Fleet representatives from VFA-106.
- Analyzed fleet data.
- Presented data analysis results to LSO OAG.
- Coordinated with Fleet LSOs to obtain more data and identify risk areas for analysis.
- Coordinated with SHARP representatives to identify transition path for analysis.
- Update low and high fidelity simulators.

NAVAL INTEGRATED FIRE CONTROL – COUNTER AIR (NIFC-CA X)
N09-T007 / N2-5722

OBJECTIVE

This effort fills a critical training gap in the NIFC-CA community by leveraging existing investments from the Live, Virtual, and Constructive (LVC) Training Fidelity Enabling Capability. Specifically, ONR funded an AIR 4.6.5-led effort coordinated with 5.4 focusing on the development of a mission visualization capability that can be used to train cross-platform coordination associated with NIFC-CA employment utilizing the core LVC technologies.

PROJECT DURATION

MAR 2014 - APR 2019

SPONSORS

Naval Air Systems Command (NAVAIR)
Small Business Innovation Research (SBIR)
Small Business Technology Transition (STTR)

POINTS OF CONTACT

Jennifer Pagan (PI/TPOC)
jennifer.pagan1@navy.mil

Melissa Walwanis (PM)
melissa.walwanis@navy.mil

DESCRIPTION

Initial proof-of-concept capability developed in FY14 was a collaboration between NAWCAD/TSD and government contractors. Phase 1 delivered a classroom-based tool utilizing a streamlined version of the NGTS's Battle Monitor to provide a "gods-eye view" map of a scripted NIFC-CA scenario. This enabled trainees to make decisions regarding how to counter a small number of threats, provided after action review and feedback. Phase II and II.5 have expanded content and feedback for Tactical Training Group Atlantic/Pacific (TTGL/P), and E-2D Fleet Readiness Squadron (FRS).

NEED

As integrated warfare capabilities like NIFC-CA become increasingly important to Navy's Carrier Strike Groups, the requirement for Virtual and Constructive training environments becomes increasingly necessary in order to provide true systems-of-systems and multi-team training. Currently, the integrated commands are significantly limited in the training they can provide and most of that is only done live based on LVC limitations training.

BENEFITS

This capability provides the Fleet with a mission visualization tool for classroom based training allowing for visualization during the scenario, collaborative decision making, and feedback on performance to enable readiness and cross platform coordination. Additionally, the high fidelity, physics-based models developed for NIFC-CA X are resident in the NGTS and therefore can also support simulation-based training for NIFC-CA.

STATUS

The tool has been enhanced under funding from the Small Business Innovative Research program to support a more flexible architecture including: the ability to manipulate the blue force laydown, scale threats to meet training objectives, and flexible performance assessment architecture. These capabilities were delivered to the E-2D Fleet Replacement Squadron (FRS) to support training their Air Defense syllabus. Additionally, the updated tool was delivered to Tactical Training Group Atlantic (TTGL) and deployed during the USS Eisenhower's Warfare Commanders Conference in August.

MILESTONES

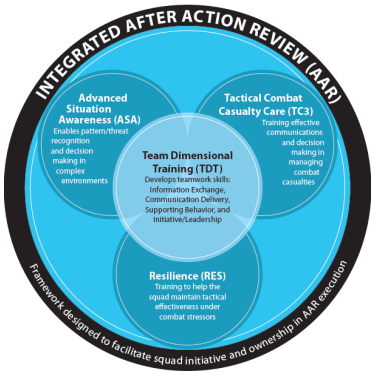
- Receipt of the 16th Annual Naval Air Warfare Center Aircraft Division Commander's Award
- Phase 2 capability delivered and demonstrated to Tactical Training Group Pacific (JUL 2017)
- Harry S. Truman (HST) Strike Group utilized NIFC-CA X during AD Syndicate (JUL 2017)
- Delivered to 4 systems to HST Strike Group (APR 2018)
- Delivered final Phase III capability to E-2D FRS for use in Air Defense syllabus (APR 2019)
- Delivered final Phase III capability to TTGL and deployed during USS Eisenhower's Warfare
- Commander's Conference (AUG 2019)

TEAM OVERMATCH (TOVM): ENHANCED RESILIENCE TRAINING FOR TEAMS

OBJECTIVES

1) Accelerate the development of high performing teams by integrating team decision making skills with tactical training, 2) Develop readiness, psychological resilience, and casualty care decisions through integrated and structured After Action Reviews (AARs), and 3) Provide teams with TOvM Wizard adaptability tools to develop their own Overmatch training support package resources.

Building on Existing Warrior Skills Training



TOvM:
Training to help squad members maintain tactical effectiveness through increasing situation awareness, developing and improving teamwork behaviors, communication, and improving decision making under battlefield stressors.

PROJECT DURATION
DEC 2018 - SEP 2020

SPONSORS
Defense Health Agency (DHA)

POINT OF CONTACT
Laura Milham, Ph.D. (PI)
laura.milham@navy.mil

DESCRIPTION

Our Soldiers face unimaginable stress on the battlefield - sleep deprivation, physical exhaustion, lack of food, and the ever-present threat of the enemy. TOvM developed team resilience strategies that focus on the recognition of self/buddy cues that illustrate Acute Stress Reactions (ASRs) and teach 'tactical resilience care' behaviors to provide on-the-spot stress injury care. This was integrated into the TOvM Training Support Package (TSP) that provides comprehensive planning and execution support for conducting a Platoon-level exercise with integrated cognitive strategies, practice scenarios, and curriculum.

The TOvM TSP is currently under development to be a tailorable, web-accessible database to search and generate a TSP with fully integrated tactical training objectives and TOvM learning objectives for similar and novel domains.

NEED

There is a need to contextualize resilience training within tactical training for self and buddy care. Further, there is a need to contextualize decision making under stress training within tactical training.

BENEFITS

TOvM is the first U.S. demonstration of a training program designed to address ASRs during high-risk operations.

This training may mitigate the risk associated with having a team member functionally impaired during combat operations by applying first aid strategies for stress injuries that can be conducted during a tactical mission.

TOVM is a guided methodology to enable new users in critical response, life threatening, high stress occupations/environments to self-adapt the curriculum to support their unique missions.

STATUS

Developing Overmatch Planning and Scenario Design Capability; application to law enforcement (NSA Orlando, CENSECFOR and FLETC); TOvM Resilience Training Effectiveness Evaluation (RTER) Study; Integration of Enhanced Resilience into TC3 Sim; Integration of Overmatch Planning and Scenario Design Capability into TC3 technologies

MILESTONES

- Deployed ToVM: USARCENT: 3rd/1st Armor Brigade Combat Team, Camp Buehring, Kuwait (Dec 17), 2) USARPAC: 25th Infantry Division, Camp Casey, Korea (Jun18), 3) IIMEF: 2MARDIV, Camp Lejeune, NC (Apr 17), 4) USARPAC: 25th Infantry Division, Schofield Barracks, HI (Aug 18).
- Developed individual and team resilience instructional strategies and tools that ensure resilience skills will be applied in real life via iCOVER – training products (curriculum, learning objectives, performance assessment, and integrated AARs) designed to teach service members how to recognize and respond to ASRs using a simple, 6-step procedure. (May 2018; June 2019)
- Developed a TC3 manikin operation class (December 2018)
- Developed a Team Resilience Virtual Application Practice that provides immersive scenarios that allow interactive training on recognition of ASR, procedural knowledge, and execution practice (April 2018)

ACCELERATING THE DEVELOPMENT OF SMALL-UNIT DECISION-MAKING (ADSUDM)

OBJECTIVE

The purpose of this effort is to enhance USMC simulation-based Small-Unit Decision Making (SUDM) training through multiple integrated software components: 1) Decision Making-Learning Management System (DM-LMS) for tracking trainee performance over time and providing After Action Review, 2) Digital Integrated Representation of Tactical Environment (DIRTE) tools for simulation terrain database generation, and 3) Simulation Tailored Training and Assessment (ST2A) that provides adaptive training for computer-based decision-making training.

Left: Spartan After Action Review (SPAAR) tool (part of DM-LMS).
Right: The Adaptive Perceptual Cognitive Training System (APACTS) (ST2A)

PROJECT DURATION

JUL 2016 - JUN 2019

SPONSORS

Office of Naval Research, ONR-34

POINTS OF CONTACT

Natalie Steinhauser (PI)
natalie.steinhauser@navy.mil

Melissa Walwanis (PM)
melissa.walwanis@navy.mil

DESCRIPTION

ADSUDM features 3 interoperable software components that collectively form the overall Decision-Making (DM) training capability. Central to the architecture is a relational database that provides a persistent store of Marine performance data that can be accessed and annotated to support streamlined After Action Review (AAR), personalized curriculum delivery, and performance analytics data for unit leaders. ADSUDM also includes an adaptive trainer that monitors student performance and provides embedded tutoring and scenario adaptation focused on terrain reasoning skills. Lastly, ADSUDM integrates software tools for instructors to rapidly generate relevant real-world terrains to support DM training.

NEED

1) Expeditionary Force 21
2) 37th Commandant of the Marine Corps FRAGO 01/2016 and the USMC 36th Commandant's Planning Guidance 2015
3) SITE Initial Capabilities Document (ICD) (Gap 8 & 11) [NOTE: SITE is now ITRS]
4) FNC Gap 15-44: Training Time and Cost Reduction Technologies (e.g., ICD, CDD, etc.)
5) FNC Gap 16-46: Small Unit Decision Making Training Technologies
6) FNC Gap 16-45: Optimized Mixed Training Environments for Operations
7) DVTE CDD - system deficiency identified: After Action Review
8) USMC Force Development Strategic Plan 2015.

BENEFITS

The ADSUDM effort will improve small unit performance and DM skills, save the Marine Corps both time and cost to train, provide additional reps and sets for decision-making training, decrease the time required to develop squad leaders, and provide AAR capabilities after training event completion for both live and virtual training events.

STATUS

Demonstrations of the ADSUDM technologies have been given at various events and to many stakeholders, including: School of Infantry (SOI)-East, 2nd Battalions/6th Marines, Infantry Officer Course, Program Manager Training Systems (PM TRASYS), Training and Education Command (TECOM), and the Assistant Commandant of the Marine Corps. In 2017, Tactical Decision Kits (TDKs) with ADSUDM software were deployed by the USMC Rapid Capabilities Office (RCO) to all 24 USMC Infantry battalions. Based on feedback from the TDK deployment (and mini-systems provided to schoolhouses), TDK 2.0 was released in Feb 2019 and a final version (TDK 2.2) was released in April 2019. ADSUDM ended in June of 2019 and the software was delivered on Milgaming.army.mil and to PM TRASYS for transition.

MILESTONES

- Yearly update to the Technology Transition Agreements (TTA) for ST2A, DIRTE, and DM-LMS
- Demonstrations: IITSEC 2017 & 2018, Modern Day Marine 2017 & 2018, Naval Future Force S&T Expo 2017, and to various USMC battalions, school houses, the Assistant Commandant of the Marine Corps, and to various other stakeholders including TECOM and PM TRASYS.
- Transition: The Rapid Capabilities Office (RCO) of the USMC transitioned initial versions of the ADSUDM software and hardware to the Tactical Decision Kits (TDKs) that were delivered to all battalions in the Marine Corps (24) in 2017.
- Data Collection and testing events with Marine Corps battalion: Spartan Tactical Games I, II, III, and IV.
- The final version of the TDK software (TDK 2.2) was delivered to milgaming.army.mil and to the Marine Corps in 2019 for transition.
- Training videos and user guides were developed for the TDK components and uploaded to milgaming.army.mil

DISTRIBUTED VIRTUAL REALITY TESTBED

OBJECTIVE

The objective of this effort is to develop a distributed, multi-user virtual reality (VR) test bed. The test bed will enable virtual cooperative team training in which two or more students, who are in the same or different geographical locations, to execute team training tasks together in a virtual world.

LCDR Ryan Kramer explores a simulated Virginia class submarine in the VR prototype for the Virtual Interactive Shipboard Instructional Tour® (VISIT®)

PROJECT DURATION

OCT 2017 - SEP 2019

SPONSORS

Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: WFD

POINTS OF CONTACT

Didier Lessage (PI)
didier.lessage@navy.mil

CDR Will Wells (PM)
wilfred.wells@navy.mil

DESCRIPTION

Our technical approach is to leverage our existing single participant VR assets (e.g., HTC VIVE, Oculus Rift, 3D models, Unity scripts) and our technical experience to develop a framework for rapid, distributed, multi-user VR training prototype development. Our approach will also provide a cross-platform (e.g., Linux, Windows, macOS) distributed VR environment that will act as a template for future VR research, experimentation, and prototype development.

NEED

In many existing team training and collaborative environments, each individual is physically collocated (e.g., pilot/copilot, navigation bridge crew, maintenance team) in order to utilize physical equipment (e.g., cockpits, navigation equipment, gear being maintained). By placing virtual instances of the equipment in a shared virtual environment, it becomes possible for team collaboration without requiring geographic collocation.

BENEFITS

The proposed effort has multiple benefits for NAWCTSD. To perform this task, the workforce must learn the best methods for networking multiple VR devices together seamlessly. The team members must also gain experience using realistic avatars so that each participant can effectively interact with the other participants in the virtual world to accomplish team training tasks. These improved skills will result in a more capable workforce that will be better prepared to employ emerging VR technologies solve future training problems. The software libraries and packages developed as part of this effort can be reused and will allow the lab to leverage the experience to solve other problems in the domain of team tasks in networked VR.

STATUS

Incorporated COTS networking asset (Photon Networking) to enable the creation of multiplayer rooms and lobbies in virtual reality.

Incorporate E28-Arresting Gear trainer models to build a virtual environment for users to interact with.

Identified and began implementation of task within the E28-Arresting Gear trainer for users to follow in the virtual environment.

Ongoing documentation of design decisions and lessons learned with networking and virtual reality.

Ongoing testing conducted throughout development.

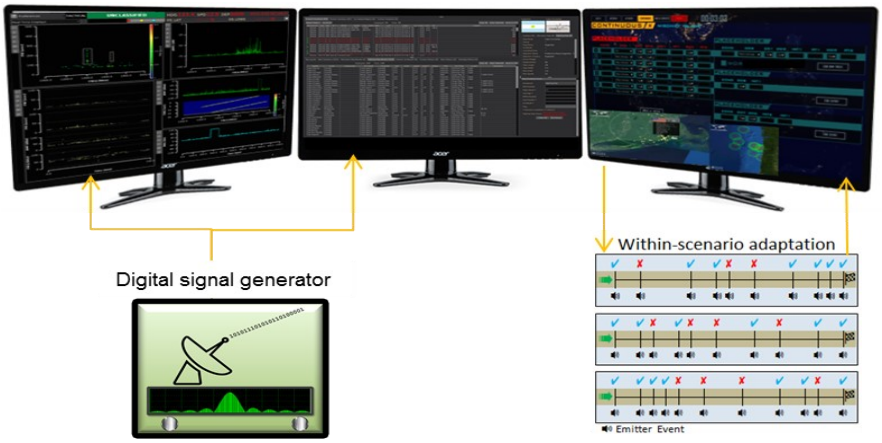
MILESTONES

- Finalize implementation of identified E28-Arresting Gear task
- Complete documentation of design decisions and lessons learned

ELECTRONIC WARFARE—MICRO ADAPTIVE TRAINING (EW-MAT)

OBJECTIVE

The main objectives of this Future Naval Capability (FNC) are to (1) create validated micro-adaptive training algorithms to diagnose the strengths and weakness of operators in real time as they perform actions using the on-board tactical system, (2) develop a digital signal generator that will inject realistic signals in an on-board trainer, (3) evolve the state-of-the-art in EW hardware and software to create a common EW framework for air, sea, and undersea platforms.



PROJECT DURATION

SEP 2017 - DEC 2022

SPONSORS

Office of Naval Research, ONR-31

POINTS OF CONTACT

Marc Prince (PI)
marcandre.prince@navy.mil

Wendi Van Buskirk, Ph. D. (PI)
wendi.vanbuskirk@navy.mil

Melissa Walwanis
melissa.walwanis@navy.mil

DESCRIPTION

The research team will develop a training architecture within ONR's Rough Squid EW Sandbox that allows operators to perform actions using the on-board tactical system hardware/software. The architecture will support a digital signal simulator to inject realistic and robust signals representative of advanced EW sensors along with micro-adaptive training algorithms to diagnose the strengths and weaknesses of operators in real time during training.

NEED

Submarine EW operators provide critical, time-sensitive information for maintaining ship safety and avoiding counter-detection. Yet there is no current capability for embedded, on-board adaptive training for Electronic Warfare (EW) operators. As described by the Submarine Force Electronic Warfare Wholeness Campaign, training is needed which can "rapidly improve experience level of current EW operators." Furthermore, the Submarine Tactical Requirements Group (STRG) recently has recommended Adaptive Training (AT) to fulfill critical training gaps (requirement STRG-TRG-.0(1)).

BENEFITS

Research has demonstrated that AT systems lead to improved performance while requiring less training time. These outcomes provide the potential to enhance training for submariners by improving the Navy's ability to provide tailored, individualized instruction to operators, and therefore enhancing readiness, without increasing the Submarine Force's overall training costs, time, or number of instructors. Additionally, investing in a cross-platform training solutions (e.g., the digital signal generator), will lead to more highly trained operators in the Fleet capable of managing increasingly complex RF environments. Thus allowing the Navy to maintain its maritime superiority and decisive edge.

STATUS

This is a new start FNC. The first major development thrust involves expanding upon the adaptive training service modules, scenarios, network interfaces, and user interfaces that were developed in the Submarine EW Adaptive Trainer (SEW-AT) effort and incorporating them natively into Ghost Rider Analyst Spectrum Publisher (GRASP). Additionally, we will tackle several S&T challenges including the appropriate design of adaptive training (in terms of instructional content and adaptive scheduling) and its performance impact/training value.

MILESTONES

- Demonstrated SEW-AT v2.0 to the Submarine Force Training Committee (SFTC) Executive Board. Demon provided an opportunity for OICs from the training commands to see what features and benefits the SEW-AT v2.0 system is providing to their fleet operators.
- Integrated SEW-AT 2.0 with Ghost Rider Analyst Spectrum Publisher (GRASP).
- Van Buskirk, W.L., Fraulini, N.W., Schroeder, B.L., Johnson, C.I., Marraffino, M.D., (2019). Application of theory to the development of an adaptive training system for a submarine electronic warfare task. In R. Sottilare & J. Schwarz (Eds.), *Lecture Notes in Computer Science: Vol. 11597. Adaptive Instructional Systems* (pp. 352-362). Cham, Switzerland: Springer.
- Schroeder, B.L., Fraulini, N.W., Marraffino, M.D., Van Buskirk, W.L., Johnson, C.I., (2019, Accepted). Individual difference in adaptive training: Distress, workload, and coping. To be published in *Proceedings of the Human Factors and Ergonomics Society*.
- Marraffino, M. D., Schroeder, B.L., Fraulini, N. W., Johnson, C. I., Van Buskirk, W.L. (2018). Effects of difficulty adaptation schedules on trainee performance. Poster presented to the *20th Congress of the International Ergonomics Association*.
- Schroeder, B. L., Fraulini, N. W., Marraffino, M. D., Landsberg, C. R., Van Buskirk, W. L., & Johnson, C. I. (2018). Exploring techniques for individualized training: Interacting effects of difficulty adaptation and personality. Poster presented to the *20th Congress of the International Ergonomics Association*.

FUTURE INTEGRATED TRAINING ENVIRONMENT (FITE)

OBJECTIVE

The purpose of the FITE effort is to meet the needs and demands of the United States Marine Corps (USMC) by addressing the technical challenges associated with linking air and ground simulations. The FITE effort enables existing and future disparate simulation components to communicate efficiently and operate together in an integrated manner to enhance warfighter capability with a specific focus on Close Air Support. This effort also develops virtual reality integrated training solutions for Joint Terminal Attack Controllers (JTAC).

FITE Integrated Virtual Reality Training solutions for Close Air Support: JTAC Virtual Trainer (left), Viper Virtual Trainer (right)

PROJECT DURATION
JAN 2017 - DEC 2020

SPONSORS
Office of Naval Research
ONR-34

POINTS OF CONTACT
Natalie Steinhauser
natalie.steinhauser@navy.mil

Melissa Walwanis
melissa.walwanis@navy.mil

DESCRIPTION

The FITE effort supports the Marine Corps Live, Virtual, and Constructive - Training Environment (LVC-TE) program by addressing the technical challenges associated with linking air and ground simulations. FITE is comprised of two components: the Synthetic Battlespace Service (SBS) and the Synthetic Environment Service (SES). FITE SBS provides an extensible service that allows dissimilar simulation components to effectively interact with one another in real-time, based on what each simulation requires for the training event. FITE SES synthesizes and fuses terrain generation capabilities across dissimilar simulation systems to facilitate an integrated and interoperable training environment.

NEED

USMC Leadership, via a Deliberate Universal Needs Statement (DUNS), expressed a requirement for a distributed mission operations (DMO)-capable training simulator capability for Joint Terminal Attack Controllers (JTAC), Joint Forward Observers, pilots and aircrews to train effectively in a common, simulated operating environment. This requirement is also reinforced by the Marine Air Ground Task Force (MAGTF) Fires Operational Advisory Group (OAG) Tactical Air Control Party (TACP) Simulation recommendation to have "full TACP simulation interoperability and interoperable distributed mission training with Aviation Combat Element (ACE) and Joint Systems."

BENEFITS

The FITE effort will enable existing and future disparate simulation components to communicate efficiently and operate together in an integrated manner, thus meeting the training needs and demands of the USMC fires community and leadership.

STATUS

The current FITE system includes the integration/interoperability of the USMC Deployable Virtual Training Environment - Combined Arms Network (DVTE-CAN), and the ONR Warfighter Augmented Reality (WAR) system. Throughout FY19, significant progress was also made on FITEware Adaptors (for bridging, filtering, and enumeration conversions), the JTAC Virtual Trainer, terrain generation, and dynamic environment services. The FY20 effort will focus on incorporating FITEware SBS and SES technologies into more USMC training exercises and events (e.g., at 29 Palms BSC), in various simulation/training environments. FITE developers will also continue to prototype dynamic and multi-resolution environment services, maintain set-repo.org, and coordinate with other USMC and ONR programs.

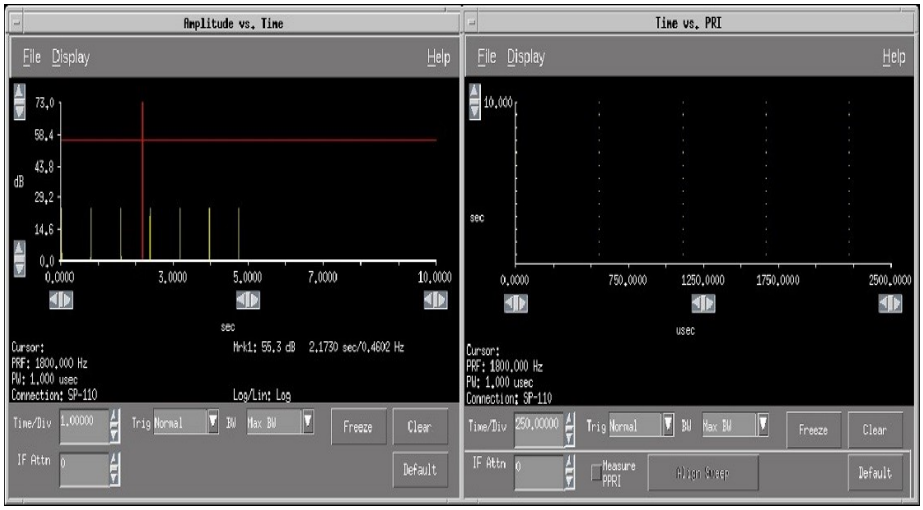
MILESTONES

- Demos, training and interactions at: 10th Marines, 29 Palms BSC, MAWTS-1, WTI 18-2, 1st Anglico & SOI-W, CCLTF at Pentagon, stakeholders at I/ITSEC, ADVTE, 11th Marines (NOV & DEC 2018; FEB, MAR, JUN, AUG, & SEP 2019)
- Delivered JTAC Virtual Trainer kits to NSW and USMC (NOV 2018)
- Delivered Viper Virtual Trainers to 29 Palms Battle Sim Center (SEP 2019)
- Prototyped tool with workflow to create, edit, and launch simulation events and associated FITEware components. (FEB 2019)
- Launched set-repo.org for sharing high fidelity virtual terrains (FEB 2019)
- Currently supporting DIS v6 & v7, and HLA WAR & CAN, and RPR2 protocols

INVESTIGATION OF MICRO-ADAPTATION SCHEDULES TO SUPPORT ELECTRONIC SUPPORT MEASURES (ESM) OPERATOR ADAPTIVE TRAINING

OBJECTIVE

This project aims to compare different difficulty adaptation schedules within an Adaptive Training (AT) system in an effort to determine the most efficient and effective way to employ AT algorithms within a submarine Electronic Support Measures Domain.



Simulated Real-time Displays

PROJECT DURATION

DEC 2016 - DEC 2018

SPONSORS

Office of Naval Research, ONR-31

POINTS OF CONTACT

Matthew Marraffino, Ph.D. (PI)
matthew.marraffino@navy.mil

Melissa Walwanis (PM)
melissa.walwanis@navy.mil

DESCRIPTION

Previous research has shown that including Adaptive Training (AT) techniques to a domain trainer is more effective than its non-adaptive counterpart. However, there are still research questions yet to be answered that may further increase the effectiveness of AT. In this effort we are comparing within- and between-scenario difficulty algorithms to determine if increasing the rate of difficulty adaptation will lead to more efficient and effective learning outcomes. Adapting immediately, within a scenario, based on in-situ performance should keep the trainee in their Zone of Proximal Development (ZPD) and quickly adapt if a student falls out of their ZPD.

NEED

AT was highlighted as a priority in the Submarine Training Requirements Group letter. AT has also been identified as a solution for COMSUBPAC to satisfy the CNO's High Velocity Learning request. Additionally, AT is in line with ONR's Science and Technology (S&T) Strategy for Warfighter Performance which indicates a need for sailors to received tailored training.

BENEFITS

Current efforts under Scalable, Integrated RF Systems for Undersea Platforms (SIRFSUP) TACAID are addressing on-board training needs in the ESM community by using an Adaptive Training solution. The current effort will provide data to guide adaptation schedule decisions for the SIRFSUP effort in order develop the most cost-effective and efficient method of adaptation for ESM operator training.

STATUS

The project finished data collection in analysis during FY 2018. Data from 91 novice participants was collected and analyzed comparing within- and between-scenario difficulty adaptation schedules for a submarine ESM inspired task. Overall results indicated an advantage for a micro-adaptive approach to difficulty adaptation. A manuscript detailing the research is currently under internal review before being submitted for publication.

MILESTONES

- Completed data collection and analysis of 91 participants.
- Mentoring of two University of Central Florida Human Factors PhD students.
- Created GUI to collect task performance data on ESM inspired task.
- Developed an adaptive engine that assesses and adapts difficulty after each point of assessment.
- Presented data at the International Ergonomics Association Conference, Human Factors and Ergonomics Society Conference
- Manuscript is being prepared for publication

LEARNING CONTINUUM AND PERFORMANCE AID (LCAPA)

OBJECTIVE

LCaPA, also known as My Navy Learning, creates a Sailor-focused interface that provides easy access to all Navy learning to empower Sailors' use of education, training, and professional development resources. The learning ecosystem enables robust personalized development through continuous and adaptive interaction in order to maximize Sailor readiness. The proposed architecture will leverage the Authoritative Data Environment (ADE) to align with Sailor needs across the enterprise.

PAL3 in use

PROJECT DURATION
OCT 2017 - SEP 2021

SPONSORS
Office of Naval Research, ONR-34

POINTS OF CONTACT
Randolph Astwood Jr., Ph.D. (PI)
randy.astwood@navy.mil

Melissa Walwanis (PM)
melissa.walwanis@navy.mil

DESCRIPTION
LCaPA seeks to develop a Sailor-focused interface that provides ease-of-access to Navy learning through the use of education, training, and professional development resources. The program has six development lines of effort:

- Competency Mapping
- Learner Record
- User Interface and Experience (UI/UX)
- Re-use of Content
- Adaptive Learning
- Training Effectiveness Measurement Support

NEED
Today Sailors typically attend school and receive most of their rate -specific training up front, which can last up to two years. By the time they reach their assignments their skills could have atrophied or the technology they trained on has become outdated.

BENEFITS
LCaPA intends to provide Sailors with a career-long learning continuum where training is delivered at multiple points throughout a Sailor's career utilizing modern delivery methods to enable faster learning, better knowledge retention, and reduce skill degradation. With training content being continuously updated and rapidly delivered to the Fleet, an expertly-designed system could bolster Sailors having convenient access to training content and support that is accessible anytime from anywhere. This will significantly reduce the cost and time for getting the training to the Fleet and increase agility in the Navy's rapidly changing world.

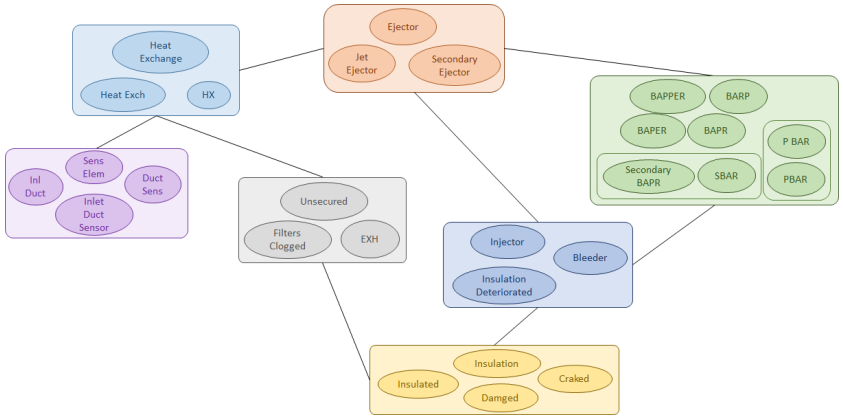
MILESTONES

- Effort is in Year 1 of the Future Naval Capabilities (FNC) Phase
- In FY19 three performers have been selected to support the FNC:
  - The Naval Surface Warfare Center Dahlgren Division (NSWCDD) Damn Neck Activity, Soar Technologies, & Aptima, Inc.
- Competency Framework Planned Completion Dates:
  - OS Rating: Q2 FY20, PS Rating: Q3 FY20, YN Rating: Q1 FY21
- Learner Record Library Data Elements Planned Completion Dates
  - OS Rating: Q3 FY20, PS Rating: Q4 FY20, YN Rating: Q2 FY21

LEXICAL NORMALIZATION TO FACILITATE INFORMATION EXTRACTION OF NAVY TEXT

OBJECTIVE

Develop and evaluate Navy-specific unsupervised Natural Language Processing (NLP) models to improve the handling of domain specific terms, abbreviations, and anomalies that are present across Navy enterprise free text responses, such as maintainer logs. The second objective is to evaluate the ability of the resulting trained models to generalize to other Navy text domains.



Representation of lexical relationships of some Navy-specific language.

PROJECT DURATION

OCT 2019 - SEP 2021

SPONSORS

Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: BAR

POINTS OF CONTACT

Dr. Michael Lipschultz (PI)
michael.lipschultz@navy.mil

Dr. Nelson Lerma
nelson.lerma@navy.mil

CDR Wilfred Wells (PM)
wilfred.wells@navy.mil

DESCRIPTION

Proven unsupervised natural language processing models for Navy text facilitates faster information extraction from maintenance logs. First though, the text must be cleaned (e.g. identify acronyms, fix typing errors) then semantic meaning must be extracted. These will enable identification of the documented reason for the maintainer action, what action they took, and what aircraft part(s) were involved in that action. These tasks can be embedded within a larger system for more robust identification of patterns within other corpora. Increasing robustness and thoroughness in the analysis of aircraft health and maintenance actions is necessary to transition towards prescriptive maintenance.

NEED

The Navy produces significant amounts of unstructured, human-generated text which contain issues (e.g. typos in maintenance reports and repetition in training) that are roadblocks to making use of automated techniques for search and understanding. Supervised training methods can be costly, especially if repeated across domains. Unsupervised models that can generalize across Navy domain spaces can reduce cost and provide greater use case opportunities. The resulting unsupervised NLP algorithms generated and proven by this effort will improve and broaden the use of advanced machine learning applications on Navy text data

BENEFITS

These models will improve the extraction of information for effective search and understanding of the data, and enable the effective use of the data within machine learning applications

STATUS

This is an FY20 new start.

MILESTONES

- **FY20:**
  - Implement unsupervised algorithm for lexical normalization
  - Train lexical normalization model and tagged text
- **FY21:**
  - Implement remaining unsupervised modeling algorithms
  - Train models
  - Author technical report

MISHAP AWARENESS SCENARIO TRAINING FOR ENSURING READINESS (MASTER) N172-117

OBJECTIVE

Develop a customizable software program that provides outputs to result in a suite of training tools and technologies that support recreation of aviation mishap events to convey lessons learned and improve safety training through classroom based videos and interactive, immersive visualization techniques.

Aviation survival training seeks to advance mishap awareness training through interactive, immersive visualization techniques such as moderate fidelity training systems.

PROJECT DURATION

SEP 2017 - SEP 2020

SPONSORS

Naval Air Systems Command (NAVAIR)
Small Business Innovative Research (SBIR)

POINTS OF CONTACT

Beth Atkinson (TPOC)
beth.atkinson@navy.mil

Sarah Warnham (TPOC)
Sarah.warnham@navy.mil

John Hodak (PM)
john.hodak@navy.mil

DESCRIPTION

Advances in virtual reality and computer graphics make it possible to create a software program that allows the user to set a scenario based off of mishap data to recreate mishap events for training leveraging a range of media. The Navy seeks a single scenario development technology that provides inputs to develop a range of training opportunities that are consistent and require minimal investment by the program to continue to expand mishap training scenarios. This system should allow for the development of new scenarios, as well as provide an ability to modify previously created scenarios within the tool through a simplified user interface.

NEED

Spatial disorientation (SD) and situational awareness (SA) are significant contributing factors to the majority of aviation mishap events. The aviation survival training community has requirements to provide sensory physiology/situation awareness training; however, the current training is predominantly classroom based instruction that leverages videos which are not easily updated as new platforms or situations occur.

BENEFITS

Providing a more immersive range of training opportunities will allow for more trainee experience and engagement and likely improve the fidelity and appropriateness of the training. Operator performance will also increase through the ability to better recognize and/or implement emergency procedures when experiencing SD/SA situations, creating safer and more effective warfighter operations.

STATUS

This SBIR has undergone competitive source selection resulting in three contract awards for a gated Phase II. The awarded industry partners will spend Phase II continuing to develop customizable software tool for the development of mishap training curricula. The rest of the base period will involve conducting demonstrations and designing/developing prototypes for evaluation.

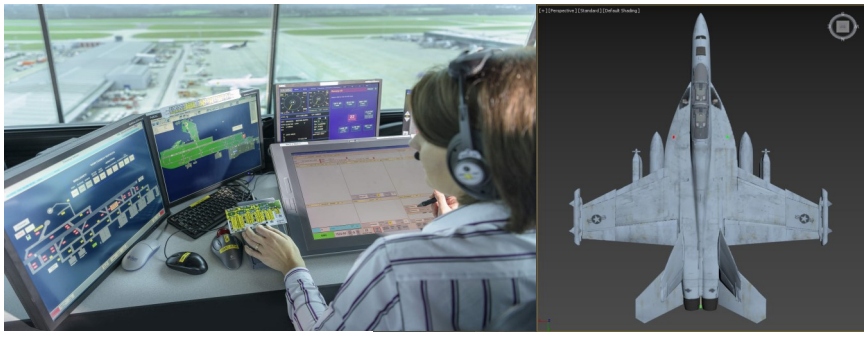
MILESTONES

- Phase I:
  - Kickoff meetings were held with each of the four Phase I contractors, and contractors status was monitored via bi-monthly progress reports and periodic status updates
  - Closeout briefs were held with each of the contractors to discuss Phase I progress and Phase II plans
  - Phase I Option was awarded for three vendors
- Phase II:
  - Phase II gated contracts awarded
  - Kickoff meetings were held with each of the Phase II contractors to discuss Phase I Option progress and Phase I plans
  - Demonstrations are scheduled for August 2019 to review Phase II base efforts, part of the evaluation process for continued Phase II funding

NAVAL AIR TECHNICAL TRAINING CENTER (NATTC) AIR TRAFFIC CONTROL FUNDAMENTALS LAB

OBJECTIVE

Build, test, and deliver a new Air Traffic Control Fundamentals Lab Trainer, which will be utilized for Air Traffic Control "A" school (ACA1) located at NATTC, Pensacola, FL.



PROJECT DURATION

APR 2019 - SEP 2021

SPONSORS

Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: BAR;
Naval Aviation Training Systems Program Office, PMA-205

POINTS OF CONTACT

Courtney McNamara (PI)
courtney.mcnamara@navy.mil

CDR Wilfred Wells
wilfred.wells@navy.mil

DESCRIPTION

The new training system will allow the airfield, aircraft, and ground vehicles to be visualized in a virtual environment. The system will allow highlighting of aircraft, airfield features, and vehicles to help target class discussion and focus on the specific aspects of the training. An Instructor Operator Station (IOS) will be created to allow instructors to dynamically create/load scenarios. The system will able to play, pause, and resume scenarios, allowing them complete control of the scenario to add discussion points during training.

The system will allow multiple roles to be played simultaneously. Allowing more than three students to participate in training at a time. This will actively engage more of the class and allow the students to greatly increase their hands-on time with the system. The system will include speech recognition for student phraseology. This will allow trainees to practice their voice commands without increasing instructor workload. This tool could also be broken off as a standalone system for afterhours practice. The system will include the communications and VIDS systems, so students can learn what they'd expect to see when they transition to the tower simulator.

NEED

The current Air Traffic Control Static Lab requires instructors and students physically move models of aircraft and vehicles around a table top depiction of an airfield. The trainer does not have role player automation, the ability to train phraseology, and trainer capacity is limited to 3 students (out of 14) at a time. These deficits have led to delays in student skill acquisition (e.g. inability to complete the advanced tower simulator) and increased training attrition rates (currently at 37%).

BENEFITS

With an average of 650 students trained per year, the high attrition rates are not sustainable. This updated trainer will increase trainer efficiency, reduce instructor workload, and give students five times more hands on practice time during Phase 1 of training. This coupled with earlier introduction to ATC Tower tools like the radar, VIDS, and EVTS systems will increase student performance in Phase 2 of ATC Training and reduce the attrition rates for the overall course.

STATUS

A prototype of the Trainer will be available for instructor/NATTC testing by the end of FY19. PMA-205 has started a kick-off for the effort to deliver a full training system in FY20.

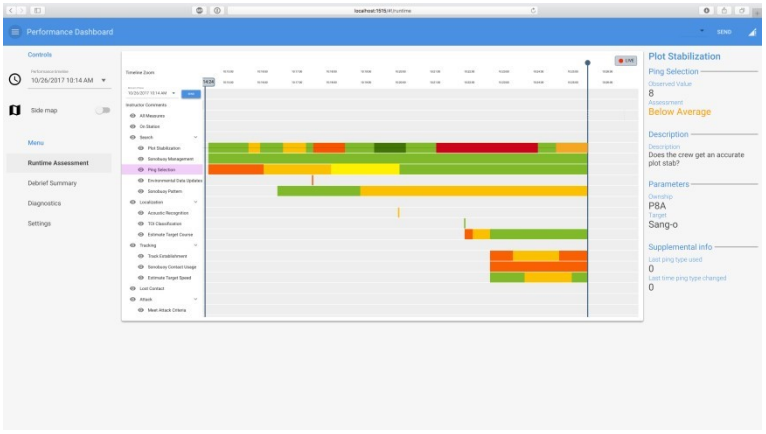
MILESTONES

- Prototype for NATTC Review 4th Quarter FY19
- Initial Operational Capability FY20
- Final Operational Capability FY21

POST-MISSION ASSESSMENT FOR TACTICAL TRAINING & TREND ANALYSIS (PMATT-TA): SIMULATION-BASED TRAINING TOOLS

OBJECTIVE

PMATT-TA implements instructional tools for simulation-based training to increase training effectiveness and efficiency automated performance measurement and assessment capabilities that support post event reporting and trend analysis, facilitating a better understanding of aircrew performance and proficiency.



The PMATT-TA Increment 2 instructor interface provides a timeline display with quick access to automated, system-based performance measurement results

PROJECT DURATION

OCT 2010 - SEP 2020

SPONSORS

PMA-290; PMA-205; Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: TT; Office of Naval Research (ONR); NAVAIR Small Business Technology Transition (STTR)

POINTS OF CONTACT

Beth Atkinson (PI)
beth.atkinson@navy.mil

Mitch Tindall (Co-PI)
mitchell.tindall@navy.mil

John Hodak (PM)
john.hodak@navy.mil

DESCRIPTION

PMATT-TA efforts for simulation-based training tools targets research, development and implementation of a automated system -based performance measures, increased automation for post mission reporting, and technology to support community sustainment and development of performance measures as tactics, techniques, procedures, and mission tasking evolves.

NEED

A Statement of Urgent Need (CPRG, JUN 2010) highlighted the lack of existing Navy products to support force-wide Anti-Submarine Warfare training assessment. The call cited the lack of centralized performance data as the key limiting factor that needed to be address with objective, outcome-based performance data to understand aircrew performance based on measures that provide force-wide tactical proficiency and support targeted remediation via training solutions.

BENEFITS

PMATT-TA's simulation-based training tools increases the reliability and standardization in performance feedback provided to aircrew. PMATT-TA will also assist stakeholders in accurately gauging fleet readiness and competencies in a streamlined and easy-to-use way based on the results of observer and system-based performance measures. The final product seeks to provide a novel technology to view trends in training and performance, ultimately allowing for more informed decision making and proficiency tracking.

STATUS

PMATT-TA's simulation-based training tools underwent extensive testing and integration in FY17-18. Following completion of final testing, the PMATT-TA Performance Dashboard was installed within the P-8 Weapons Tactics Trainer (WTT) as part of Training System Release (TSR)-13 in January 2018. Iterative testing continued throughout FY18-FY19 as part of a software update for training systems for TSR-14 and TSR-15. For FY20, preliminary efforts are underway for TSR-16 software release and planning is underway for future TSR software updates.

MILESTONES

- Manuscripts/Publications:
  - Atkinson, Tindall, Killilea, Anania. (2018). Advancing performance assessment for aviation training. Proceedings of AHFE.
  - Atkinson, Tindall, Killilea, Tolland, & Dean. (2017). Standardizing human performance measurement for ease of data analytics. Proceedings of the I/ITSEC.
  - Tindall & Atkinson. (2019). Standardizing performance measurement while ensuring psychometric validity . Proceedings of the I/ITSEC.
- Presentations:
  - Demonstration exhibit at IITSEC 2017.
- Workforce Development: Mentored junior teammates on program management, interaction for transition, usability analyses, and coordination with fleet customers.
- Transitions: Transition of PMATT-TA Performance Dashboard to PMA-290 with APN funding (FY18-20).

REPURPOSING COMPUTATIONAL ANALYSES OF TACTICS FOR TRAINING ASSESSMENTS (N18A-T003)

OBJECTIVE

Design and develop a software technology that leverages data science and advanced computational analyses of tactical data sources to improve training scenarios and assessments and make training more adaptive, efficient, and effective.

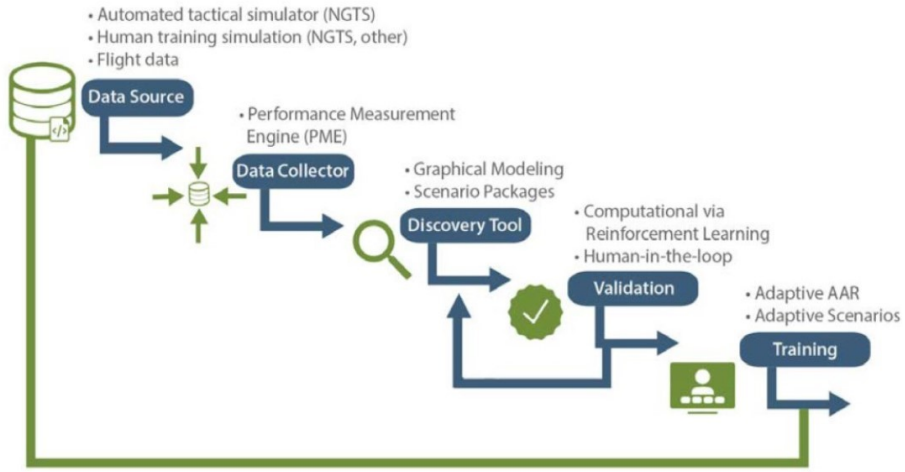


Figure 1. System data flow diagram of TOPMAST.

PROJECT DURATION

SEP 2018 - SEP 2021

SPONSORS

Naval Air Systems Command (NAVAIR)
Small Business Technology Transition (STTR)

POINTS OF CONTACT

Mitchell Tindall, Ph.D. (TPOC)
mitchell.tindall@navy.mil

Beth Atkinson (Co-TPOC)
beth.atkinson@navy.mil

John Hodak (PM)
john.hodak@navy.mil

DESCRIPTION

As the complexity of Tactics, Techniques, and Procedures (TTP) increase, testing in part via computational simulation and optimization is necessary. Such analyses systematically vary tactical applications of the warfare capability to a variety of threat scenarios, simulate and score each encounter, and generate a ranked list of the most successful tactics per threat. The scenarios, measures, and knowledge generated in this type of work are rich and voluminous, providing opportunities to leverage data science. This effort seeks to deliver a software technology solution capable of re-using analytic data outputs for populating training content.

NEED

Emerging warfare capabilities offer a great many new tactical options to commanders. However, this also increases the demands on decision-makers during operations. The dynamic and complex nature of integrated warfare results in training challenges to prepare for those engagements. To address this need, this effort seeks: 1) the capability to generate scenario libraries, and 2) the ability to improve integrated assessments of human tactical skills to make training more efficient and effective.

BENEFITS

Navy leadership has called for technologies that support analytics of big data sets such as avionics and human performance; however, as new systems or technologies are introduced and/or new tactics emerge to maintain superiority, existing training scenarios can quickly become obsolete. Advance statistical or novel modeling techniques are sought to address the unique challenge of ensuring training scenarios are current.

STATUS

This STTR has completed Phase I efforts by three vendors. Closeout briefs were held in September FY19. Proposals have been reviewed and the consensus evaluation has resulted in the award of phase II proposals.

MILESTONES

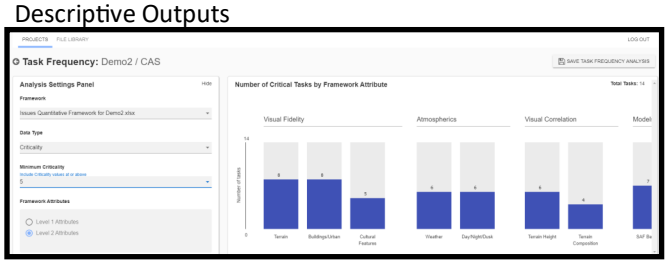
- Phase I:
  - Kickoff meetings were held with each of the three Phase I contractors
  - Contractors status was monitored via bi-monthly progress reports and periodic status updates
  - Closeout briefs were held with each of the contractors to discuss Phase I progress and Phase II plans
- Phase II:
  - Phase II proposals are under review
  - Phase II awards are targeted for Q4 FY19
  - Kickoffs will be held in Q1 FY20

SYSTEMATIC TEAM ASSESSMENT OF READINESS TRAINING (START) APPLIED TO MEDICINE: MEDIC/CORPSMAN PROFICIENCY MODEL (MED-PM)

OBJECTIVE

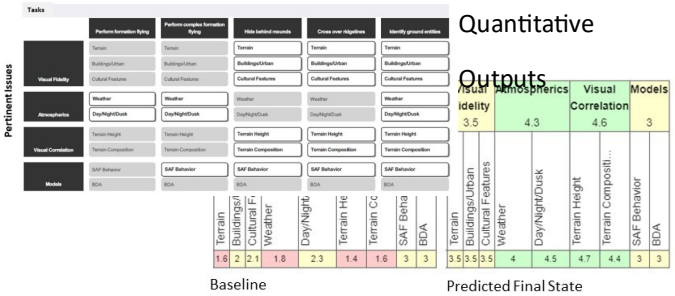
To develop a medical skills proficiency model and training trade space tool yielding decision quality results for training and acquisition stakeholders. The tool provides diagnostics of the health or capability of the system to produce proficient learners; "what if-ing" of alternative training system configurations considering the impact on proficiency attainment; and presents outputs - training requirements and training system health metrics - in intuitive visualizations.

Descriptive Outputs



Qualitative Outputs

Quantitative Outputs



Med-PM proficiency trade space tool.

DESCRIPTION

The Med-PM project extended prior DoD and DHA funded work. Specifically, a model of Combat Medic/Corpsman proficiency was built leveraging NAWCTSD's Navy Aviation Proficiency Model. The medical proficiency model serves as the core of a trade space tool, also developed for this effort, that allows analysis and tradeoffs of training system capabilities that impact attainment of proficiency and training system effectiveness such as instructional features, fidelity and Knowledge, Skills, and Attitudes (KSAs).

NEED

Training initiatives such as Tactical Combat Casualty Care (TCCC) have made a tremendous difference in preparing medical providers to save lives on the battlefield. Conflict exists however, over estimating the capabilities of medical skills training approaches that include animal simulation. Therefore, a need exists for modeling and analysis methods to examine the impact of alternative training approaches on medical skills development.

BENEFITS

The medical proficiency model and trade space analysis tool will optimize training and acquisition decisions; and from a research and development perspective, identify gaps in applied learning science. The tool has wide applicability across domains for training system assessment and comparison, allowing decision makers to make informed investments related to curricula changes and/or training technologies.

STATUS

The project was completed with the following accomplishments: elements of the skill acquisition and retention framework were refined; model elements were instantiated within in a prototype software training system trade space tool with an intuitive user interface, and training system capabilities were modeled across medical, aviation, and combined platform distributed training systems.

PROJECT DURATION

OCT 2016 - APR 2019

SPONSORS

Defense Health Agency (DHA)
Joint Program Committee, JPC-1

POINTS OF CONTACT

Dawn Riddle, Ph.D. (PI)
dawnriddle@navy.mil

Melissa Walwanis (PM)
melissa.walwanis@navy.mil

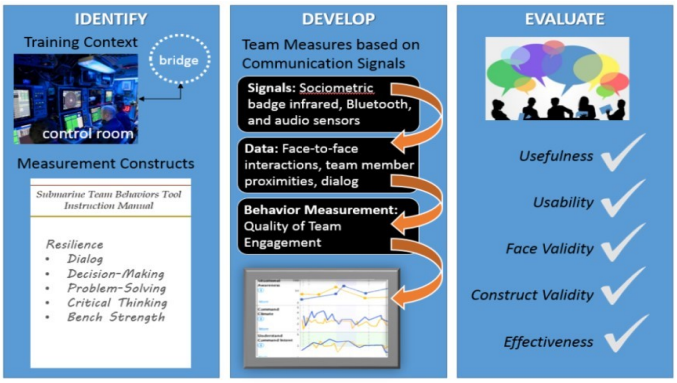
MILESTONES

- Skill Acquisition and Retention Framework enhanced
- Med-PM trade space analysis prototype tool developed
- Training venue modeling completed; training system capabilities were modeled across medical, aviation, and combined platform distributed training systems

TEAM-BASED ADVANCED RESILIENCE ACCELERATOR (TARA) OSD10-CR3

OBJECTIVE

Develop a prototype system called Team-based Advanced Resilience Accelerator (TARA) for tracking observed behaviors during Submarine team training, especially teamwork and team resilience skills. TARA will enhance briefs and After Action Reviews (AARs) by providing concrete descriptions of training objectives as well as immediate post-training access to data-driven visualizations of team performance. These features will facilitate instructors as they provide descriptive and prescriptive feedback and make recommendations for future training that target areas of weakness within the team.



TARA system concept

PROJECT DURATION

SEP 2017 - SEP 2019

SPONSORS

Naval Aviation Training Systems Program Office, PMA-205

Naval Air Systems Command (NAVAIR)
Small Business Innovative Research (SBIR)

POINTS OF CONTACT

Natalie Steinhauser (PI)
natalie.steinhauser@navy.mil

John Hodak (PM)
john.hodak@navy.mil

DESCRIPTION

This research and development effort will expand on existing solutions to develop TARA, a team behavior measurement and feedback system that will support coaching, mentoring, training, and self-assessment of team skills. Ultimately, TARA will support performance assessments over time to allow instructors and teams to discover the deep connections that exist between their actions, the task conditions, and outcomes, which will provide them with the foundation they need to act and make intuitive decisions as a resilient team. The TARA system is comprised of Submarine SPOTLITE, for online assessments and immediate performance feedback, and Learning Locker, for storing and tracking team performance over time. Together, these provide benefits for instructor and trainee in terms of understanding a team's strengths and weaknesses, and by using this knowledge to select the optimal training path for the team.

NEED

NAE Science & Technology Objective Alignment: 10. Naval Warfighter Performance (NWP) Capability Gap (10.1 NWP STO-1: Training and Education)

Submarine Learning Center expressed an interest in streamlining and enhancing team assessment and team training within scenario simulation trainers and provided a letter of support for this effort.

TARA will result in the accelerated development of resilient team skills that are needed for the team to perform effectively and efficiently when on duty. Performance assessment and targeted/ adaptive training is needed to accelerate these skills, but instructors are already overworked in these environments. Providing tools to assist the instructor are needed; TARA meets this need.

BENEFITS

The proposed work will benefit the Submarine Force by providing advanced resilience training to tactical teams at all five levels of training practices: Formal Schools, Formal Qualification, Continuing Training, Inspection and Certifications, and Self-Assessment. These teams will be better equipped to recognize danger and seize opportunity in times of uncertainty, as well as being able to adapt to changing situations. This effort aims to improve the effectiveness and efficiency of training by improving assessment quality and feedback, tailoring training experiences based on past performance, and potentially reducing training time by excluding learned activities.

STATUS

The Contract for this effort was awarded Sept 2017. The first annual technical review of this effort took place Sept 2018. The FY19 effort involved the software development and integration of the tools to include live performance tagging, team member self assessment, and AAR capabilities. FY20 will involve final delivery and demonstrations.

MILESTONES

♦FY19 Deliverables:

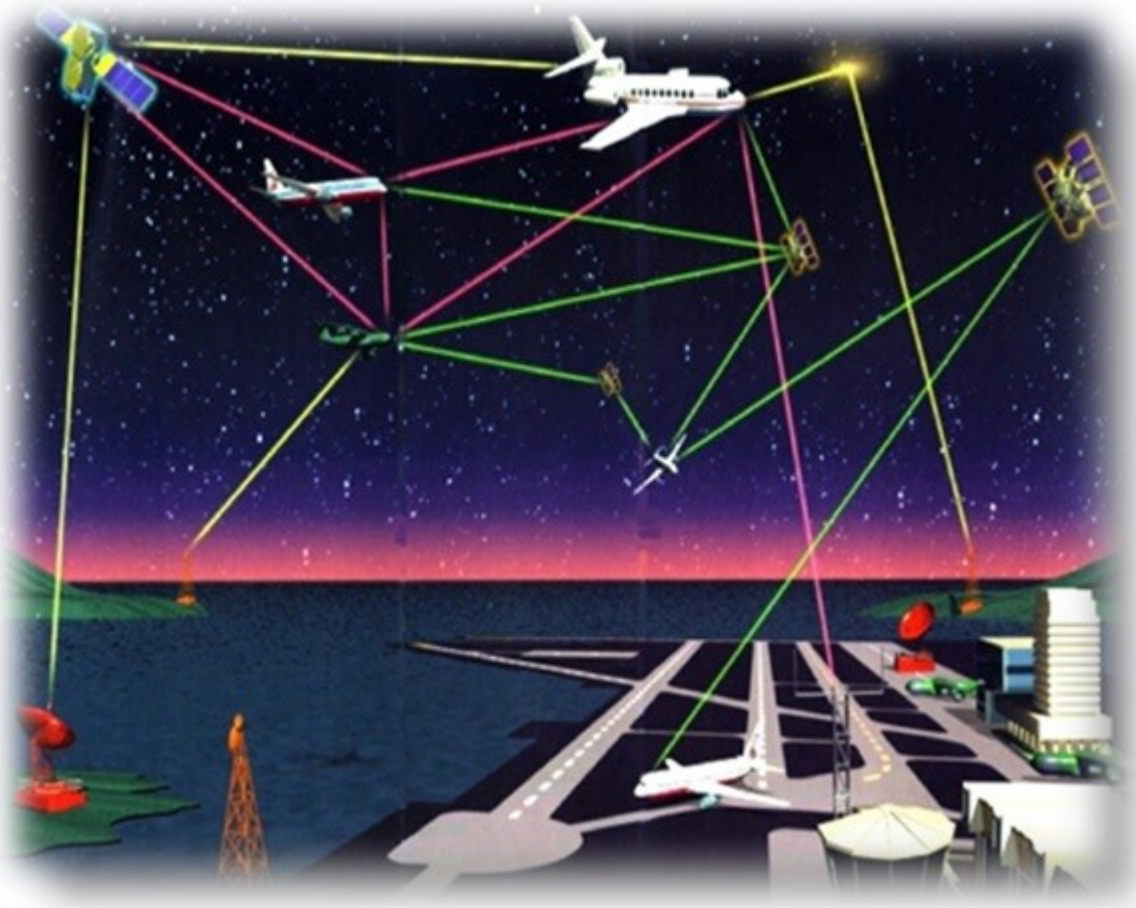
1. Demonstration of TARA to Submarine Learning Center
2. Quarterly Government Progress Reports
3. Yearly Progress Review Presentation and Slides
4. Install and test software (Aug 19)
5. Conduct usability tests and compile results
6. Final Report and Demonstration (Aug/Sep 19)

CORE CAPABILITY 3:
ADVANCED TRAINING SYSTEMS TECHNOLOGY

Training systems, such as LVC simulations, provide an appropriate mix of environments where learners can interact in real time with each other using networked devices. Technology can augment warfighter preparedness by providing training opportunities that might not be available due to factors such as cost, safety, and resource availability. Training technology includes the ability to provide realistic rendering and modeling, multisensory input/output devices (e.g., visual/audio/haptic displays, speech recognition, and flight control sticks), and system interconnectivity, such as Web servers, networking bandwidth, and processing speed.

The following Technology areas comprise this Core Capability:

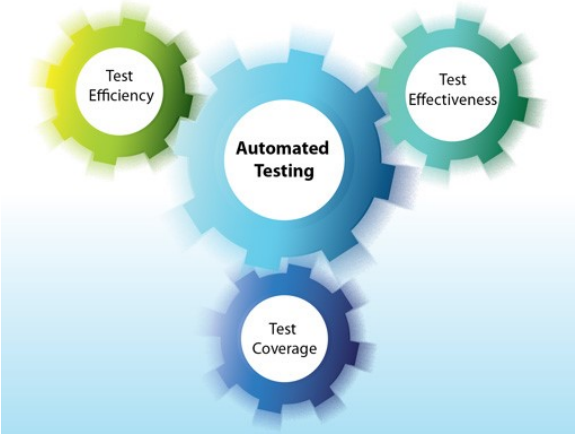
- High-Fidelity Training Environments
- Simulation Interoperability and Distributed LVC Technology



AUTOMATED SOFTWARE TESTING CAPABILITY

OBJECTIVE

Analyze, design and implement an automated and extensible software testing capability for the IDEA Lab, and then deploy it in the development and maintenance of the Federation Agreements Compliance Test Tool (FACTT) Suite software as a use case.



Automated Testing Benefits

PROJECT DURATION

OCT 2019 - SEP 2021

SPONSORS

Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: WFD: SG

POINTS OF CONTACT

David Shen (PI)
david.t.shen@navy.mil

Brett Trantham
Brett.trantham@navy.mil

CDR Wilfred Wells (PM)
wilfred.wells@navy.mil

DESCRIPTION

The proposed effort will analyze, design and implement an automated and extensible software testing capability for the IDEA Lab, and then deploy it in the development and maintenance of the Federation Agreements Compliance Test Tool (FACTT) Suite software as a use case. The choice of FACTT Suite is fitting because it is a critical and contractually required software product for assessing NASMP/NIS standards' compliance for the Fleet Synthetic Training - Aviation (FST-A) simulations and it has become an increasingly complex software system which has hampered its development and testing efforts and causing delays in delivering critical capability to the users.

NEED

This capability is urgently needed to address the current inefficiencies in software development and testing processes in the NAWCTSD-IDEA Lab which has contributed to delays in software product deliveries and at a higher cost. Particularly, FACTT Suite will immediately benefit from it as an early technology adopter.

BENEFITS

The proposed capability will enable software developers to uncover implementation issues sooner while requiring less manual labor. This capability will enhance the IDEA Lab software development process by shortening the software development and testing cycles and yielding more robust software products in a timely manner.

STATUS

This is an FY20 new start.

MILESTONES

- Research on automated testing technology and strategies complete (Oct 19)
- Software requirement for automated testing infrastructure complete (Nov 19)
- Software design for automated testing infrastructure complete (Dec 19)
- Software upgrade for FACTT Suite complete (Sep/20)
- Software implementation for automated testing infrastructure complete (Jun 21)
- Stand up the automated testing infrastructure for FACTT Suite complete (Aug 21)

CHIEF OF NAVAL AIR TRAINING (CNATRA) T-45 VR-PTT TRAINING EVALUATION

OBJECTIVE

Investigate use of extended reality technology to support self-study, event preparation, and event remediation in order to enhance performance for T-6B and T-45C student naval officers at Chief of Naval Air Training (CNATRA).

BISim T-45 VR-PTT

CNATRA T-45 4E18 VR-PTT

CNATRA PTN T-6B VR-PTT

BISim T-45 ARVS

PROJECT DURATION

MAR 2018 - SEP 2019

SPONSORS

Naval Aviation Training Systems Program Office, PMA-205

Office of Naval Research, ONR-34

Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: BAR

POINTS OF CONTACT

Cecily McCoy-Fisher, Ph.D. (PI)
cecily.mccoy-fisher@navy.mil

CDR Thomas Foster, MSC, USN, Ph.D. (PM)
thomas.c.foster30.mil@mail.mil

LT. Joseph E. Mercado, MSC, USN, Ph.D. (PM)

DESCRIPTION

The Research Psychologists in NAWCTSD's Science for Training Evaluation, Analysis, Learning and Theory (STEALTH) Lab are developing and executing a training evaluation plan for the purpose of informing CNATRA and PMA-205 leadership on the effectiveness of various virtual and mixed reality devices to improve training and desired training outcomes (e.g., performance in the aircraft, reduction in re-flys).

BENEFITS

If effective, the Navy could include the devices in the CNATRA curriculum as supplemental, part-task training. These devices have the potential to provide training opportunity for stages that currently only have aircraft training, which can provide added training utility and time, reduce cost, and increase student performance in the aircraft. replace some in air training with new part task trainer.

NEED

- Operational Requirement: NASMP IV Priority 5: "Continue strategy refinement to provide a basis of understanding the potential for leveraging technology to solve the training challenges of the future."
- PMA-205 Strategic Initiative to investigate utility of Virtual and Augmented Reality.

STATUS

Various virtual reality part-task trainers were delivered to NAS Kingsville, NAS Corpus Christi, NAS Meridian, and NAS Whiting Field. One mixed reality system was integrated with the T-45C Operational Flight Trainer and was demonstrated at NAS Kingsville. A device capability evaluation was conducted and the results, along with system implementation recommendations, were summarized in a technical report.

MILESTONES

- NOV 2018– CNATRA T-45 4E18 VR-PTTs were delivered to NAS Kingsville and NAS Meridian
- DEC 2018–BISim T-45 VR-PTTs were delivered to NAS Kingsville
- MAR 2019–BISim T-45 ARVS was delivered for demonstration at NAS Kingsville
- MAR 2019–CNATRA PTN T-45 VR-PTTs were delivered to NAS Corpus Christi and NAS Whiting Field
- NOV 2018–JUNE 2019–NAWCTSD conducted the extended reality training evaluation
- OCT 2019–"Student Naval Aviation Extended Reality Device Capability Evaluation" technical report delivered to sponsors

CNATRA TH-57 VIRTUAL REALITY TRAINING EVALUATION

OBJECTIVE

Investigate the use of virtual reality technology to support self-study, event preparation, and event remediation in order to enhance performance for TH-57 student naval aviators (SNAs) at Chief of Naval Air Training (CNATRA).

PROJECT DURATION

OCT 2019 - SEP 2020

SPONSORS

Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: BAR

POINTS OF CONTACT

Cecily McCoy-Fisher, Ph.D. (PI)
cecily.mccoy-fisher@navy.mil

Ada Mishler, PhD (Co-PI)
ada.d.mishler@navy.mil

DESCRIPTION

The Research Psychologists in NAWCTSD's Science for Training Evaluation, Analysis, Learning and Theory (STEALTH) Lab are developing and executing a device capability evaluation plan. The purpose of this evaluation is to inform CNATRA leadership on the effectiveness of virtual reality (VR) devices to improve training and desired training outcomes (e.g., performance in the aircraft, reduction in re-flies) for the TH-57 community.

NEED

- Operational Requirement: NASMP IV Priority 5: "Continue strategy refinement to provide a basis of understanding the potential for leveraging technology to solve the training challenges of the future."
- PMA-205 Strategic Initiative to investigate utility of Virtual and Augmented Reality.

BENEFITS

If effective, the Navy could incorporate the VR devices in the CNATRA curriculum as supplemental, part-task training. These devices have the potential to provide training opportunity for stages that currently only use live aircraft training. Potential benefits include additional training utility and practice time, decrease in training cost, and increase in student performance within the aircraft.

STATUS

Contract awarded to deliver ten TH-57 VR part-task trainers to NAS Whiting Field. The research team is finalizing the experimental design for the training effectiveness evaluation.

MILESTONES

- FEB 2020: TH-57 Ryan Helimod Mark IIIs will be delivered to NAS Whiting Field
- FEB–APR 2020: NAWCTSD will collect data from the SNAs via in-person and online data collection measurement
- MAY 2020: NAWCTSD will facilitate focus group discussions with CNATRA Instructors, Engineers, and Leadership
- MAY–SEPT 2020: NAWCTSD will analyze data and summarize findings in a technical report

DYNAMIC FLIGHT SIMULATION AS A SUPPLEMENT TO IN-FLIGHT PILOT TRAINING (N112-111)

OBJECTIVE

Aptima and Soar Technology are conducting a follow-on effort to extend the work achieved under the Carrier Qualification Training Reduction via Advanced Piloting System (CQTRAPS) contract. The purpose of this effort is to advance the capabilities of the single Landing Signal Operator operational trainer, known as the LSOT, resident in the LSO School at NAS Oceana through the incorporation of three products driven by analytical, computational, and data modeling based on real world aviation system and SME data.

PROJECT DURATION

OCT 2016 - MAR 2019

SPONSORS

Naval Aviation Training Systems Program Office, PMA-205

POINTS OF CONTACT

Heather Priest, Ph.D. (TPOC)
heather.priest@navy.mil

John Hodak (PM)
john.hodak@navy.mil

DESCRIPTION

In an effort to mitigate the predicted impact of training optimization on the LSO training pipeline, this effort will provide a rich data set for a working computational model to ensure accurate, real life approaches for training and the development of more accurate flight models based on emerging technologies and pilot proficiency levels. In addition, the data will inform scenarios, events, and metrics for inclusion in the training scenarios for pilots, LSOs, and other Air Ops teams (e.g., Air Boss).

NEED

LSOT deficiencies that are realistic and data driven are requirements being prioritized to Type Commander (TYCOM) and at Enabler Naval Aviation Requirements Group (ENARG) via Force Paddles and the LSO School Office in Charge. In addition, the Precision Landing Mode (PLM) install is being tested for implementation next Fiscal Year and will drive requests for Carrier Qualification (CQ) training and changes to Field Carrier Landing Practice (FCLP) requirements. This effort will help improve training technology for pilots, LSOs, and Primary Flight Control (Pri-Fly) and provide supporting data for recommendations.

BENEFITS

There is currently only a single LSO trainer (LSOT) located at NAS Oceana in the LSO School. Because of this limited availability, the throughput and maintenance of this device is a difficult problem to manage for LSO instructors and PMA-205 LSOT program managers. Analytical and computational models, as well as a baseline Landing Quality Index to assess CQ and inform LSO training and currency will add to the training value and inform acquisition and currency decisions. By using live data, this scientific effort will help the development of more realistic models and provide additional instructional capabilities that can be implemented in existing and re-hosted LSOT, as well as provide objective data for recommendations.

STATUS

Data analysis report and briefings based on live data have been delivered to LSO School and NAWCTSD. The LSO live data set was used to compute initial landing quality index scores and to patterns of indicators of potential performance decrements. The team completed implementation of the threshold level model-simulation API into test software for possible future integration.

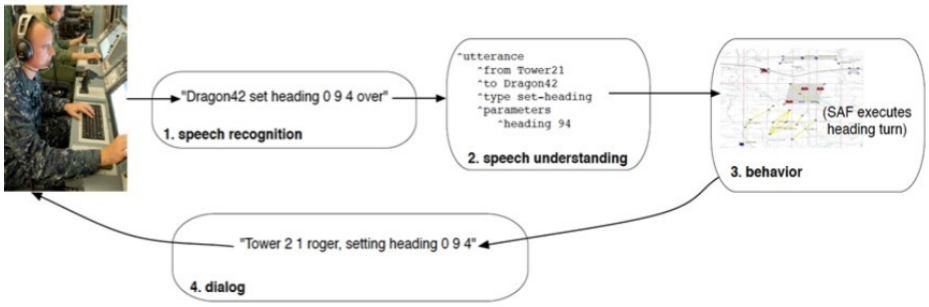
MILESTONES

- Created an application that read in all text files in each of the subdirectories and created two comma-separated values (csv) files, one for each subdirectory representing 959,016 traps.
- Developed a grammar that successfully parsed most of the LSO's glideslope comments on the 1500 or so traps in the data set.
- Performed customer directed analyses on the resulting data set.
- Developed an initial functional model of carrier landings from the beginning of the groove pattern and "lands" via gradual descent and control maneuvers of the aircraft.
- Implemented the threshold level model-simulation API model and, using the Raft model-simulation interface middleware, developed test capabilities and test scenarios to test API functionality.
- Integrated the model development environment and implemented the initial model, using the goal decomposition developed in consultation with LSO School.

END-USER SPEECH RECOGNITION SUPPORT TOOLS FOR CREW RESOURCE MANAGEMENT TRAINING SYSTEMS (N17A-T010)

OBJECTIVE

Develop an innovative software capability to improve the utility of structured automatic speech recognition (ASR) by allowing end-users to customize the set of supported utterances without external support.



A sample speech recognition and understanding process

PROJECT DURATION

AUG 2017 - JUL 2020

SPONSORS

Naval Air Systems Command (NAVAIR)
Small Business Technology Transition (STTR)

POINTS OF CONTACT

John Killilea (TPOC)
john.killilea@navy.mil

Beth Atkinson (Co-TPOC)
beth.atkinson@navy.mil

John Hodak (PM)
john.hodak@navy.mil

DESCRIPTION

The resulting software capability should be modular and flexible in nature to allow multiple aviation platforms to leverage the functionality. For example, consider U.S. Naval aviation crews that conduct similar mission sets, but have their own unique doctrinal phraseology. Although each platform may prosecute an antisubmarine warfare (ASW) mission similarly, their doctrinal phraseology is likely specific to their respective platforms. The solution should have enough flexibility to account for platform specific changes, or multiple platform accommodations. Further, the resulting software capability should include up-front "train the speaker" modules.

NEED

ASR successes within simulation-based training systems have been modest. Some domains have overcome the complex challenges that exist in implementing ASR by making use of enforced doctrinal phraseology, which the speech recognition technologies can exploit. However, in more complex and fluid training environments that are less structured, more complex natural-language processing techniques are necessary to achieve that purpose. These environments require ASR systems with the flexibility for the instructor to customize and edit the feature.

BENEFITS

This effort seeks to provide a capability for end users of ASR-enabled training systems to edit or customize the feature to better match their particular needs, which is a significant system upgrade. Within military domains where tactics and protocols adapt over time, so the technology sought should provide training personnel with functionality to append a particular phrase or a specific term to the existing grammar.

STATUS

This STTR has undergone competitive source selection to award Phase II. Currently, two performers were selected to move forward with a gated Phase II. The two performers were selected as they both came to the problem with unique and innovative solutions to the STTR topic. The selected performers have conducted feasibility analyses, designed and developed prototypes, and are now turning the prototype systems into full technology capabilities.

MILESTONES

- Phase I:
  - ◊ Closeout briefs were held with each of the contractors to discuss Phase I progress and Phase II plans
  - ◊ Phase I Option was awarded for two vendors
- Phase II:
  - ◊ Phase II contract awarded in October 2018 and initial technical work is in progress
  - ◊ The gated period of the Phase II contract will closeout in August of 2019
  - ◊ Down-select to one performer is planned for early FY 20 to continue the 15 month Phase II

EXPLORATION OF KINESTHETIC AND HAPTIC TECHNOLOGIES IN VIRTUAL TRAINING ENVIRONMENTS

OBJECTIVE

The objective of this effort is to enhance a virtual reality (VR) trainer with the ability to teach physical procedures while providing the user with haptic feedback. This will involve a full exploration of the various commercial off-the-shelf wearable haptic devices. We will implement a virtual, full hand simulation and provide both textural and thermal feedback as well as realistic physical resistance in an immersive VR environment.

LCDR Ryan Kramer explores a simulated Virginia class submarine in the VR prototype for the Virtual Interactive Shipboard Instructional Tour® (VISIT®).

PROJECT DURATION

OCT 2017 - SEP 2019

SPONSORS

Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: WFD

POINTS OF CONTACT

Eric Peterson (PI)
eric.k.peterson@navy.mil

CDR Wilfred Wells
wilfred.wells@navy.mil

DESCRIPTION

Our development will focus on integrating various haptic devices with the HTC Vive (VR Head Mounted Display) and Unity (software gaming environment). Each haptic device comes packaged with an Application Programming Interface (API) and a Unity plugin that we must research thoroughly before device testing can begin. Once the various Software Development Kits (SDKs) are fully understood, appropriate tests can be developed to explore the strengths and weaknesses of each device. We will test the ability of each device to perform specific tasks such as turning valves on a submarine and operating controls necessary to perform maintenance on the E-28 aircraft arresting gear.

NEED

Haptic devices are an emerging technology and their training benefit has yet to be fully explored and validated. There is a strong demand signal for VR training using these novel, emerging devices. The primary reasons are twofold: (1) the requirement to reduce cost to develop and maintain training, and (2) the desire to provide just-in-time training anywhere, independent of location .

BENEFITS

The knowledge gained during this effort will be leveraged into proposals for customers and serve as the framework to build test beds or prototypes with the plan to transition them into production ready training products such as VISIT 3D™.

STATUS

This project concluded in Sep 2019 with the following major accomplishments:

1) Conducted capability assessment and a pilot usability study documenting strengths and weaknesses of each device procured to include: Manus Prime One, Avatar VR, UltraLeap Stratos, Leap Motion, and VMG 30+

2) Integration Experiments: Integrate the devices into existing 3D training systems and determine their effectiveness.

3) Documented lessons learned and developed a product usability report.

MILESTONES

- FY18, Explored the latest haptic technologies and their associated software development kits. Upon mastery of the APIs, we developed performance and capability tests for each platform. We met our goal to procure and explore, at least, five unique haptic glove devices.
- FY19: Conducted a thorough assessment of the haptic device technology procured as it relates to warfighter training and documented the results.

EXTENDED FIELD OF VIEW (FOV) VIDEO AVIATION TRAINING AIDS

OBJECTIVE

Investigate the viability of improving initial flight training by comparing traditional training methods to use of these methods augmented by the incorporation of extended FOV video.

The T-6A Texan II is a tandem-seat, turboprop trainer whose mission is to train Navy and Marine Corps pilots and Naval Flight Officers.

PROJECT DURATION

OCT 2017 - SEP 2019

SPONSORS

Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: BAR

POINTS OF CONTACT

LT Aditya Prasad (PI)
aditya.prasad1@navy.mil

CDR Wilfred Wells
wilfred.wells@navy.mil

DESCRIPTION

Two populations of student aviator performance will be measured and compared on targeted primary flight syllabus events. During mission planning and rehearsal, the first group will utilize traditional "chair flying" techniques, in which student aviators mentally rehearse for upcoming events by walking through checklists, procedures, and decision points. The second group will have access to extended FOV video recordings of the event that provide perspective on task load, timing, sequence, and spatial orientation of visual and audio cues the student could expect to see during the event.

NEED

360° video and VR training technology are rapidly becoming mainstay, and vendors continue to penetrate senior leadership ranks with promises of effectiveness. Empirical evidence of the effectiveness of these training media for the undergraduate military flight curriculum is urgently needed by PMA and resource sponsor decision makers to help these and other NAE stakeholders make better informed decisions about capability purchases. We need a much stronger body of literature regarding the utility of VR for aviation training.

BENEFITS

Incorporating extended FOV video into training could yield faster orientation to challenging mission types, as students would already have exposure to the visual and audio cue and decision sequences they could expect to see. The simulator and flight time typically required to develop situational awareness to a new flight regime could be potentially reduced.

STATUS

Stereoscopic 3D camera mounting rig currently undergoing interim flight clearance process at NAS Whiting Field. Recently awarded FY20 funding–extending project length by one year in order to provide ample time to collect data from a sufficient number of participants (three 2-week data collection periods spread out over CY20).

MILESTONES

- Identification of representative sorties in TH-57 (completed March 2018)
- Design metrics and experimental design (completed March 2019)
- Conduct recording and playback media analyses (June-August 2019)
- IRB Approval (expected September 2019)

FLIGHT DECK CREW REFRESHER TRAINING EXPANSION PACKS (TEP)

OBJECTIVE

The objective of this effort is to create an expandable framework of game-engine-based, immersive 3D Flight Deck Crew Refresher Training Expansion Packs (TEP) for use by trainees in Fleet Concentration Areas (FCAs). The TEPs shall allow for individual, team, or multi-team training events, and shall utilize appropriate combinations of state of the industry immersive technologies, including virtual reality.

Screenshot of actual 3D flight deck and aircraft models used for the effort.

PROJECT DURATION

JUL 2017 - SEPT 2020

FUNDING S PONSORS

Office of Naval Research, ONR-34
Naval Aviation Training Systems Program Office, PMA-205
CVN 78-Class Program Office, PMS-378

POINTS OF CONTACT

Courtney McNamara (PI)
courtney.mcnamara@navy.mil

DESCRIPTION

NAWCTSD has created an expandable system baseline architecture and built three flight deck teams: 1) Primary Flight Control (Pri-Fly) TEP, 2) Landing Signal Officer (TEP), and 3) Catapult Launch TEP. The development process has included over 55 fleet SMES from 5 carrier hulls and 2 schoolhouses. Work is continuing by adding faults, scenarios, and passes to the existing teams, expanding teams, and delivering to Norfolk in the C-ARTS system via a CRADA with Cape-Henry Associates and PMS-378,

NEED

Flight Deck Crew readiness, refresher, and certification training opportunities are limited. The training pipeline and available technology for flight deck crew initial training is often limited or outdated. Flight deck crew members are often sent to other underway carriers for refresher training and readiness sustainment. This is costly to the ship and logistically challenging. This practice results in crew members not training with their actual team members. New Ford Class carrier crew members are not training on the correct ALRE gear.

BENEFITS

- Increase readiness, refresher, and certification training opportunities for aircraft carrier flight deck personnel by providing training at FCAs for individual, teams, and multi-team coordination.
- Allow for single trainee, single team, and multi-team training opportunities for flight deck crews.
- Prevent stovepipe training solutions for flight deck crews.
- Target crew specific ALRE and flight deck parameters (e.g., Legacy Steam Catapults vs EMALS).
- Include technologies that allow trainees to use realistic communications and equipment and provide an immersive environment for the trainee with the appropriate fidelity.

STATUS

The Primary Flight Control (Pri-Fly) and Landing Signal Officer (LSO) Editions were delivered to the LSO School in NAS Oceana in FY18. The Catapult Launch Team was delivered to CNATT in FY18. All three teams will receive updates and additional functionality in FY19-FY20. Pri-Fly and Catapult Launch will be delivered to Norfolk Naval Station in FY20.

YOUTUBE LINK:

https://www.youtube.com/watch?v=OSQLBX2WUqI

MILESTONES

- Final system:
  - Pri-Fly TEP with connectivity to LSO and/or Catapult Crew
  - Software Baseline Architecture for connectivity of all future TEPs
  - Ending technology readiness level (TRL): TRL Level 6
- Documentation:
  - User Manual
  - Technical Manual

IMMERSIVE PARACHUTE DESCENT PROCEDURE, MALFUNCTION, AND DECISION-MAKING TRAINING SYSTEM (N161-007)

OBJECTIVE

Develop a novel reconfigurable device training system that provides immersive Parachute Descent Procedure (PDP), malfunction and decision-making training to allow the survival training community to deliver cross-platform training without the need for multiple training systems or platform specific peripherals.

Left: Aviation Survival Training Center instructors test prototype parachute procedure trainer during feedback session for design refinement.

Right: Game-based variant of parachute trainer installed at local game arcade for user testing.

PROJECT DURATION

JUN 2016 - SEP 2021

SPONSORS

Naval Air Systems Command (NAVAIR) | Small Business Innovative Research (SBIR)

POINTS OF CONTACT

Beth Atkinson (TPOC)
beth.atkinson@navy.mil

John Hodak (PM)
john.hodak@navy.mil

DESCRIPTION

This project is a Small Business Innovative Research (SBIR) project targeted at researching, designing, and developing a novel, immersive training system that provides the ability to train aviators by addressing three capabilities gaps: 1) training quality and effectiveness, 2) supportability, and 3) training realism. The training system should provide a reconfigurable interface that supports all Navy standard flight equipment and parachute equipment. Developed technology would provide the ability to demonstrate effectively both standard procedures (e.g., inflation of the life preserver, releasing the raft when applicable) and parachute malfunctions.

NEED

Current parachute procedure safety training is based on technology that has inadequate effectiveness and realism, primarily due to limitations that prevent interfacing with standard flight and parachute equipment. An advanced training solution will provide a reconfigurable connection for a variety of aircrew equipment and seat kits, which differ by platform.

BENEFITS

Cross-platform survival training, without the need for multiple training systems, will help avoid potential training costs, as well as allow aviators more flexibility within training systems. The increased fidelity of the training will also help aviators more effectively learn about parachute descent procedures, which are important survival procedures.

STATUS

This SBIR underwent a competitive source selection to award Phase I contracts, during which four contractors conducted feasibility analyses and designed/developed prototypes. Based on progress made during Phase I and technical feasibility of Phase II designs, the evaluation team recommended a gated Phase II award for two vendors to continue design and development efforts. Resulting prototypes from Phase II base efforts were delivered and demonstrated to personnel within the Naval Survival Training Institute. A single vendor will continue design and development efforts during FY19-FY20, working to deliver a comprehensive, reconfigurable prototype for evaluation.

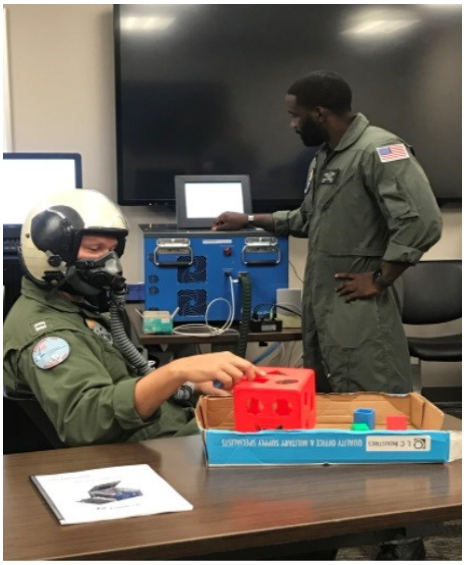
MILESTONES

- Phase I:
  - Four Phase I contractors status was monitored via bi-monthly progress reports and periodic status updates
  - Closeout briefs were held, resulting in Phase I Option awards for two vendors
- Phase II:
  - Phase II gated efforts were awarded for two vendors, resulting in a demonstration prototype
  - Phase II base period resulted in selection of a single Phase II vendor for the option period, with expansion funding
  - Software and/or hardware updates made approximately quarterly to address user feedback and provide iterative improvements in technology
  - A multi-player arcade style game was developed based on the parachute trainer, which competed in the I/ITSEC 2018 Serious Game Challenge and has since been installed at a local video arcade for public use

RESEARCH TO ADVANCE THE ON-DEMAND HYPOXIA TRAINER FOR SURVIVAL TRAINING

OBJECTIVE

The effort seeks to continue research and development of a next generation hypoxia-training device. The goals of this research include analysis of average flow rate requirements, impacts of oxygen concentration on recovery, and continued development to enhance the system effectiveness and reliability.



Engineering testing of On-Demand Hypoxia Trainer with Aerospace Physiologists at NAS Pensacola to validate pressure on demand and initial training profile for hypoxia training.

PROJECT DURATION

MAR 2018 - MAR 2020

SPONSORS

Naval Aviation Training Systems Program Office, PMA-205
Defense Health Agency, DHA

POINTS OF CONTACT

Beth Atkinson (PI)
Beth.Atkinson@navy.mil

CDR Wilfred Wells
wilfred.wells@navy.mil

DESCRIPTION

This effort seeks to empirically evaluate research questions about the On-Demand Hypoxia Training (ODHT) including: 1) the impact of variable oxygen concentration on recovery rates, 2) the effect of variable flow rates on breathing and experience of hypoxia symptoms, and 3) development to refine the product based on iterative fleet validation testing. Finally, this effort will investigate parallels that can be drawn between the cognitive decrements associated with alcohol intoxication and those associated with hypoxia.

BENEFITS

The acknowledged success of hypoxia training makes it paramount that the Navy ensures these capabilities remain available. In addition to providing a means for addressing the larger Navy research into mitigating hypoxia physiological episodes, this effort will advance the lab's understanding of hypoxia training. Further, this effort will provide the means to thoroughly investigate a novel technology to determine the effectiveness and efficiency of the devices to deliver higher fidelity training opportunities.

NEED

Hypoxia continues to remain a highly visible safety issue, with training being a significant part of the mitigation process. An ODHT prototype technology has been developed to overcome . However, in order to ensure a successful transition of the OHDT, additional research is necessary. These proposed studies will provide results that are essential to inform the design, establish standard operating procedures, and validate the effectiveness and reliability of a novel prototype hypoxia trainer prior to procurement.

STATUS

The team has received approval on research protocols submitted to the Institutional Review Board to collect data. Initial data has been collected for flow rate and oxygen recovery research questions. Efforts continue to refine the design and development of the system regulator and other subassemblies based on fleet validation testing. Preliminary findings on the parallels between cognitive decrements associated with hypoxia and alcohol intoxication have been completed.

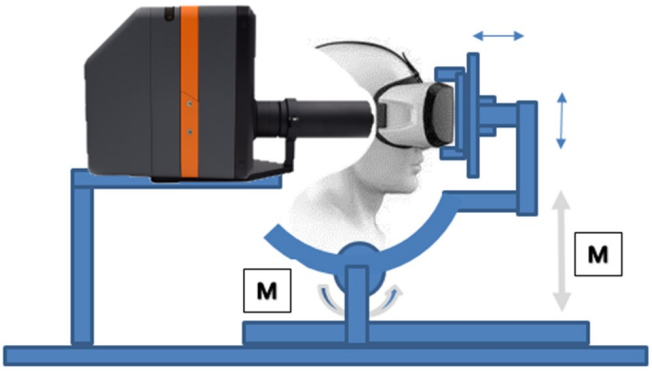
MILESTONES

- Presentations: Atkinson, Entinger, Tindall, Gilg, Scripture, Immeker, McEttrick, Sciarini, & Murr, (2018). A preliminary look at hypoxia compared to alcohol intoxication. Poster presented at AsMA 2018-Dallas, TX.
- Workforce Development: Mentored junior teammates on program management, data collection and analysis, and coordination with fleet customers.
- Transitions: Based on data collected at Miramar, CA and Pensacola, FL the team has designed and developed alternative human machine interface options and refined the subassembly design to increase the fidelity of the pressure-on-demand airflow ahead of procurement of a training device. PMA-205 plans to procure devices in FY20 with fielding continuing into FY21. Results of additional human testing research will refine the Standard Operating Procedures for the aviation survival training location.

STRATEGIC DEVELOPMENT OF NEAR EYE DISPLAY PERFORMANCE METRICS FOR NAVAL AVIATION TRAINING APPLICATION

OBJECTIVE

Develop techniques, tools, and procedures for measuring performance of near eye display systems (NED), such as virtual reality (VR), augmented reality (AR), and mixed reality (MR) head mounted displays (HMD).



Concept Near-eye Display Imaging Colorimeter and AR/VR Headset Testing Mount

PROJECT DURATION
APR 2019 - DEC 2021

SPONSORS
Naval Air Warfare Center Aircraft Division
(NAWCAD) | NISE: SG
Naval Aviation Training Systems Program Office, PMA-205
H-53 Heavy Lift Helicopter Program Office, PMA-261

POINTS OF CONTACT
Benito Graniela (TPOC)
benito.graniela@navy.mil

Bruce Riner (TPOC)
bruce.riner@navy.mil

CDR Wilfred Wells

DESCRIPTION
This project is looking at VR/AR/MR technology and adapting existing visual system measuring techniques and procedures to NED. The Navy is seeking collaboration with developers and system integrators to develop metrics and procedures that accurate quantify performance.

NEED
The popularity and advancing capabilities of commercial VR/AR/MR headsets has opened the opportunity for the innovative application to Naval Aviation Training Applications. However, current methods for assessing visual display systems do not necessarily apply to NED devices.

BENEFITS
Knowledge within the Navy on the pros and cons and applicability of VR/AR/MR devices to Naval Aviation missions is necessary. Technology is currently advancing quickly and it is therefore necessary to keep track of advances and capabilities and update a road map for further R&D and SBIRs. This project will generate the necessary Navy workforce knowledge and enable new subject matter experts to answer these questions.

STATUS
Established lab at TSD, which included the procurement (headsets and lens) and development of VR/AR lab equipment and software (VR/AR mount [see figure] & VR test patterns). Identified initial set of VR/AR parameters and started to research and document metrics and procedures. Coordinated efforts with FSI and MFS.

MILESTONES

- 219 WFD SD award 4/9/19.
- Established CRADA with FSI July 2019.
- NISE Sec 219 End of Year Review Sep 2019.
- Complete first set of field and lab metrics Spring 2020.
- Complete development of NED mount Spring 2020.
- NISE Sec 219 FY20 Mid Year Review Spring 2020.
- Baseline performance of NED Summer 2020.
- Publish paper on initial results Summer 2020.
- Publish paper on final metrics and results Summer 2021
- Final Report Dec 2021.

TRANSITION OF A PRESSURE ON-DEMAND NORMOBARIC HYPOXIA TRAINING DEVICE FOR SURVIVAL SCHOOLHOUSES

OBJECTIVE

The effort seeks to support the technology transition of a next generation hypoxia-training device under development. The goals of this research include analysis of logistical concerns, human factors evaluations, and human testing to validate the fidelity and effectiveness.

Engineering testing of On-Demand Hypoxia Trainer with Aerospace Physiologists at NAS Pensacola to validate pressure on demand and initial training profile for hypoxia training.

PROJECT DURATION

OCT 2017 - SEP 2019

SPONSORS

Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: TT

POINTS OF CONTACT

Beth Atkinson (PI)
Beth.Atkinson@navy.mil

CDR Wilfred Wells
wilfred.wells@navy.mil

DESCRIPTION

This effort will conduct the research and development efforts necessary for validating the fidelity, safety and concept of operations of the On-Demand Hypoxia Training Device under development for transition to PMA-205. In addition to the required research, we intend to conduct separate independent tests and evaluations to document the performance parameters and benefits of the novel technology for existing and potential acquisition communities. Specific tasks include: research and analysis of logistic requirements for training technology; conduct Human Factors Evaluation of the instructor console; conduct human testing with a military aviator population; and validation of training system.

NEED

As hypoxia continues to remain a highly visible safety issue, focus on a range of potential mitigation solutions is imperative. While a variety of engineering solutions aimed at the aircraft are being considered and tested, the final line of defense will remain in the hands of our trainers.

BENEFITS

The acknowledged success of hypoxia training makes it paramount that the Navy ensures these capabilities remain available. In addition to providing a means for addressing the larger Navy research into mitigating hypoxia physiological episodes, this effort will advance the lab's understanding of hypoxia training. Through usability analyses, researchers will document ways to increase the ease of use of the instructional capability. Further, this effort will provide the means to thoroughly investigate a novel technology to determine the effectiveness and efficiency of the devices to deliver higher fidelity training opportunities.

STATUS

First year tasking in FY18 focused on researching logistic requirements, conducting human factors evaluations of the prototype instructor console, and preliminary engineering testing with a military population. FY19 focus included completing data collection, analysis and reporting.

MILESTONES

- Manuscripts/Publications: Atkinson, Reeh, Zbranek, Balasubramanian, McEttrick, Immeker, & Scheeler. (2017). Increased system fidelity for navy aviation hypoxia training. Proceedings of the 2017 I/ITSEC.
- Presentations:
  - Atkinson et al. (2018). Aircrew self-report of physiological episodes: Lessons learned & the road ahead. Poster presented at AsMA 2018
  - Atkinson, Reeh, Zbranek, Balasubramanian, Marnane, McEttrick, Immeker, Scheeler, Netherland & Berry. (2019) Preliminary Analysis of a Pressure on Demand Hypoxia Training Device for Aviation Survival Training. Presented at AsMA 2019.
- Workforce Development: Mentored junior teammates on program management, transition, engineering and usability analyses.
- Awards: B. Atkinson, (2018, January 15). Naval Aerospace & Operational Physiology Special Recognition Award.
- Transitions: In FY18-19 engineering testing was conducted at multiple fleet sites including Miramar, CA and Pensacola, FL. A prototype system has been delivered to the Aviation Survival Training Center Pensacola for pre-procurement testing. The acquisition has been kicked off by PMA-205 with a planned procurement in FY20.

TUX-FLIGHTFIT: AUGMENTED REALITY (AR) TRAINING SOLUTION FOR U.S. NAVY PR RATE

OBJECTIVE

Develop augmented Reality (AR) training software for commercial Head Mounted Display (HMD) systems, leveraging AR Structured On-the-job-training (S-OJT) prototype Transparent User Experience (TUX) developed for previously completed project, "Spatial Augmented Reality Training Utilizing a Transparent Display" (19WFD-SG-17-015).

Representation of Augmented Reality Structured-On-the-Job Training in action

PROJECT DURATION

JAN 2020 - SEP 2020

SPONSORS

Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: iSPRINT

POINTS OF CONTACT

Sam Cosgrove (PI)
samuel.cosgrove@navy.mil

CDR Wilfred Wells (PM)
wilfred.wells@navy.mil

DESCRIPTION

The Physiological Episodes Action Team (PEAT) identified that poor fitting of protective wear and flight equipment as a possible branch of a Root Cause Analysis (RCA) for the physiological episodes experienced by U.S. Navy pilots. Additionally, a gap was identified in Aircrew Survival Equipmentman (PR) rate training for fitting equipment on pilots. To address this gap, PR rates need structured on-the-job training (S-OJT). The training requires many scenarios to cover procedure variance for flight equipment and body types and should be scaffolded ("walk, crawl, run" style) to provide guided and unguided learning scenarios. The training will also need visual accuracy for virtualized equipment for visual cue recognition of equipment states

NEED

The throughput of current training equipment cannot adequately serve the PR rate community. To meet these training requirements, PR rates need an augmented environment that can be rapidly reconfigured and provide a scaffolded learning experience.

BENEFITS

If successful, AR training at required fidelity can be delivered widely to many fleet communities at lower cost.

STATUS

This is an FY20 new start.

MILESTONES

- After in-house development testing and Front End Analysis, two AR training systems will be demonstrated at a representative operational environment in FY20 for on-site utility evaluation.

CREW ROLE-PLAYER ENABLED BY AUTOMATED TECHNOLOGY ENHANCEMENTS (CREATE) N142-090

OBJECTIVE

Develop a software application/ suite that provides a synthetic crew role player to support complex crewmember interactions during dynamic training events.

Aircrewmen assigned to Patrol Squadron (VP) 8 perform pre-flight procedures aboard a Boeing P-8A Poseidon maritime aircraft in preparation to support search and rescue efforts for the missing Republic of Korea cargo ship crew in the FOURTH Fleet Area of Operations

PROJECT DURATION

OCT 2014 - SEP 2020

SPONSORS

Naval Air Systems Command (NAVAIR)
Small Business Innovative Research (SBIR)

POINTS OF CONTACT

John Killilea (TPOC)
john.killilea@navy.mil

Beth Atkinson (Co-TPOC)
beth.atkinson@navy.mil

John Hodak (PM)
john.hodak@navy.mil

DESCRIPTION

This effort seeks to design and develop a software application/ suite that provides a synthetic role-playing capability that will serve to enhance the training pipeline and potentially avoid costs and provide value added without the use of training aids. The required technology solution must integrate speech capabilities (i.e., recognition, understanding, synthesis), Subject Matter Expert level tactical domain information, reaction to multitasking and high stress situations, and relay of information via means other than speech communication (e.g., software inputs), are required.

NEED

Current Navy crew training requires the assembly of an entire crew or the use of Subject Matter Experts to support crew training. While training benefits from the additional costs associated with bringing a full crew together, some individual training could benefit from the added realism provided by crew interaction. During these events, the emphasis is on the crew member's individual skills; however, many tasks associated with their role may rely on inputs from other crew members.

BENEFITS

CREATE will enhance the training pipeline by streamlining the instructor's efforts during training. This will also add to the potential cost avoidance and provide value added without the use of training aids. Instructors will be able to manage more trainees at once in a more efficient manner, and be able to deliver more tailored instruction and feedback if necessary, increasing the quality of training.

STATUS

During Phase 2 and 2.5 efforts, the government worked with the contractor and transition customers to continue component research and development. Throughout this period, periodic demonstrations were conducted to the P-8A Fleet Project Team. Expansion efforts under the Phase II involved initial integration efforts with Boeing and NGTS, which were expanded upon during Phase II.5 efforts. The team works to continuously improve the speech recognition capabilities of the technology. Phase 3 began in May of 2019 and focuses on implementation and testing within the P-8A part-task trainer, as well as further speech recognition hardening and testing.

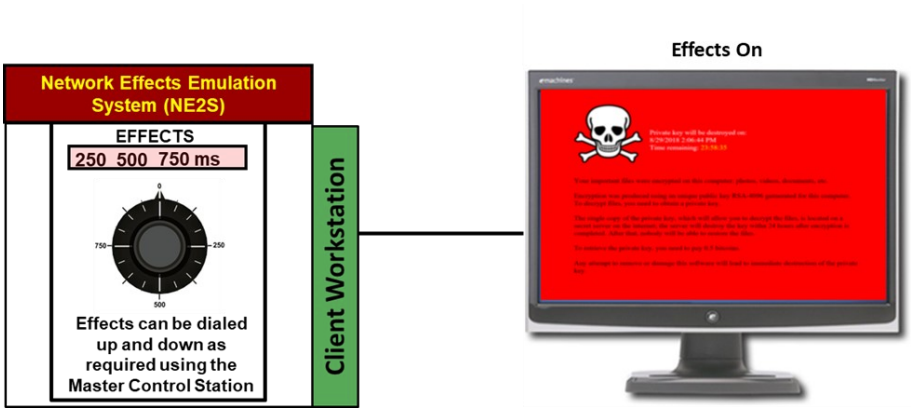
MILESTONES

- Phase III:
  - Phase III contract awarded May of 2019
  - Phase III focuses on the testing and integration of the CREATE system with the P-8A Part-Task Training simulators

- Manuscripts/Publications: Atkinson, B. F. W., Killilea, J. P., Stensrud, B., Marinier, B., Schermerhorn, P., Dettmering, C., Saadat, S., & Anania, E. C. (2017). *Crew role-players enabled by automated technology enhancements*. Proceedings of the Interservice/ Industry Training Simulation & Education Conference, Orlando, FL.
- Anania, E. C., Killilea, J. P., Atkinson, B. F. W. (2018). *The application of automation systems for training - Implications of trust*. Proceedings of the Interservice/Industry Training Simulation & Education Conference, Orlando, FL.
- Presentations: Anania, E. C., Atkinson, B. F. W., & Killilea, J. (2017, October). *The application of automation systems for training - Implications of trust*. Presenting at the SAFE Symposium, Orlando, FL.

COMPUTER DEFENSE NETWORK (CDN) TRAINER (N171-023)

OBJECTIVE
Develop a prototype Computer Network Defense (CND) trainer to enable CND personnel to be active participants in traditional Navy training and exercises.



PROJECT DURATION
AUG 2018 - MAR 2020

SPONSORS
Naval Air Systems Command (NAVAIR) | Small Business Innovative Research (SBIR)

POINTS OF CONTACT
Derek Bryan (PI)
dbryan@ingeniaservices.com

Jonathan Glass (PM)
jonathan.glass@navy.mil

DESCRIPTION
The CND trainer is a Phase II SBIR project that is developing a prototype software tool that safely and securely emulates cyber threats on operator workstations. The emulated threats trigger operational CND sensors and databases (e.g., Host-Based Security System) used by CND personnel to assess and maintain the cyber security of Navy networks and systems. Emulated threats are configured, deployed, and managed via a web-based Master Control Station.

NEED
Recent research within the Joint training community, the Naval Postgraduate School, and others has resulted in the development of several cyber emulator prototypes. Some of these cyber emulators have been demonstrated and deployed during exercises, in limited and small enclaves, to provide a basic cyber-degraded environment for a staff to experience and fight through. While useful in that context, these emulators are not designed or capable of stimulating CND capabilities critical to defending our networks. What is needed is a training capability that can securely and realistically stimulate CND sensors, databases, processes, and personnel and that can be synchronized with the overall training scenario and exercise control processes and procedures.

BENEFITS
The CND Trainer will allow Navy CND personnel, ashore and afloat, to be active participants in training and exercises in a way that was previously not possible, consequently improving the cyber security of Navy networks and enhancing overall mission assurance and command and control of Naval operations.

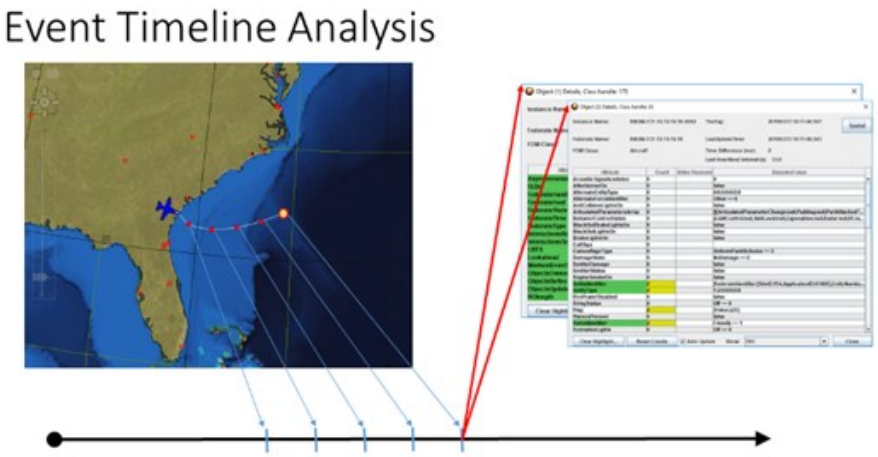
STATUS
Five months remaining in the Phase II base period. On schedule.

MILESTONES
- Phase I
  - ◊ Two contractors selected for Phase I.
  - ◊ CND Trainer requirements developed and validated.
  - ◊ Two designs proposed and evaluated by Navy engineers and scientists.
- Phase II
  - ◊ One contractor selected for Phase II.
  - ◊ CND Trainer prototype under development and has been deployed for testing at the U.S. Army's Maneuver Battle Lab.
  - ◊ Phase II base period ends March 2020.
  - ◊ Several potential DoD and commercial transition partners.

DISTRIBUTED SIMULATION DATA MONITORING, ANALYSIS, AND VERIFICATION

OBJECTIVE

The object of this effort is to research, design, and implement enhanced distributed simulation data monitoring, analysis, and verification capability for the Federation Agreement Compliance Test Tool (FACTT) Suite.



PROJECT DURATION

APR 2019 - NOV 2021

SPONSORS

Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: WFD

POINTS OF CONTACT

David Shen (PI)
david.t.shen@navy.mil

Brett Trantham (DPI)
brett.trantham@navy.mil

CDR Wilfred Wells (PM)
wilfred.wells@navy.mil

DESCRIPTION

There are three capability to be implemented in this effort:

1. Capability to perform analysis and verification of the data collected by the existing FS JBUS federation data translation test capability.
2. Capability to monitor and record all simulation data within a period of time while detecting and marking the occurrence of events of interest as specified by the user on a timeline .
3. Capability to monitor the simulation and provide user selected metrics during runtime. This capability will generate metrics related to the overall simulation traffic such as throughput and transmission delay as well as finer granularity metrics related to specific classes or instances of simulation objects such as max and average object update intervals per class or instance.

NEED

There are many challenging areas related to testing and verification of distributed simulation data. The proposed capabilities will address some of those issues by performing data analysis on raw simulation data and presenting them to the users in a format that is easier to understand and conducive to further analysis and assessment.

BENEFITS

This effort will speed up the analysis and testing platform compliance to the Navy Aviation Simulation Master Plan (NASMP)/ NCTE Interoperability Standard (NIS) standards.

STATUS

The current requirements collection and analysis phase is in progress and it is expect to end by the end FY19 with the generation of a Software Requirement Specification (SRS).

MILESTONES

- ♦ SRS complete
- ♦ CDR complete
- ♦ Implementation and testing complete

DISTRIBUTED TRAINING NETWORK GUARD (DTNG)

OBJECTIVE

Develop a controlled interface that allows for extension and enhancements in a cost effective, short time period. The DTNG controlled interface operates between two simulation network security enclaves of differing administrative domains having the same security classification. The DTNG enforces security policies and controls the flow of information between these domains via a filtering rule set that pass, fail, or sanitize the training simulation data.

DTNG Logo

PROJECT DURATION

OCT 2016 - SEPT 2019

SPONSORS

Naval Aviation Training Systems Program Office, PMA-205
Joint Strike Fighter (JSF)

POINTS OF CONTACT

Jeanette Lobel (PI)
jeanette.lobel@navy.mil

John Hodak (PM)
john.hodak@navy.mil

DESCRIPTION

The DTNG provides a capability to label, segregate, protect, and exchange data between two interconnected simulation networks operating at the same classification level. This capability is designed to meet the data format and near real-time performance requirements of distributed training exercises.

As a controlled interface, the fundamental security requirements for the DTNG are to (a) protect classified information appropriately, (b) protect information from malicious or accidental tampering, loss, and destruction, (c) protect the DTNG system from foreseeable denial of service conditions, and (d) manage changes affecting the security of the DTNG.

NEED

Distributed training environments are in need of a controlled interface that enables training system connectivity with the ability to process multiple live, virtual and constructive (LVC) protocols, offering protection of program-specific "need-to-know" data from one or more of the participating training systems.

BENEFITS

The DTNG allows the various aviation platforms such as F/A-18, JSF, and E-2D to train in LVC environments with coalition partners while protecting sensitive information. Aviation platforms will no longer be limited to Training and Readiness (T&R) checks at the lowest required level of classification, and will greatly increase the efficiency and usage of training systems. Aviation platforms will also no longer need to hold separate, standalone events to conduct their higher classification specific, protected data training–allowing more Navy crews to train together and increase the number of T&R opportunities.

STATUS

DTNG was developed in the Interoperability, Design, Engineering & Application (IDEA) lab. The first DTNG system was deployed in the Navy Aviation Distributed Training Center (NADTC) at NAS Oceana in May 2017. Additional DTNG systems have been deployed to the NADTC in the second quarter of FY-19 to support other Navy aviation platforms. The DTNG supports the Distributed Interactive Simulation (DIS) v6 simulation protocol, while maintaining interoperability with High Level Architecture (HLA) simulation protocols with the use of the Joint Simulation Bus (JBUS) gateway. Development for this version of the DTNG has completed and is in the sustainment phase.

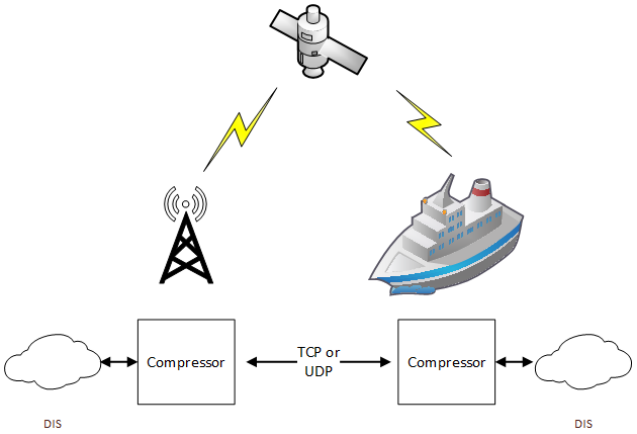
MILESTONES

- DTNG v3.2.0 baseline installed in the NADTC, NAS Oceana in February 2019. System enters sustainment phase.
- DTNG v3.1.3 baseline installed in the NADTC, NAS Oceana in May 2017.
- DTNG 3.1.0 baseline completed and submitted for ATO approval to support F-18 C/D training system. (December 2016)

LIVE VIRTUAL CONSTRUCTIVE (LVC) DATA TRANSPORT COMPRESSION

OBJECTIVE

Investigate and develop a tool to provide lossless compression modeling of training simulation data (Compressed-Distributed Interactive Simulation / Distributed Interactive Simulation) for transmission between land-based facilities and live assets over bandwidth-constrained and contested data channels. Identify techniques to cope with data loss incurred in the communications channel and recover from the data loss.



Investigate use of streaming data compression to pass modeling and simulation data over a narrow bandwidth data channel.

PROJECT DURATION

OCT 2019 - SEP 2020

SPONSORS

Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: WFD

POINTS OF CONTACT

Peter McCarthy (PI)
peter.mccarthy@navy.mil

CDR Wilfred Wells (PM)
wilfred.wells@navy.mil

DESCRIPTION

Modeling and simulation data occurs in small, frequent packets (typically 100-1000 bytes). Lossless compression on a single packet of this size is not possible so this compression must occur on a stream of packets. The challenges include: (1) The data compression is across a stream of packets, packet loss must be recognized and accounted for in some way. (2) Greater compression is possible across a longer stream of packets. How often should the stream state be reset to balance compression needs and packet loss.

NEED

As training begins to incorporate live ships at sea, there is increased need to pass modeling and simulation data between these ships and shore-based training assets. This data is passed over bandwidth-limited channels, such as a satellite channel. To be maximally useful, these compression techniques should be transparent to the network connection and not require pre-configuration.

BENEFITS

Interoperability is essential to supporting training in an integrated, interactive environment. Early participation in standards development ensures that the Navy's requirements are represented and that we maintain awareness of novel developments by other SISO members that may benefit our Science and Technology, Research and Development, and/or acquisition. Further, calls for quantitative data and big data analytics to understand proficiency requires access to the right data. Therefore, it is imperative to ensure that distributed training environments support assessment of performance and provides an architecture that facilitates distributed debriefs.

STATUS

This is an FY20 new start.

MILESTONES

- Obtain data compression library and procure two VTBe hardware units (Nov 18)
- Design and implement data compression module for VTBe. (Mar 19)
- Design and implement user controls for data compression module. (May 19)
- Conduct experimentation in lossy data environments with data compression module and explore the tradeoff between compression and loss recovery. (Jun 19)
- Conduct experimentation into the tradeoff between data truncation and lossless data compression. (Jul 19)
- Participate in delivery event with ONR-34 at a COMPTUEX. (Aug 19)

ENVIRONMENT DESIGNED TO UNDERTAKE COUNTER A2AD TACTICS TRAINING & EXPERIMENTATION (EDUCAT2E)

OBJECTIVE

The current effort will participate in analyses, definition and development of human performance measures, standards and interfaces for use in the Navy Continuous Training Environment (NCTE), and in the development of constructive models. Live, Virtual and Constructive (LVC) demonstrations are planned throughout the effort to display technologies and capabilities and gain subject matter expert feedback.

Participants in Fleet Synthetic Training Research, Development, Test & Evaluation event

PROJECT DURATION

OCT 2014 - SEP 2018

SPONSORS

Office of Naval Research, ONR-34

POINT OF CONTACT

Jennifer Pagan (PI)
jennifer.pagan1@navy.mil

Melissa Walwanis (PI & PM)
melissa.walwanis@navy.mil

DESCRIPTION

This S&T effort has two primary objectives:

1) Conduct analysis of multiplatform Electronic Warfare (EW) and Air Defense teams to understand how EW supports Air Defense & define roles/responsibilities, interdependencies, and multiplatform performance metrics
2) Define and develop synthetic, scenario based, distributed EW capabilities for Strike Group Electronic Warfare and Air Defense teams that can be used for both training and experimentation.

Outputs of this effort will support development of shore-based training technologies enabling training opportunities linked to both Basic and Intermediate Phase certification exercises.

NEED

Shore-based training events often lack inclusion of Information Warfare techniques preventing adequate exposure & integration within the Carrier Strike Group (CSG) prior to deployment certification. Thus, CSGs need training on all aspects of Information Warfare including Command & Control in Denied & Degraded Environments during both Basic & Intermediate training phases to effective CSG integration during deployment.

BENEFITS

This enabling capability will advance Fleet operational proficiency and readiness in sensing and characterizing EMS activity to enable adaptation and freedom of maneuver in the EMS as a means to effectively operate in C2D2E at the individual, unit and Composite Warfare Commanders levels.

STATUS

Paper-based measures and system-based measures for the Joint After Action Review-Resource Library (JAAR-RL) tool were developed under this effort are validated with EW/IO subject matter experts (SMEs) at Tactical Training Group Atlantic (TTGL). Both sets of measures were tested and implemented during the Fleet Synthetic Training - Research, Development, Test, and Evaluation (FST RDT&E) 18-1 event. Final measures have been delivered to JAAR-RL to facilitate full transition for use in operational FST events.

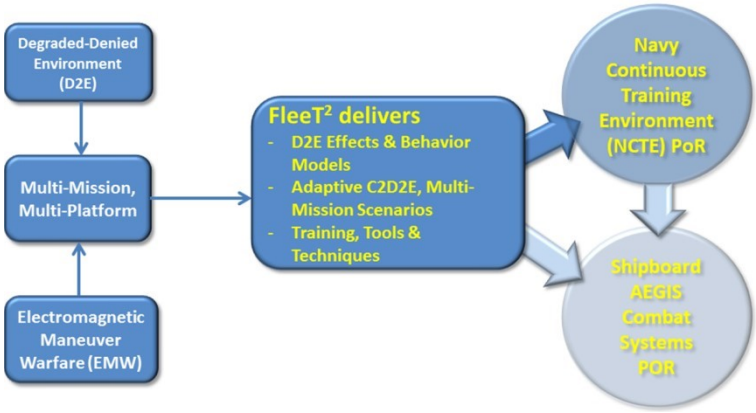
MILESTONES

- Transitioned EW/IO system-based measures to JAAR-RL
- Participated in the Fleet Synthetic Training - Research, Development, Test, and Evaluation (FST RDT&E) 18-1 event involving novel LVC training capabilities to exercise cross platform/multiteam interactions for electronic warfare team
  - Tested and implemented paper and system-based performance measures
  - Utilized distributed EA-18G training capabilities within a multiware domain to facilitate air and surface integration
- Delivered task lists, training gaps, and degradation framework to stakeholders

FLEET TRAINING TECHNOLOGIES (FLEET2)

OBJECTIVE

Currently, the Navy plans and trains for pristine Command and Control (C2) environments. While C2 is by itself complex, the emergence of peer threats makes it even more difficult to ensure resilient C2 processes. In a Denied/Degraded Environment (D2E), adversaries may deploy a variety of tactics that create a dynamic environment, rife with additional challenges. Training in the absence of these realities presents a threat to effective C2–a critical component of naval surface operations. FleeT2 will provide new training approaches and technologies.



PROJECT DURATION

OCT 2017 - OCT 2022

SPONSORS

Office of Naval Research, ONR-34

POINTS OF CONTACT

Heather Priest, Ph.D. (PI)
heather.priest@navy.mil

Melissa Walwanis (PM)
melissa.walwanis@navy.mil

DESCRIPTION

FleeT2 is designed to allow trainers to build scalable phenomenology models and virtual assets to simulate, test, and train to emergent threats and technologies. The virtual constructive simulation capabilities planned for Fleet2 will allow the system to produce accurate, detailed, threat-dense, and intense scenarios that would be cost prohibitive or otherwise impossible to perform in the real world. Synthetic models can be easily modified, repeated, and adapted to train various situations, user roles, and skill levels. Ultimately, Fleet2 will allow command teams and system operators to train for integrated, cross-platform warfare against simulated peer threats with counter D2 capabilities.

NEED

Naval surface Command and Control (C2) is a broad domain encompassing the management of coordinated electronic surveillance, information integration across enterprise sensors and information sources, and personnel/asset management in support of missions. Understanding all the demands facing C2 performers is further complicated by the fact that C2 personnel operate at many echelons of command and across many specialized functional areas. Creating the training systems and curricula necessary to support such a domain will be challenging.

BENEFITS

There are two anticipated benefits arising from the FleeT2 program. First, the fleet will have a secure environment to train to address Denied/Degraded Environment (D2E) threats. Further, the simulations will be extensible to evolving and emerging threats. Second, the fleet will be able to train for D2E operations more effectively at a lower cost. This should result in a reduction in underway deployments required for training while providing an environment that mirrors the real world.

STATUS

FleeT2 is a new start Pre-Future Naval Capability effort. In FY20 FST-RDTE V&V events will be conducted at NSCPAC in San Diego with TTGP. Technology developed will be tested and Fleet SMEs will provide feedback to team.

MILESTONES

- A Technology Transition Agreement was signed between the Office of Naval Research (Code 341), OPNAV N96 (Director, Manpower and Training), Fleet Forces Command (N72), Program Executive Office Integrated Warfare Systems Integrated Training (1IT), and the Navy Continuous Training Environment, NSWC Corona (RS20F).
- FleeT2 team conducted Fleet Synthetic Training-Research Development, Test & Evaluation (FST-RDT&E) Validation and verification (V&V) with Tactical Training Group Pacific (TTGP) to test technology and scenarios for larger exercises.
- FleeT2 team observed exercises with both TTGP and TTGL (Tactical Training Group Atlantic) including FST-J and COMPTUEX.
- FleeT2 conducted Subject Matter Expert (SME) workshop at TTGL.

INTEGRATED WARFIGHTING CAPABILITIES (IWC) FIDELITY

OBJECTIVE

This effort seeks to identify the impacts of physical fidelity on proficiency. Specifically, this effort will investigate the level of physical fidelity required to train various Naval Integrated Fire Control - Counter Air (NIFC-CA) specific tasks and skills identified by the PMA-205 funded Front End Analysis (FEA). Findings from this effort will provide empirical data to inform training requirements, as well as preliminary findings to understand the perishability.

PROJECT DURATION

OCT 2017 - SEP 2019

SPONSORS

Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: BAR

POINTS OF CONTACT

Jennifer Pagan (PI)
Jennifer.Pagan1@navy.mil

Heather Priest (PI)
heather.priest@navy.mil

CDR Wilfred Wells
wilfred.wells@navy.mil

DESCRIPTION

This effort consists of a three pronged approach to experimentation. First, a simulator analysis will be conducted. Analysis will include current Fleet training capabilities for high and low fidelity simulators will be conducted to ensure current Fleet capabilities can be appropriately replicated in the lab; and experimental assets that can replicate these capabilities as closely as possible. Next, development efforts will enhance any models that may be lacking in the selected assets. Finally, experimentation will be conducted to understand the impact of high and low physical fidelity when functional fidelity and instructional strategy are held constant.

NEED

Fleet training communities have begun to stand-up low fidelity training facilities (e.g., Air Defense Strike Group Facility [ADSGF], Fallon) to mitigate the maturity levels and issues associated with distributed SoS training. However, little research has been done to understand the impact these low fidelity devices will have on Training and Readiness (T&R) credit. This effort specifically seeks to address this need by identifying the impacts of physical fidelity on proficiency at multiple levels of the Strike Group using VC training.

BENEFITS

Findings will provide an understanding of the types of training objectives that can effectively be acquired using varying levels of physical fidelity. These findings can be applied to the broader IWC domain and to Live, Virtual, and Constructive training to provide insight on training system fidelity requirements. Additionally, this effort will provide empirical data associated with quantifying the amount of training required to acquire and maintain IWC skills in terms of learning and decay rates to better inform T&R and proficiency requirements.

STATUS

Analysis of current simulation Fleet training and experimental capabilities has been completed and experimental assets identified. Enhancements to ownship weapons model for the high fidelity simulator at Manned Flight Simulator have been verified and validated with Fleet Subject Matter Experts (SMEs). Scenarios and measures have been developed and also verified and validated with Fleet SMEs. Refining of measures took place with Fleet SMEs. Final measure implementation completed and final test set to take place end of FY19. Final analysis and report will be completed after testing.

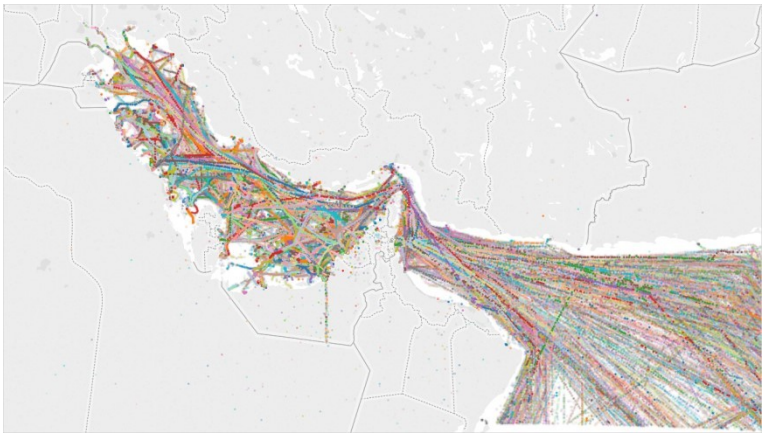
MILESTONES

- Observations of training conducted at Advanced Strike Group Facility completed (FY17)
- Analysis of training systems report completed (FY18)
- Weapons model development, scenarios, and measures validated and verified with Fleet SMEs (FY18)
- Final test of models and measures to take place end of FY19
- Final analysis and report completed end of FY19

VERIFICATION AND VALIDATION OF HIGHER FIDELITY CONSTRUCTIVE ENTITIES FOR UAS TRAINING

OBJECTIVE

This research effort will (1) assess the impact of using live data within the Next Generation Threat System (NGTS) to improve training realism and fidelity of constructive entities and to verify the gains in training effectiveness and efficiency that result for UAS operators and Naval Aviators and (2) create a controlled training effectiveness evaluation (TEE) process that can be replicated and generalized to component trainers across domains.



Raw input data reflecting real-world, white shipping behavior. This data helps to quickly populate scenarios, reducing operator workload.

PROJECT DURATION
OCT 2017 - SEP 2020

SPONSORS
Naval Air Warfare Center Aircraft Division (NAWCAD) | NISE: BAR

POINTS OF CONTACT
Alyssa Mercado (PI)
alyssa.mercado@navy.mil

CDR Wilfred Wells
wilfred.wells@navy.mil

DESCRIPTION
Utilizing science of learning research principles, we will empirically evaluate the effects of higher fidelity training stimuli on performance. Using the Dynamic Adaptive and Modular Entities for UAS (DYADEM) capability, we will conduct a controlled experiment with novice participants and the fleet to test our hypotheses (investigating reported instructor workload), collect quantitative/objective data, and create a method of assessing a capability meant to improve a training system without adding training content. Specifically, we wish to explore the effects of the new capability on performance, distinct from the NGTS training content.

NEED
Currently, the impact of the DYADEM capability on workload and performance has yet to be investigated or verified. This is due both to a lack of experimental control in applied/operational training settings as well as a lack of process or methodology that is needed to scientifically and systematically test the training effectiveness of technology that does not add additional training content but rather enhances current training fidelity.

BENEFITS
The impact of the proposed work will improve training not only for UAS but for P-8 and Triton, increase NGTS capabilities, inform training decisions, and predict what the impact will be on the fleet community as well as determining the return on investment for component training. The findings from this research will be used to drive future TEE studies to show value in Naval training capabilities. Additionally, this research offers guidance for LVC Test and Training to optimize individual and collective test and training capabilities through development, expansion, and refinement of live-virtual-constructive capabilities across test and training environments, learner populations, and across domains, systems, and security levels.

STATUS
In FY19 the team (1) worked with engineers and subject matter experts (SMEs) on scenario and testbed design (2) completed experimental design and measure selection (3) created a new testbed to measure instructor workload.

MILESTONES

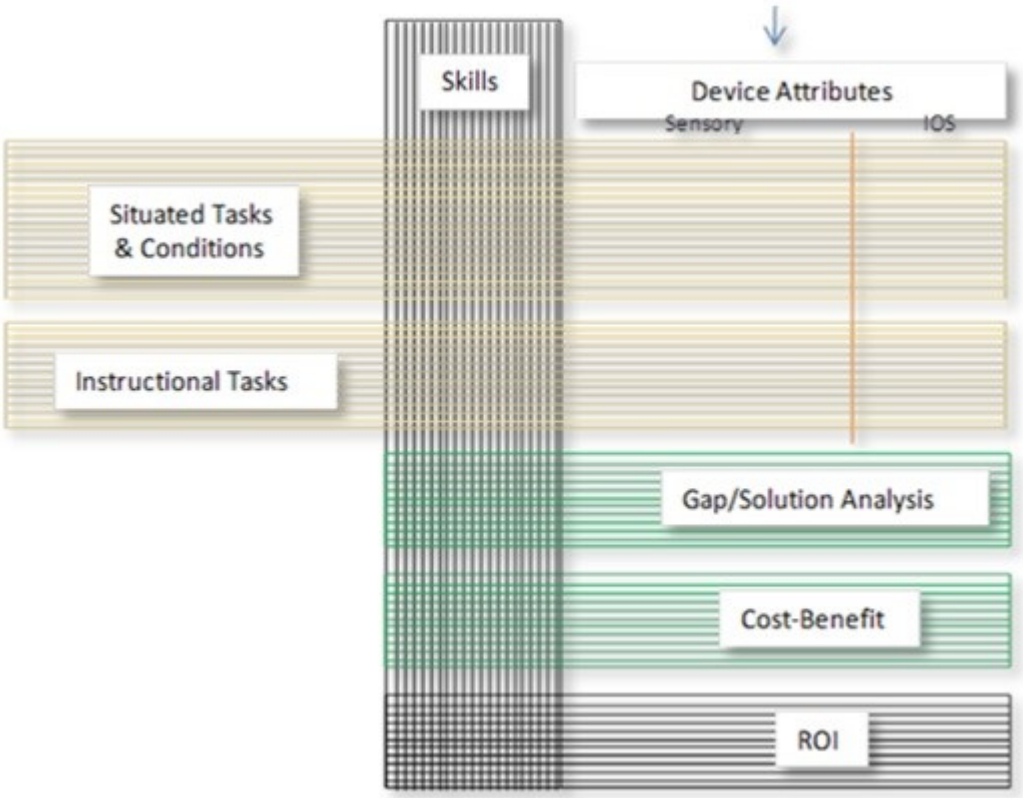
- Experimental and scenario design completed including measure selection (AUG 2019)
- Testbed design and implementation completed (SEP 2019)
- Pilot testing and experimentation to take place in FY20
- Document and publish study results and provide knowledge product to relevant training PMAs and ISR (Sep 2020)

CORE CAPABILITY 4:
HUMAN SYSTEMS ANALYSIS, DESIGN AND EVALUATION

AIR-4.6 supports and improves human performance through the analysis, design, evaluation, and acquisition of cost-effective training solutions that are both responsive and proven to meet learning, performance, and readiness requirements. This capability is utilized across aviation, surface, undersea and cross warfare domains. Through the application of analytical methods, grounded design theories, and instructional design principles, analysts conceptualize, evaluate, and optimize the design and implementation of training systems and pipelines.

The following Technology areas comprise this Core Capability:

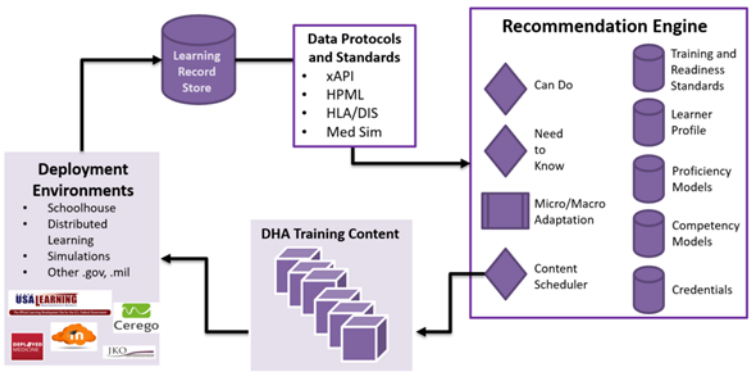
- High-Fidelity Training Environments
- Courseware Design
- Training Optimization Analysis
- Training Effectiveness Evaluation (TEE)



DEFENSE HEALTH AGENCY (DHA)
TOTAL LEARNING ARCHITECTURE (TLA)

OBJECTIVE

The goal of the effort is to begin the ambitious task of moving the DHA community to a holistic learning architecture. The Total Learning Architecture (TLA) will attempt to define DHA's unique learning needs, strategies to present them, and mechanisms to deliver them.



PROJECT DURATION

OCT 2018 - JAN 2021

SPONSORS

Joint Project Manager for Medical Modeling & Simulation (JPM MMS), Defense Health Agency (DHA) J-4

POINTS OF CONTACT

Erin Baker (PI)
erin.baker@navy.mil

DESCRIPTION

NAWCTSD with academic and industry partners developed the requirements and science and technology roadmap necessary to enable a Total Learning Architecture to provide the Military Health System (MHS) with the infrastructure to support lifelong learning or collect enterprise/ individual metrics on competencies and readiness.

NEED

The DHA TLA is being developed to address the following MHS issues:

- Incomplete training enterprise infrastructure and analytics for training, education, and human performance
- Fragmented linkages between education, training, and operational goals
- Inconsistencies and inefficiencies in performance and talent management

BENEFITS

Development and transition of a TLA will 1) provide an integrated and enterprise-wide education, training, and human performance improvement infrastructure; 2) provide a data-driven framework for training and education; 3) enable lifelong, blended, data-driven, and responsive training ; and 4) facilitate continuous competency maintenance.

STATUS

Year 1 of this effort just concluded, and resulted in:

- Draft Total Learning Architecture Analysis Report and Roadmap
- Draft Total Learning Architecture Functional Requirements Document

Year 2 of this effort will result in:

- TLA Component Analysis and Requirements
- Develop Measurement and Assessment Strategy
- Investigation as to whether this research is applicable to Military Health system patient education and training

MILESTONES

- Draft TLA Analysis Report and Roadmap (September 2019)
- Draft TLA Functional requirements Document (September 2019)
- Draft TLA Component Level Functional Requirements Document (January 2021)
- Draft Measurement and Assessment Strategy (January 2021)

EFFECTIVENESS ASSESSMENTS OF MIXED & IMMERSIVE REALITY FOR AVIATION TRAINING (N171-021)

OBJECTIVE

To develop a methodology that results in a capability to investigate the training effectiveness, comparable utility, and return on investment of an augmented reality solution for applied training task.

Sample Augmented Reality headset used for testing toolkit

PROJECT DURATION

MAY 2017 - OCT 2020

SPONSORS

Naval Air Systems Command (NAVAIR)
Small Business Innovation Research (SBIR)

POINTS OF CONTACT

John Killilea (TPOC)
john.killilea@navy.mil

Richard Plumlee (Co-TPOC)
richard.plumlee@navy.mil

John Hodak (PM)
john.hodak@navy.mil

DESCRIPTION

Augmented reality (AR) has been on the cusp of ushering in a training paradigm shift for over a decade by allowing overlays of a digital world on real platforms. Although the Navy and industry counterparts have been exploring the value of using AR technology in training, few rigorous measurements of effectiveness have been conducted of AR itself, as well as comparing it to other related training technologies. Yet, as technology improves, AR remains a promising training capability as it enables embedded "train as you fight" training. The Navy is seeking an analysis tool grounded in a methodology that supports comparison of AR and alternative solutions for a representative training environment.

NEED

The resulting tool will include development of generalizable, best-of-breed methodology that will allow researchers to quantify the effectiveness of modern AR training and how AR training performance compares to related technologies. This effort focuses on delivering a rigorous measurement of effectiveness of AR and ability to calculate return on investment or design solution tradeoffs of comparative technologies.

BENEFITS

The development of a tool that has the capability to measure the training effectiveness, comparable utility, and return on investment of an augmented reality solution for applied training task.

STATUS

During Phase I efforts, performers identified feasibility solutions and produced early rapid prototypes for AR and alternative training solutions (e.g., handheld tablet training, game-engine based virtual environment training) for aviation training. A single performer was selected for a Phase II award that began in November of 2018. This work will focus on building out the training effectiveness evaluation tool, as well as developing and incorporating the tool within a test environment. Tool development and the testbed environment are occurring simultaneously for verification and validation testing to occur in late FY19 and early FY20. Final prototype analysis tool will be delivered Oct 2020.

MILESTONES

- Phase I:
  - Phase I progress and initial Phase II proposals included experimental design plan, including identification of applicable methods of assessing effectiveness, utility performance comparisons, and return on investment analyses
- Phase II:
  - Phase II contract awarded to single vendor, with a capability demonstration of the AR, VR, and mobile training prototypes at I/ITSEC 2018
- Publications:
  - Abich, J., IV, Murphy, J., Eudy, M., & Killilea, J. (2019). *Considerations for training effectiveness evaluations of emerging technologies.* Proceedings of the 12th MODSIM World, Norfolk, VA, April 22-24, 2019
  - Abich, J., IV, Murphy, J., Pierce, M., & Killilea, J. (2019). *Process validation of a modified training effectiveness evaluation framework.* Proceedings of I/ITSEC 2019, Orlando, FL, December 2-5, 2019 (submitted)

OCEANOGRAPHY TACTICS TRAINING FOR EMPLOYMENT READINESS (N182-119)

OBJECTIVE

Develop a software-based tool to rapidly generate web-based animated training content for employment of advanced oceanography tactics and is capable of incorporating adaptive content presentation based on learner progress through knowledge assessments.

TRITON Systems Inc., example of animated training scenario.

PROJECT DURATION

SEP 2018 - SEP 2021

SPONSORS

Naval Air Systems Command (NAVAIR)
Small Business Innovation Research (SBIR)

POINTS OF CONTACT

Mitchell Tindall, Ph.D. (TPOC)
mitchell.tindall@navy.mil

Beth Atkinson (Co-TPOC)
beth.atkinson@navy.mil

John Hodak (PM)
john.hodak@navy.mil

DESCRIPTION

The Navy's crawl-walk-run approach to aviation training provides learning opportunities through mixed media beginning with classroom lectures and computer-based training, engagement with equipment through individual and part task training, and finally aircrew training in high fidelity simulation-based or live environments. Early computer-based training focuses on very specific foundational skills and teaches them in a vacuum. To address this issue, the Navy advocates building a capability that allows instructors or Subject Matter Experts (SMEs) to easily build training scenarios that are immersive and interactive physics-based animations and models.

NEED

This effort addresses the unidimensionality of early computer-based training by providing opportunities for trainees to start combining and building upon skills. The goal is to increase the accessibility of remediation or advanced skill development training opportunities by providing instructors with tools to rapidly develop web-based training content that animates advanced oceanography tactical employment to provide learners with the opportunity to remediate challenging skills and/or increase their skill base. Additionally, the capability should allow instructors and SMEs to build in assessment and consider intelligent tutoring functionality to ensures trainees have a degree of mastery before moving forward.

BENEFITS

Navy leadership has called for technologies that help to advance the Navy's crawl-walk-run approach to aviation training. This effort seeks to provide learning opportunities through mixed media beginning with classroom lectures and computer-based training, engagement with equipment through individual and part task training, and finally aircrew training in high fidelity simulation-based or live environments.

STATUS

This SBIR topic was released for small business proposals to Phase I. The government technical evaluation team has completed review of 14 Phase I proposals. After an extensive review of Phase I proposals, three contractors were selected for award. Phase I option period ended and one contractor was invited to write a phase II proposal after completing a working prototype of their technology at the close of the base period. The prototype demonstrated had met several of the requirements of the solicitation, exceeding expectations of what is accomplished in a phase I base. At the phase I base closeout the contractor was provided with feedback to improve the usability, 3-D visualization as well as to hire aviation-based anti-submarine warfare subject matter experts of the prototype. The phase II kickoff will be used to evaluate their ability to take feedback and continue development toward the requirement.

MILESTONES

- Phase I:
  - Proposals from 14 vendors were evaluated for technical approach, qualifications, and commercialization
  - Three contractors were selected for Phase I awards
  - Kickoff meetings are scheduled for early November
  - Base period closeout briefs will be held in early March
- Phase II:
  - Phase II kickoff meeting will be held in September FY 20
  - Software and prototype development shall continue until November FY21
  - Software and prototype testing and delivery November FY22

Evaluating and Improving the Naval Aviation Survival Training Program:
Evaluation of Spatial Disorientation Curriculum Enhancement

OBJECTIVE
To perform a training effectiveness study of the Spatial Disorientation (SD) curriculum in its current state in order to define appropriate upgrades to the training products used in the NASP curriculum and provide Commercial Off The Shelf (COTS) system(s) recommendation to bridge identified gaps.

CAMP LEMONNIER, DJIBOUTI. A 303rd Expeditionary Rescue Squadron HH-60 Pave Hawk practices brownout landings near Camp Lemonnier, Djibouti, March 22, 2014. Brownout occurs when the rotor wash causes dirt, dust or sand to become airborne which can cause the crew to lose sight of the ground. (U.S. Air Force photo by Staff Sgt. Staci Miller/RELEASED).

PROJECT DURATION
JAN 2019 - DEC 2021

SPONSORS
Office of the Assistant Secretary of Defense for Health Affairs [OASD(HA)]

POINTS OF CONTACT
Ms. Beth Atkinson (PI)
beth.atkinson@navy.mil

LCDR Lee Sciarini (API)
lee.sciarini@navy.mil

DESCRIPTION
In the Naval community, Spatial Disorientation (SD) and Situational Awareness (SA) are significant contributing factors to the majority of aviation mishap events. The Navy spends millions of dollars on safety training every year to educate aviation personnel of the warning signs to SD and loss of SA but the training lacks customizable visualizations of actual SD and SA events. The Naval Aviation Survival Training Program (NASTP) uses the SD curriculum for initial and refresher training for all aircrew designated to fly in all type/model/series (TMS) Naval aircraft. Maintained at the Naval Survival Training Institute (NSTI), SD curriculum is PowerPoint based lectures intended to introduce and expose trainees to various types of SD that can be experienced in the aviation domain.

NEED
Recently, Navy Medicine Operational Training Center (NMOTC) was designated as Curriculum Control Authority (CCA) for the NASTP. Gaps were identified in the resources and expertise needed to conduct a transfer of training analysis for all SD and SA training in order to recommend updates to ensure learning objectives are met. This need was identified by the NASTP Trainer Management Team (TMT), in a point paper by the OIC of NSTI, and in a Training System Requirements Analysis (TSRA) conducted by the Naval Airwarfare Center-Training Systems Division (NAWCTSD). Additionally, the TSRA indicates that the very nature of how SD training is delivered to trainees needs to be updated in order to achieve training objectives.

BENEFITS
This effort seeks to leverage advances in virtual reality and modeling and simulation for Commercial off the Shelf (COTS) recommendations that would enhance current SD and SA training by allowing users to set scenarios based on mishap data to recreate SD and/or SA events. The end product would provide trainees with a better understanding of the warning signs of SD and loss of SA for more impactful training.

STATUS
This effort was selected for funding in FY19 as a new topic by OASD-HA. Currently, resources are being aligned to execute associated tasking.

MILESTONES
- Evaluate existing SD training procedures and curriculum.
- Conduct a Cognitive Training Analysis (CTA) / Front-End Analysis (FEA) for SD training.
- Conduct a detailed review of SD and current COTS technologies.
- Document experimental design and submit IRB protocol.
- Conduct comparative training effectiveness research study between the SD and the identified COTS systems.
- Report results to the DHA, TMT, the NASTP IPT, PMA-205 and appropriate peer reviewed outlets.

Evaluating and Improving the Naval Aviation Survival Training Program:
Initial Operational Evaluation & Upgrade for the Normobaric Hypoxia Trainer (9A19)

OBJECTIVE
To conduct an effectiveness study to analyze current physiological hazards curriculum, more specifically, hypoxia training to identify gaps and provide technological enhancements to the newly acquired Normobaric Hypoxia Trainer (NHT).

Device 9A19 Normobaric Hypoxia Trainer (NHT) undergoing system testing in at the Aviation Survival Training Center, Jacksonville, FL.

PROJECT DURATION
APR 2019 - JUN 2021

SPONSORS
Office of the Assistant Secretary of Defense for Health Affairs [OASD(HA)]

POINTS OF CONTACT
Ms. Beth Atkinson (PI)
beth.atkinson@navy.mil

LCDR Lee Sciarini (API)
lee.sciarini@navy.mil

DESCRIPTION
Currently, the Naval Aviation Survival Training Program (NASTP) is transitioning from the hypobaric chamber to the Normobaric Hypoxia Trainer (NHT) for physiological hazards training. The NHT is designed to safely expose aircrew and aviators to a high-altitude, low-oxygen aircraft environment. Training scenarios involve instructors monitoring trainees as they complete a series of operationally-relevant tasks on computer tablets/ simulator within the NHT while the atmospheric equivalent altitude slowly increases to 25K'. Performance is then assessed and outcomes from training will assist aircrew in recognizing symptom indicators, completing proper procedures to alleviate symptoms, and efficiently performing emergency procedures using actual aircraft life support equipment in order to prevent hypoxia related mishaps.

NEED
As part of the current installation plan, each NHT will be delivered with six tablet computers for training six aircrew positions. However, the tablets will not include simulation/ software based domain-relevant tasks. This gap results in no cognitive or psychomotor tasking for aircrew during training which has been identified by the NASTP Trainer Management Team (TMT). Additionally, developmental testing of the NHT at Aviation Survival Training Center (ASTC) in Jacksonville has revealed opportunities to improve situation awareness by upgrading the COMNET software control and the instructor/ operator (IO) stations. These identified upgrades will enhance trainee safety, improve trainee throughput, and increase training effectiveness.

BENEFITS
Through this effort, NHT will receive technology enhancements for both instructor and trainee that directly impacts the NASTP curriculum, translating to increased readiness, improved warfighter performance, and increased survivability.

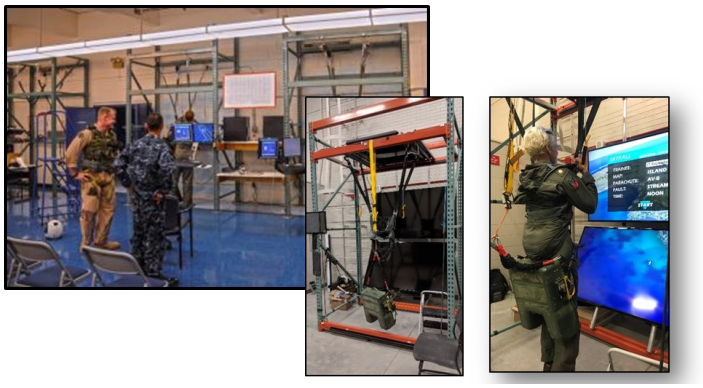
STATUS
This effort was selected for funding in FY19 as a new topic by OASD-HA. Currently, resources are being aligned to execute associated tasking.

MILESTONES
- Analyze the hypoxia training requirements in order to clarify instructional problems and objectives.
- Design learning objectives and training concepts.
- Develop aircrew task software.
- Demonstrate and validate software and procedures for ASTC instructors and aircrew trainees.
- Perform formative and summative evaluations of the aircrew training task .
- Investigate areas to advance software and develop software updates to the COMMNET and IO station.

Evaluating and Improving the Naval Aviation Survival Training Program: *Virtual Reality Parachute Descent Trainer (Device 9C4/9C4A) Evaluation* Virtual Reality Parachute Descent Trainer (Device 9C4/9C4A) Evaluation

OBJECTIVE

To complete a comparative training effectiveness study between the current VRPDT to contemporary Commercial Off The Shelf (COTS) systems. This effort will help determine if upgrades to the existing system are capable of closing existing gaps or if a COTS solution is capable of providing aviators training on DPs, malfunctions and decision-making with the requisite training quality and effectiveness, supportability, and training realism.



Current virtual reality based parachute trainer and proposed next generation parachute training solution.

PROJECT DURATION

JAN 2019 - DEC 2021

SPONSORS

Office of the Assistant Secretary of Defense for Health Affairs [OASD(HA)]

POINTS OF CONTACT

Ms. Beth Atkinson (PI)
beth.atkinson@navy.mil

John Hodak (PM)
john.hodak@navy.mil

DESCRIPTION

In the Naval community, aviation survival training is an important focus area. The Naval Aviation Survival Training Program (NASTP) uses the VRPDT to conduct initial and refresher training for all aircrew designated to fly in parachute equipped fixed wing aircraft. The VRPDT is an immersive training device with embedded parachute descent scenarios which allows students to practice procedures to get safely from the aircraft to the ground, reinforcing what is learned in the classroom. Additionally, the simulation can present parachute canopy malfunctions which students must correctly identify in order to perform the corrective procedures.

NEED

The current configuration of the VRPDT does not support F-35 which is needed at multiple Aviation Survival Training Centers (ASTCs). Additionally, other type/model/series (T/M/S) aircraft may not be adequately represented. This gap has been identified by the Naval Survival Training Institute (NSTI) and the Trainer Management Team (TMT). Physically, the VRPDT has numerous problems due to the system's inability to interface with standard flight and parachute equipment across all T/M/S of aircraft. Also, being based on 25-year-old technology, the limited field of view (FOV) of the head mounted display (HMD) system reduces the quality and effectiveness of training. Further, the dated display, graphics capabilities, and equipment configurations do not provide the appropriate level of physical and environmental fidelity to train all required tasks. Therefore, there is a need to compare the current system to modern commercially available solutions capable of closing the gaps listed above.

BENEFITS

This results from this effort will be used to determine if a Commercial off the Shelf (COTS) solution is capable of closing the gaps identified by the TMT and inform acquisition decisions of parachute decent training systems for all eight ASTCs.

STATUS

This effort was selected for funding in FY19 as a new topic by OASD-HA. Currently, resources are being aligned to execute associated tasking.

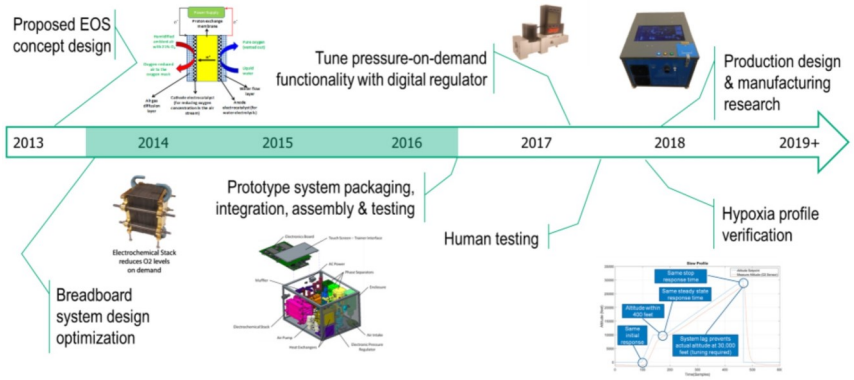
MILESTONES

- Evaluate existing parachute decent training procedures and curriculum.
- Conduct CTA/FEA for F-35 and other T/M/S to refine learning objectives and training concepts.
- Conduct a detailed review of VRPDT and current COTS technologies.
- Document experimental design and submit IRB protocol.
- Conduct comparative training effectiveness research study between the VRPDT and the identified COTS systems.
- Report results to the DHA, TMT, the NASTP IPT, PMA-205 and appropriate peer reviewed outlets.

MASK-ON HYPOXIA TRAINING DEVICE (N132-093)

OBJECTIVE

The effort seeks to support the technology transition of a next generation hypoxia-training device under development as part of NAVAIR SBIR N132-093. The goals of this research include analysis of logistical concerns, human factors evaluations, and human testing to validate the fidelity and effectiveness.



Development timeline of an On-Demand Hypoxia Trainer based on research and development conducted under SBIR Phase I, Phase II and Phase II.5 efforts.

PROJECT DURATION

NOV 2013 - OCT 2019

SPONSOR(S)

Naval Air Systems Command (NAVAIR)
Small Business Innovation Research (SBIR)

Naval Aviation Training Systems Program Office, PMA-205

POINTS OF CONTACT

Beth Atkinson (TPOC)
beth.atkinson@navy.mil

DESCRIPTION

This effort will conduct the research and development efforts necessary for validating the fidelity, safety and concept of operations of the On-Demand Hypoxia Training Device under development for transition to PMA-205. In addition to the required research, we intend to conduct separate independent tests and evaluations to document the performance parameters and benefits of the novel technology for existing and potential acquisition communities. Specific tasks include: research and analysis of logistic requirements for training technology; conduct Human Factors Evaluation of the instructor console; conduct human testing with a military aviator population; and validation of training system.

NEED

As hypoxia continues to remain a highly visible safety issue, focus on a range of potential mitigation solutions is imperative. While a variety of engineering solutions aimed at the aircraft are being considered and tested, the final line of defense will remain in the hands of our trainers.

BENEFITS

The acknowledged success of hypoxia training makes it paramount that the Navy ensures these capabilities remain available. In addition to providing a means for addressing the larger Navy research into mitigating hypoxia physiological episodes, this effort will advance the lab's understanding of hypoxia training. Through usability analyses, researchers will document ways to increase the ease of use of the instructional capability. Further, this effort will provide the means to thoroughly investigate a novel technology to determine the effectiveness and efficiency of the devices to deliver higher fidelity training opportunities.

STATUS

Phase II efforts have resulted in a refined system prototype, human research, maintenance and sustainment analysis, as well as refining processes via research for manufacturing, reliability, and sustainability of the system. Transition is planned for FY20, with a procurement contract of 40 units for delivery to the 8 Aviation Survival Training Centers through FY21.

MILESTONES

♦ **Phase II.5**

- Contract awarded based on Technology Transition Agreement from PMA-205 (May 2017-Aug 2018)
-Refined prototype developed to support engineering and human testing
-Fleet engineering testing conducted to refine pressure on demand capability

♦ **2nd Phase II**

- Contract awarded to refine design and manufacturing research and development (July 2018-Apr 2019)
-Refined prototype developed to support engineering and human testing
-Iterative usability testing of system and endurance and reliability testing in process
-Contract awarded based on Technology Transition Agreement from PMA-205 (MAY2017-AUG2018)
- Closeout briefs were held with each of the contractors to discuss Phase I progress and Phase II plans
-Phase I Option was awarded for two vendors
-Phase II.5 contract awarded based on Technology Transition Agreement from PMA-205 (MAY2017-AUG2018)
-
-Refined prototype developed to support engineering and human testing-Fleet engineering testing conducted to refine pressure on demand capability
-IRB approved for human subjects testing
-Preliminary device documentation and drawings delivered
-Second Phase II contract awarded to refine design and manufacturing research and development (JUL2018-APR2019)
-IRB approved for human subjects testing
-Iterative usability testing of system in progress
-Endurance and reliability testing in process

NAVAL AIR WARFARE CENTER TRAINING SYSTEMS DIVISION

NAWCTSD supports Department of Defense (DoD) and Navy Science, Technology, Engineering and Mathematics (STEM) goals and priorities. Through Command and ONR funding support, the Program addresses the challenge to educate, train, recruit and retain personnel in STEM critical skill shortfall disciplines for National Security and Defense needs. The Navy's STEM Program, is built around five priorities:

1. **Inspire** the next generation of scientists and engineers (S&Es)

2. **Engage** students and build their STEM confidence and skills through hands-on learning activities that incorporate naval-relevant content

3. **Educate** students to be well prepared for employment in STEM careers that support the Navy and Marine Corps

4. **Employ,** retain and develop Naval STEM professionals, and

5. **Collaborate** across the Naval STEM enterprise, and with best practices organizations to maximize benefits to the Department.

FY19 NAVY LOCAL IMPACT AT A GLANCE

STEM Program Launched	2009
Geographic Reach	Brevard County Orange County Osceola County Seminole County Volusia County
S&E Mentors & Coaches	1 part-time site coordinator 114 S&Es 15 mentors (robotics and Blankner)
Personal Interactions	200 teachers 7,692 students

To enhance STEM education in the Central Florida area, NAWCTSD has partnered with Orange, Seminole, and Brevard County Public Schools, the University of Central Florida, the National Center for Simulation Education and Workforce Development Committee, the Central Florida STEM Education Council (CFSEC) and its members, the Florida High Tech Corridor Council's techPATH, the Orlando Science Center, and the U.S. Naval Academy.

FLIGHT LAB AFTERSCHOOL

OBJECTIVE

The goal of this effort is to support ONR's mission of fostering Science, Technology, Engineering, and Mathematics (STEM) education for students. Through the Flexible Learning Experience: Aviation Classroom Experience (FLEX-ACE) –an aviation simulation classroom–students will be able to engage with hands-on, immersive, USMC/Navy-specific, STEM-related content. By reinforcing STEM learning through experiences that model real-world careers, we endeavor to inspire future generations to explore STEM careers–especially STEM careers within the Navy and USMC.

Above left. Entrance to the Flight Lab at OSC

Above right. Students enjoying the Flight Lab

Left. Inside of the Flight lab at OSC

PROJECT DURATION

JAN 2019 - DEC 2021

SPONSORS

Office of Naval Research, ONR-34

POINTS OF CONTACT

Natalie Steinhauser (PI)
natalie.steinhauser@navy.mil

Dani McNeely (PM)
danielle.mcneely@navy.mil

DESCRIPTION

The Flight Lab Afterschool program uses the TEQGames-developed FLEX-ACE program to teach students STEM concepts via an immersive, aviation-centered virtual reality (VR) laboratory. The program focuses on underserved audiences, including girls in STEM, and currently includes four 9-week cohorts recruited from afterschool clubs in the greater Orlando Metro area. These students will engage with the aviation-themed immersive content nine times over a semester. The effectiveness of the program will be analyzed by assessing pre- and posttest performance on aviation-specific and STEM general knowledge, as well as flight skills in the simulation.

NEED

It is essential for the USMC and Navy to maintain recruitment of top STEM talent, as STEM fields are critical to the effective training and performance of the Warfighter. However, many adolescents lose interest in STEM early in their academic careers–sometimes as early as the 3rd grade. Thus, there is a need to provide meaningful, educational opportunities for youth to experience STEM "beyond the textbook." It is imperative to get children engaged in STEM in interactive ways–hence, the immersive, game-based learning environment offered by FLEX-ACE.

BENEFITS

The exhibit and overall effort:

- Support the DoD and ONR's mission of fostering K-12 STEM education.
- Engage 5th-12th grade students with hands-on, immersive USMC/Navy STEM-related content experiences.
- Inspire and motivate the next generation to explore STEM careers.
- Provide opportunities for evaluation and assessment of the impact of immersive STEM programs on students and the community.

STATUS

As of SEP 2019, the afterschool sites have been selected, semester curriculum has been outlined, and all scenarios have been developed. The pre-assessments have been administered to all cohorts, and analysis of the resultant data is ongoing. The afterschool workshops will continue throughout the remainder of this calendar year, with post-assessments taking place in mid-December 2019 and early January 2020.

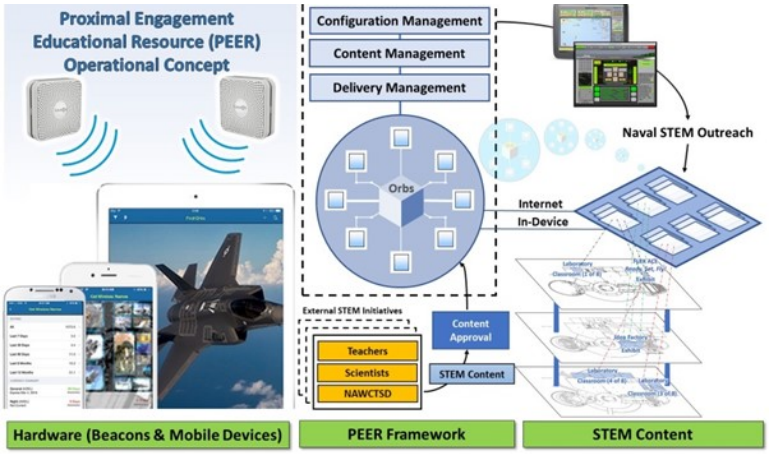
MILESTONES

- April 2019 – Program Kick-off with ONR
- Aug 2019 – Finalized scenarios and assessment materials; completed participant outreach/recruitment efforts
- Sep 2019 – Data collection (pretests) from program participants

PROXIMAL ENGAGEMENT EDUCATIONAL RESOURCES (PEER)

OBJECTIVE

The objective of the Proximal Engagement Educational Resource (PEER) was to provide a new interactive Science, Technology, Engineering, and Mathematics (STEM) enhanced learning experiences throughout classrooms and events using Proximal Web technologies. The STEM content delivered was developed in coordination with NAWCTSD and participating local school districts and aligning with the Naval Ready Relevant Learning (RRL) construct.



GBL, Inc. image of technology concept

PROJECT DURATION

APR 2018 - DEC 2018

SPONSORS

Office of Secretary of Defense (OSD)

POINTS OF CONTACT

Emily Sherkow (PM)
Emily.sherkow@navy.mil

DESCRIPTION

PEER delivered learning content to individual students' mobile devices allowing them to work at their own pace, and quiz them on the attained knowledge. PEER permitted the instructor to (1) control the content given to the student(s) and (2) continue on with the material without any student being left behind when they require more time. This easily modifiable immersive learning content delivery system exposed participants to STEM learning challenges in both military and non-military scenarios. Because of the ease of management and brief latency time of postings, these Orbs can be created to remain current with the latest program launches, application processes, and candidate criteria.

NEED

The PEER project created a scalable new type of immersive STEM engagement environment for underserved population. PEER technologies allowed the teachers to manage specific sites where students viewed web content as Orbs on mobile devices. This was accomplished by disabling the browser on the mobile devices, potentially simplifying information assurance protection e.g. lower probability of ransomware cyber attack.

BENEFITS

The PEER project leveraged technologies successfully demonstrated at I/ITSEC and expand the reach across local middle and high schools, as well as local high school and university career education centers. The project commenced with participation in I/ITSEC STEM day, where students and educators partook in Treasure Hunt activities to learn STEM required critical thinking in a fun game-like environment to target engaged student participation. The project implemented PEER pilots across the local classrooms at the selected middle and high schools and university career education centers. Finally, the project showcased composite results across all pilot programs for presentation and utilization at I/ITSEC.

STATUS

The PEER project was extremely successful with all participant organizations (local schools' classrooms and career education centers, colleges/university career education centers, and conference venues) expressed a high-interest to continue pilot activities with the FutureOrb framework technologies.

MILESTONES

- Proximal Web FutureOrb technologies demonstrated at eight (8) locations across the three (3) venues :
  - K-12 classrooms, Conferences (I/ITSEC and ITEA), and Career Education Centers
  - 22 STEM and Naval workforce learning experiences were delivered to 552 student and adult participants
  - 30 separate FutureOrb user accounts were established by participating organizational personnel whom successfully performed configuration and content management activities
  - Qualitative measures were gathered by participants through surveys and from teachers/administrators through interviews
  - All teachers/administrators were able to successfully utilize FutureOrb configuration management, content management, and delivery management system components to create and replicate new STEM learning experiences.
  - At conferences, the PEER team completed replication activities to create new learning experiences.

LABORATORY CAPABILITIES

At the Naval Air Warfare Center Training Systems Division (NAWCTSD), we have many laboratories engaged in research and development. These labs work to advance the state-of-the-art in training technologies in human factors, human-machine interfaces, augmented reality and virtual reality, data analysis, acoustics and sensors, visual systems, data analysis, fabrication, interoperability, Live-Virtual-Constructive (LVC) applications and technologies, communications, and more. The following section provides summaries the capabilities and expertise in the labs.

Acoustic Training and Simulation (ATaS) Lab

CAPABILITIES

- SME support with Real-Time Acoustic Training System Tuning
- Development and Maintenance of Acoustic Databases
- Data updates based on dynamics of Intel
- Database Distribution
- Target Tuning
- NCTE ASW database standard
- Update and provide appropriate databases for Foreign Military Sales (FMS) of Aviation ASW/Acoustic Trainers.

TOOLS

- The **ATAS Database** contains detailed data on Contacts (ships, submarines, torpedoes, and biologicals) using over 100 tables.
- The **Common Sensor Database (CSDB)** contains detailed data on Sensors (DICASS, DIFAR, MAC, and Towed Array) using over 150 tables.
- **The Active Emitter (AE) Database** contains detailed data on active sonars for contacts and sensors using over 40 tables.
- **Digitized Sounds** provide audio for Contacts and Sensors
- **CASE FI Single Node** Acoustic processor used to adjust fidelity of acoustic contacts prior to fleet delivery

MISSION

Provide current sensor and acoustic data used in modeling and simulation across Navy Anti-Submarine Warfare training devices.

EXPERTISE

- Navy Subject Matter Experts – Anti-Submarine Warfare, Underwater acoustic analysis
- Systems Engineer – Configuration Management

For More Information Please Contact

NAWCTSD Technology Transfer Program Manager

ORLO_Orlando_Tech_Transfer@navy.mil

BATTLE LAB

Basic & Applied Training & Technology for Learning & Evaluation Lab

MISSION

Conduct and manage science and technology (S&T), research and development (R&D), transition and acquisition consultation efforts through the application of cognitive science, behavioral research and training evaluations to improve training and human performance in a variety of learning environments.

EXPERTISE

- Human Performance Assessment; Data Science & Effectiveness Analyses
- Synthetic & Distributed Training Enhancements & Evaluation
- Aviation Training for Survival, Aircrew, & Maintenance
- Instructional Technology Improvements & Adaptive Training
- Accelerating the Development of Small Unit Decision Making
- Team Resilience Strategies for Tactical Combat Casualty Care

CAPABILITIES

- **Human Performance Analytics Research, Development & Implementation** including individual and team performance, performance measurement authoring tools, databases for performance trend analysis and data analytics, computational techniques for evolving data for trend identification, tools for evaluating data re-use to enhance training scenarios and performance assessments, and standards for increasing interoperability of human performance analysis.
- **Synthetic Environments Research, Development & Implementation** including standards support and interoperability mission effectiveness analyses, researching cross domain management tools, integrated behavior modeling and speech analysis for synthetic teammates, skill adjustments for automated behavior modeling, and speech recognition support tools.
- **Instructional Strategies & Methods for Team Training** including digital integrated representation of the tactical environment, tailored training and assessments, decision making training strategies, learning management systems, resilience training strategies and methods, and adaptive training.
- **Aviation Survival Training Research, Development & Implementation** including hypoxia training enhancements, parachute descent procedure and malfunction training, and mishap and spatial disorientation training.
- **Instructional Technology Improvements** including next generation manned-unmanned teaming concepts, data science driven aircrew performance measurement and proficiency tools for debriefing and evaluation, machine learning support for malfunction troubleshooting, workload assessment
- **Aircrew & Maintenance Training Systems Improvements** including oceanography tactics training, maritime intelligence-surveillance-reconnaissance training, physiological episode distractor application, and communication training.

TOOLS

- Post Mission Assessment for Tactical Training & Trend Analysis (PMATT-TA)
- Techniques to Adjust Computational Trends Involving Changing Data (TACTIC-D)
- Crew Role-player Enabled by Automated Technology Enhancements (CREATE)
- Accelerating the Development of Small Unit Decision Making (ADSUDM)
- Squad Overmatch (SOvM) / Team Overmatch (TOvM)
- Oceanography Tactics Training for Employment Readiness (OTTER)
- Radio Operations Guidance and Education Resource (ROGER)

For More Information Please Contact

NAWCTSD Technology Transfer Program Manager

ORLO_Orlando_Tech_Transfer@navy.mil

Concept Development & Integration Lab (CDIL)

CAPABILITIES

Electronic Communications Subject Matter Expertise:
Voice Communications (Analog & Digital);
Live-Virtual-Constructive Interoperability;
RF Propagation / Terrain Modeling

Cyberwarfare Training:
Realistic emulation of Network and Host based Cyberspace attacks; USS Secures Capture the Flag

Rapid Prototyping / Proof of Principle Development:
Requirements -> First Article Test;
System Interoperability; DoD Standardization

Software Development

Hardware / Electronic Design & Fabrication

TEMPEST Separation & Certification

Technology Research:
RF Communications; Modeling & Simulation;
Cyberwarfare Training

Acquisition Support:
Technical Consulting / Market Surveillance / Documentation Review

TOOLS

Windows, Linux & Embedded Development Environments

Altium Designer

Atmel Studio (micro-controllers)

Microsoft Visual Studio / IntelliJ

Solidworks

MISSION

Research and Development of specialized, interoperable Live-Virtual-Constructive applications and technologies; provide smart buyer awareness to training system acquisition programs.

EXPERTISE

- Live—Virtual Communications
- Live & Virtual Radio Management
- RF Communications Modeling
- TEMPEST Certification
- After Action Review (AAR) applications
- Rapid Prototyping (Software & Hardware)
- Embedded Systems Development
- System Interoperability
- Modeling & Simulation Standards

For More Information Please Contact

NAWCTSD Technology Transfer Program Manager

ORLO_Orlando_Tech_Transfer@navy.mil

Interoperability, Design, Engineering, and Application (IDEA) Lab

MISSON

Support research, development, test and evaluation of training systems interoperability. The lab provides tools for visual systems analysis, database development, system integration and command demonstrations.

EXPERTISE

- Training Systems Integration
- Cross Domain Solutions for training systems
- Training Systems Interoperability Standards
- Simulation Test and Integration
- Simulation Protocol Test Tools
- Agile Software Development

CAPABILITIES

- **Interoperability Test and Integration Tools** enabling automated testing, logging and stimulation of training systems.
- **Simulation Bridge and Gateway** products to translate between differing standards and other simulation standards/ protocols
- **Virtual and Constructive Test and Integration Support** verifying training system interoperability and an active test bed for research.
- **Controlled Interface and Cross Domain Solution** development and sustainment to support distributed mission training
- **Out-The-Window (OTW) visual, sensor, terrain, and 3-D model databases** to provide maximum source data reuse across training devices for various Type/Model/Series platforms

TOOLS

- Network connections to the Navy Continuous Training Environment (NCTE), NMCI SIPR and NIPR
- Visual Studio, SVN, Jira,. Confluence, NetBeans
- 180 degree visual display w/ 4 DLP Projectors
- 4 Channel PC based IG & Video Switch

For More Information Please Contact

NAWCTSD Technology Transfer Program Manager

ORLO_Orlando_Tech_Transfer@navy.mil

LVC Development and Operations Center (LVCDOC)

CAPABILITIES

- **Network centric environment** created to be persistent and rapidly reconfigurable, supporting Research and Development (R&D) and Test and Evaluation (T&E) for LVC initiatives across all Navy platforms including aviation, surface, and undersea, in partnership with other Government organizations, Industry stakeholders, and academic institutions.
- **Interoperability Assessment and Validation** across all stages of the System Engineering Integration and Test process as a measure to accelerate LVC technology development and reduce risk.
- **Conduct technology test and integration preparation events** to improve the quality and speed of integrating new M&S capabilities into Distributed Mission Training (DMT) events.
- **Classified, Unclassified or Mixed Mode Operation** enabled by Enterprise Network Guard (ENG), a Government owned/developed, state-of-the-art Cross Domain Solution (CDS) supporting data and voice in multiple security domains across the Navy training enterprise.
- **Connection to Training Networks** to capture, store, and reuse M&S data to support analysis, development, testing, and experimentation.
- **After Action Review** to trace mission training from objectives to effectiveness.
- **Experimentation** of cutting edge hardware and software, leveraging operationally-relevant data

TOOLS

- **Distributed Simulation Standards (HLA, DIS, TENA)**
- **Protocol Conversion (JBUS & AMIE)**
- **Constructive Simulations (NGTS, JSAF, & OneSAF)**
- **Joint After Action Review (JAAR)**
- **Cyber Effects (Network Effects Emulation System (NE2S))**
- **Command and Control (C2PC)**
- **Network Monitoring/Analysis (WAN Emulation)**
- **Cross Domain Solution/Multi-Level Security (Enterprise Network Guard (ENG))**
- **Digital Radio Management (DRMS) for tactical voice transport and coordination.**

MISSION

The LVCDOC is a network centric environment that provides a reconfigurable, dynamic LVC integration domain supporting Research and Development (R&D) and Test and Evaluation (T&E) of new technologies and methods, and encouraging collaboration among LVC stakeholders.

EXPERTISE

- Modeling and Simulation
- Virtualized Network Environments
- Hardware/Software Integration
- System-of-Systems Interoperability
- Cross Domain Solutions
- Multi-Level Security
- Tactical Voice Transport
- Cyber Effects
- After Action Review
- Computer Science & Engineering
- Information Assurance

For More Information Please Contact

NAWCTSD Technology Transfer Program Manager

ORLO_Orlando_Tech_Transfer@navy.mil

Live, Virtual, Constructive, Modeling & Simulation (LVCMS) Lab

MISSION

Development of computer software, including computer system architecture and system software organization for Live, Virtual, and Constructive Modeling and Simulation Trainers, specializing in Anti-submarine Warfare and Virtual At-Sea Training Systems.

EXPERTISE

- Computer Scientists
- Computer Engineers
- Subject Matter Experts

CAPABILITIES

The LVCMS Lab capabilities include the development of computer software, including computer system architecture and system software organization for Live, Virtual, and Constructive Modeling and Simulation Trainers, specializing in Anti-submarine Warfare and Virtual At-Sea Training Systems.

- **Bravo Air Crew Tactical Team Trainer (BATTT)** The Anti-Submarine Warfare (ASW) Virtual-at-Sea Training (VAST) Bravo Acoustic Tactical Team Trainer (BATTT) system is a networked, PC-based, deployable trainer designed to support integrated and coordinated ASW tactical training and enhance team decision making
- **Romeo Air Crew Tactical Team Trainer (RATTT)** is a networked, PC-based, deployable trainer designed to support integrated and coordinated ASW tactical training and enhance team decision making
- **P-3 Air Crew Tactical Team Trainer (PACT3)** provides the first ever PC-based (small foot-print, low cost) training capability for currently fielded P-3 Maritime Patrol Aircraft that can be reused with very minor flight dynamics model modifications to represent the Navy's future P-8A Maritime Patrol Aircraft, allowing cross platform (Aviation, Surface, Undersea) coordinated ASW integrated team training.
- **Bravo Romeo Acoustic Stimulation System (BRASS):** BRASS for Sea Combat Commander (SCC) is a NAWCTSD effort for providing the Anti-Submarine Warfare (ASW) characteristics of the MH-60R Helicopter Platform stimulating the Aircraft Carrier Tactical Support Center (CV-TSC) using the SAU07000 message standard.
- **Mine Countermeasures Aircrew Training System (MCATS)** The AN/AQS-24B Sonar Mine Detecting Set is a high-speed, high-resolution sonar system with the capability to implement a laser line scan (LLS) sub-section for the detection, classification and identification of mine-like objects.

TOOLS

- Passive Generator for realistic audio for passive sensors
- APModule used for realistic audio for active sensors
- DOG to provide environmental data for ocean modeling
- Visual Studio
- HLA Gateway

For More Information Please Contact

NAWCTSD Technology Transfer Program Manager

ORLO_Orlando_Tech_Transfer@navy.mil

Multipurpose Reconfigurable Training System 3D® (MRTS 3D®) Lab

CAPABILITIES

The Multipurpose Reconfigurable Training System 3D® (MRTS 3D®) family of trainers provide virtual training environments simulating a variety of platforms, weapons, and communications systems. Each trainer consists of government owned and developed simulation software running on a stand-alone network of Commercial-Off-The-Shelf (COTS) hardware and software components. A single MRTS hardware trainer can shift between multiple software simulation applications in a few minutes. This capability enables the school to use one hardware suite to give photo-realistic virtual training on several different systems in a single day.

The MRTS 3D trainers are used in both Sailor pipeline courses and in pre-deployment team training. The instructor can manage configurations and scenarios while the students follow procedures, interact with the touch screens, and coordinate with the other stations during the various training scenarios.

FIELDED / NEW PROJECTS

Fielded MRTS 3D Trainers

- VIRGINIA Torpedo Room
- 2015 VIRGINIA EDG
- 2016 MEPP Ops & T/S
- 2016 VIRGINIA VLS Block I/II
- 2017 VIRGINIA VLS Block III

New Projects

- Standardized IOS & SDK
- FM EDG Ops & Maint
- LOS ANGELES 2nd & 3rd WLC
- EMALS/AAG Ops & Maint
- MQ-4C Triton Avionics Maint
- SLQ-32 Maintenance
- JCC Radio Trainer
- VIRGINIA HM&E Systems
- USA Vehicle Maintenance
- AEGIS MMSP Maintenance

MISSION

To provide fully immersive training environments via a common architecture for low -cost, rapidly-deployable training solutions.

EXPERTISE

- Computer Scientists
- Computer Engineers
- Graphic Artists
- Subject Matter Experts

SUPPORTED SITES

- Groton, CT
- Guam
- Kings Bay, GA
- Norfolk, VA
- Pearl Harbor, HA
- Pensacola, FL
- San Diego, CA
- Bangor, WA

For More Information Please Contact

NAWCTSD Technology Transfer Program Manager

ORLO_Orlando_Tech_Transfer@navy.mil

Submarine Surface Piloting and Navigation Training Laboratory (NAVLAB)

MISSION

Provide full trainer life cycle support for the SPAN/VESUB submarine navigation trainers of record including software/ systems development, integration test, design, packaging, and fielded updates.

EXPERTISE

- Computer Engineers/Scientists
- Submarine Subject Matter Expert

DEPLOYMENT LOCATIONS

- Bangor, WA (SSBN/SSGN)
- Kings Bay, GA (SSBN/SSGN)
- Groton, CT (SSBN/SSGN/Virginia/SSN 688/SSN 21)
- San Diego, CA (SSN 688)
- Norfolk, VA (Virginia)

For More Information Please Contact

NAWCTSD Technology Transfer Program Manager

ORLO_Orlando_Tech_Transfer@navy.mil

CAPABILITIES

The lab utilizes an integrated development environment and modular test berth to perform trainer support functions:

- Software design and development from Fleet requirements to Fleet Acceptance, based on In-House Development Process (iDP) and In-House System Engineering Technical Review (iSETR).
- Immersive, mixed-reality environments for multiple submarine baselines
- Modeling and simulation of tactical systems
- Distributed system design using High Level Architecture (HLA) and TCP/IP network.
- Modeling and simulation of virtual harbor navigation
- Software integration and testing facility
- System Delivery and Upgrade with full technical and logistics support

The Submarine Piloting and Navigation (SPAN) Trainer

The SPAN trainer provides team and individual training in piloting and navigation principles of a surfaced submarine for the Helmsman, Fathometer Operator, Navigation Center Operator, Voyage Management Operator, Contact Coordinator, Periscope Operator, RADAR Operator, Officer of the Deck, and Lookout. The team uses navigation techniques and simulated on-board equipment to ensure the ship is safely piloted and navigated in various harbors, under variable environmental conditions.

Virtual Environment for Submarine Ship Handling (VESUB) Trainer

The VESUB trainer is a virtual reality-based computer system utilizing immersive Virtual Environment and Head Mounted Display (HMD) technology. The trainer consists of Commercial-Off-The-Shelf (COTS) hardware and software integrated with custom software as a system. It is comprised of an Instructor Operator Station, visual system, student station, voice recognition/synthesis system, audio system, and multiple screen displays. It provides the Officer Of the Deck (OOD) student individual instruction in the knowledge and skills necessary to successfully and safely pilot and maneuver a surfaced submarine through restricted harbors/ waterways avoiding collisions and grounding.

TOOLS

- **Microsoft Visual Studio, Team Foundation.**
- **HLA using MAK RTI/VR-Link**
- **GDIT VShip for hydro model**

Rapid Design, Development and Fabrication (RD2F) Laboratory

CAPABILITIES

- **Turnkey Training System and Technology Design and Production** including proof of concepts, rapid prototypes, limited quantity productions, and life-cycle extension upgrades.
- **Virtual Environment and Game-based Technologies** including simulation-based training system development, Augmented and Virtual Reality integration, interactive/immersive courseware, 3D terrain and content development, hand-held toolset/equipment integration with virtual environments, and user experience design.
- **Enterprise Data Analysis, Modeling and Tool Creation** including enterprise-scale data mining and root cause analysis, AI-based predictive model creation and validation, statistical trend analysis, custom data engineering applications, and enterprise data visualization.
- **Software Application Development** including cross platform mobile development, distributed and embedded applications, real-time embedded control, machine vision and intelligence, natural language processing, adaptive applications, intelligent agents, instructor support and after action review software.
- **Electronics Design and Fabrication** including circuit design, prototype and small-quantity circuit board production, wired and wireless interfaces, firmware development, device fabrication and assembly, and production of electronic test equipment suites.
- **Mechanical Design and Fabrication** including part and assembly design, electro-mechanical and -optical devices, pneumatic systems, 3D modeling , virtual prototyping with 3D assemblies, and fabrication using a variety of materials (plastics, non-ferrous metals, stainless steels). Additive and subtractive manufacturing process are supported for both prototype and low rate production.

TOOLS

- **AAA Game Engines (e.g. Unity 3D & Unreal 4)**
- **Local High Performance Computing Stack (~7 PFLOPS Tensor Performance)**
- **Visual Studio, Team Foundation, Jira, Kubernetes, Spark, Keras, Tensor-Flow, Anaconda, Xamarin, etc.**
- **Computer Aided Design (CAD) and Manufacturing (CAM)**
- **Computer Numeric Control Machining**
- **Fused Deposition Modeling (FDM) and Polyjet 3D Printing**

MISSION

Provide the Commander NAWCTSD with an in-house, rapid-response design, development, and production capability for advanced modeling and simulation technology products.

EXPERTISE

- Modeling and Simulation
- Computer Science / Data Science
- Mixed Reality Systems
- Mobile Technology
- Rapid Design and Production
- Agile Software Development
- Electromechanical Systems
- Embedded Systems
- Hardware/Software Integration

For More Information Please Contact

NAWCTSD Technology Transfer Program Manager

ORLO_Orlando_Tech_Transfer@navy.mil

Ready Relevant Learning (RRL) Lab

MISSION

The Sailor 2025 Ready Relevant Learning (RRL) Lab supports the test and evaluation of training content and technologies in support of the goal to provide the right training at the right time in the right way for Sailors. The lab is currently testing Navy eLearning (NeL) courses and Virtual Simulations that have been developed for the Operations Specialist (OS) rating A-School and Global Command and Control System-Maritime (GCCS-M) training.

EXPERTISE

Test & Evaluation of: HTML 5 NeL courses, Instructional Virtual Simulations, Standalone courseware, mobile courseware.

CAPABILITIES

- Unclassified NeL Course Content and Hosting
- Government Acceptance Testing (GAT) of RRL Course Content
- Data Collection/Analysis of current state and future training course requirements

TOOLS

- TRANET Unclassified Network
- NETC Virtual Desktop Installation (VDI)
- Navy eLearning (NeL) TestTrack System
- NeL Atlas Pro/Enterprise Training Management Delivery System (ETMDS)
- Government Content Acceptance Testing (GCAT) Environment
- NeL Content Hosting and Reports Management Service (CHaRMS)
- Micro Focus Fortify
- NETC Test Tool

For More Information Please Contact

NAWCTSD Technology Transfer Program Manager

ORLO_Orlando_Tech_Transfer@navy.mil

Surface Training Advanced Virtual Environment (STAVE) Laboratory

CAPABILITIES

The STAVE lab supports the Virtual Ship Training System (VSTS) a modular virtual training environment network infrastructure located at Littoral Combat Ship Training Facilities (LTF). The LTF VSTS supports individual, multiple, and team training for Seaframe and Mission Module Detachment (MMDET) crew to train to qualify (T2Q) watch stander and train to certify (T2C) team training requirements. The virtual environment is networked with all physical simulators for visualization, communications and systems operations to enable expanded individual and team training events. The STAVE Lab provides configuration management of the IVSE courseware, Virtual Ship Training Systems (VSTS) products and various trainers and training systems located at the LCS Training Facilities (LTFs).

Cybersecurity Support – The LCS Lab serves as the repository of updates and patches for the unconnected trainers (not only LCS). Utilizing synchronization of repository databases, the lab can scan for patches and updates and download those required for an unconnected trainer.

Prototyping – Training Equipment Change Requests (TECRs) can be prototyped and tested in the lab before deploying them in a production environment.

External Product Integration – The LCS Lab have utilized the baselined VSTS environment to integrate, setup, and test with external products, adding training capabilities to the LTFs.

Virtual Ship Training Systems (VSTS) – Provides Network Infrastructure Services, Sustainment, Cyber security, and Centralized Management of Training Systems.

STAVE-LCS IT – Information Technology training system that brings the LCS ship IT environment virtually to train Sailors on managing the IT systems of the ship.

Virtual Reality Laboratory (VRL) - Student and Instructor Station Hardware Platform that can support multiple training environments.

Immersive Virtual Shipboard Environment (IVSE) - Install and test Courseware into hardware platform. Integrate to VSTS and create baselines for distribution to LTF.

TOOLS

- **Microsoft System Center Configuration Manager (SCCM)**
- **Virtualization Technologies**
- **Centralized Management Systems**

MISSION

Support developmental systems, rapid configurability, special hardware and software requirements and sustainment of Littoral Combat Ship Training Systems.

EXPERTISE

- Information Technology
- Cyber Security
- System Engineering
- Software Integration
- Instructional Systems Design

For More Information Please Contact

NAWCTSD Technology Transfer Program Manager

ORLO_Orlando_Tech_Transfer@navy.mil

STEALTH LAB

Science for Training, Evaluation, Analysis, Learning and Theory Lab

MISSION

Conduct Research and Development to support the design and development of training programs and instructional tools through application of advanced technologies, training effectiveness evaluations and human-computer interface design.

EXPERTISE

Research Psychologists (B.S./M.A./Ph.Ds)

- Applied Experimental and Human Factors
- Industrial/Organizational
- Modeling and Simulation

CAPABILITIES

Support for Design and Development of Training Programs and Instructional Tools

- Front End Analysis Tools/Techniques
- Cognitive Task Analyses for multi-teams and systems
- Job Task Analysis
- Personnel Selection
- Types of Feedback
- Adaptive Training
- Multi-culture Teams

Application of Advanced Technologies in Training Systems

- Live, Virtual, and Constructive (LVC)
- Augmented Reality
- Games and Gamification
- Multi-user Virtual Environments
- Virtual Worlds

Training Effectiveness Evaluations

Human Computer Interface Design

CURRENT PROJECTS

- Live, Virtual, and Constructive (LVC)
- Multidisciplinary Extended Reality Team
- Investigation of Training Fidelity for Carrier Qualification and Precision Landing Modes
- Fleet Training Technologies (FleeT2)
- Fleet Adaptive Multilevel Measurement for Operations & Unit Systems (FAM2OUS)

For More Information Please Contact

NAWCTSD Technology Transfer Program Manager

ORLO_Orlando_Tech_Transfer@navy.mil

STRIKE LAB

Simulation and Training Research to Improve Knowledge and Effectiveness

CAPABILITIES

- **Adaptive training (AT) system design and development.** We utilize cognitive theories and science-based principles to guide all aspects of AT development including task analyses, performance metrics, user interface design, assessment algorithms, instructional adaptation algorithms instructional content (including scenario development), & iterative system evaluations.
- **Instructional strategies research** aimed at understanding which instructional techniques work best for the particular task and for the individual trainee in order to optimize learning. For example, we perform basic research on the type, timing, content, valence, and modality of feedback, scaffolding, hinting/cueing, and individual differences.
- **Application of advanced technologies in training systems** including virtual and augmented reality, game-based training, and human behavioral modeling in scenario-based training systems. We seek to understand how and when to incorporate these advanced technologies in our training systems to improve learning outcomes and efficiency. Our perspective is to instantiate these technologies in a thoughtful way to maximize our return on investment rather than incorporating technology for technology's sake.
- **Training effectiveness evaluations** aimed at quantifying learning and/or performance improvements gained from the training systems we developed. We emphasize robust data collection efforts in order to assess short-term or long-term transfer and/or knowledge retention in addition to user reactions data. This approach allow Fleet decision-makers and stakeholders to make evidence-based determinations regarding the successful implementation of our training approaches.
- **User interface design and usability testing** including both formative and summative techniques such as use cases, proof of concepts, focus groups, heuristic evaluations, usability studies, science-based and/or data-driven design & re-design recommendations.

TRANSITIONED RESEARCH PRODUCTS

- Submarine Electronic Warfare Adaptive Training System (SEW-AT)

- Periscope Operator Adaptive Training System + (POAT+)

MISSION

Apply cognitive science and human factors engineering to improve warfighter readiness through optimal training and system design. Perform research to improve the instruction implemented in training systems in order to maximize learning and/or performance.

EXPERTISE

- Human Factors
- Cognitive Science
- Experimental Design
- Statistical Analyses
- Adaptive Training
- VR/AR/MR
- Individual Differences
- Training Effectiveness Evaluations
- User Interface Design
- Usability Testing

For More Information Please Contact

NAWCTSD Technology Transfer Program Manager

ORLO_Orlando_Tech_Transfer@navy.mil

Technology Research Applications Team (TechRAT) Laboratory

MISSION

Provide simulation and media solutions for the naval aviation, undersea warfare, surface warfare, and special warfare training communities.

EXPERTISE

- Modeling and Simulation
- Extended Reality Systems
- Rapid Design and Production
- Agile Software Development
- Computer Science
- Navigation Training
- Haptic Data Gloves
- Mobile Technology
- Adaptive Training

CAPABILITIES

- **Software Application Development** including individual and team training simulations, replay and after action review, mobile applications, scenario authoring tools, image generators, emulations of tactical and commercial equipment, and gaming area authoring tools.
- **Turnkey Training System Design and Production** including proof of concept, rapid prototypes, limited quantity productions, and life-cycle extension upgrades.
- **2D/3D/VR Virtual Tours** including panoramic photography-based virtual tours, 3D rendered virtual tours, and virtual reality tours. Virtual tours provide familiarization and procedural training, interactive courseware, and embedded media files.
- **Research Testbed Design and Development** to facilitate research activities including data collection, usability studies, adaptive training, and haptic device investigation.
- **Reality Capture** including 3D laser scans, photo references, 360° video references, wearable and optical motion capture.
- **Building Virtual Environments** from source material including: Computer Aided Design (CAD), 3D point clouds, photogrammetry, and traditional modeling.
- **Integrating with External Systems** including stimulating commercial and tactical hardware and software and implementing training network protocols.

TOOLS

- **Unity 3D**
- **Visual Studio, Team Foundation, Perforce**
- **3D Studio Max, Allegorithmic Substance Designer**
- **Computer Aided Design (CAD) and Manufacturing (CAM)**
- **Small and Medium Scale Fused Deposition Modeling (FDM)**
- **3D Laser scanner**
- **360° video camera**
- **OptiTrack visual motion tracking system**

For More Information Please Contact

NAWCTSD Technology Transfer Program Manager

ORLO_Orlando_Tech_Transfer@navy.mil

Trident Training System (TTS) Lab

CAPABILITIES

- **Turnkey Training System and Technology Design and Production** including proof of concepts, rapid prototypes, limited quantity productions, and life-cycle extension upgrades.
- **Software Application Development (EOG/AEAG)-**Implements automatic shutdown logic. Simulates operational status and annunciation displays. Implements cursor selectable simulation options via the displays. Implements sequential steps of operational procedures as they are selected . Detects and annunciates operator errors. Simulates cell liquid levels. Simulates effects of manual overrides of solenoid valves and pressure control valves. Simulates oxygen pressure and D/P regulator control loops
- **Electronics Design and Fabrication** including circuit design, prototype and small-quantity circuit board production, wired and wireless interfaces, firmware development, device fabrication and assembly, and production of electronic test equipment suites.
- **Mechanical Design and Fabrication** including part and assembly design, electro-mechanical and -optical devices, pneumatic systems, and fabrication using a variety of materials (plastics, non-ferrous metals, stainless steels). Additive and subtractive manufacturing process are supported for both prototype and low rate production.

TOOLS

- **Electrolytic Oxygen Generator Front Panel Simulator**
- **CITECT Software**
- **Peripheral Component Interconnect (PCI) eXtensions for Instrumentation (PXI) architecture**.
- **LabVIEW**

MISSION

Provide full trainer life cycle support for the Trident Submarine Damage Control Trainer and the Electrolytic Oxygen Generator / Automated Electrolytic Oxygen Generator Simulator (EOG/AEOG) training systems. The lab manages software/ systems development, integration test, design, packaging, and fielded updates. It uses an integrated development environment and modular test berth to perform these trainer support functions.

EXPERTISE

- Modeling and Simulation
- Electromechanical Systems
- Software Development
- Rapid Design and Production
- Hardware/Software Integration

For More Information Please Contact

NAWCTSD Technology Transfer Program Manager

ORLO_Orlando_Tech_Transfer@navy.mil

NAWCTSD RESEARCH & TECHNOLOGY ROADMAP

Disclaimer: This NAWCTSD Technology Roadmap is a living document and is subject to change. Significant portions of the information are planning in nature and are subject to change throughout the RDT&E planning process, and in response to peer reviews.

POC: Bob Seltzer & Melissa Walwanis
robert.seltzer@navy.mil / Melissa.walwanis@navy.mil

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			Current Programs
CC1 - Human Systems Engineering, Integration, and Acquisition	Research, design, and development of integrated Human Systems products	Develop tools and methodologies for deriving and managing SoS requirements	Deploying Mobile Devices for Navy Training (NISE-SG)
			Simulation Standards for Interoperability of Human Performance and Debrief Data in Training (NISE=SG)
		Human performance metrics and training solutions that support Integrated Warfare Capabilities (IWC)	Next Generation Training Systems Development for Manned & Unmanned Concepts (NISE-SG)
		SoS/Big Data Human performance analysis tools	A hybrid classification approach using down-sampling techniques and tuned hyper parameters on imbalanced datasets (NISE-BAR)
CC2 - Optimized Human Performance and Decision Support	Human-Machine Interfaces	Enhance collaborative and autonomous unmanned surveillance and strike capabilities	Adaptive Training for Maintaining Attention during UAS Operations (SBIR N162-090)
			Identification and Definition of Unmanned Aerial System Air Vehicle Operator Performance Metrics (NISE-BAR)
			Unmanned Systems -Training Experimentation & Simulation (US-TES) Lab (TSD-CIP)
			User Interface Strategies for Human-Machine Team Training in a Simulated Swarm Task (TSD:219BAR)
			Evaluating Robot User Displays to Investigate Team Effectiveness (ERUDITE) (TSD:219BAR)
		Enhance data representation and visualization for decision support	Complex-Knowledge Visualization Tool (SBIR N17A-T004)
			End-User Speech Recognition Support Tools for Crew Resource Management Training Systems (TSD: STTR N17A-T010)
		Improve mission planning and real-time re-planning	Pre-FNC Fleet Training Technologies (FleeT2) (TSD: ONR)
		Provide actionable tactical situational awareness	Aircrew Control of Remote Asset Using an Electronic Kneeboard (UAV ctl with EKB) (PAX-BAR)
			Application of Virtual / Augmented Reality Systems in Manned and Unmanned Systems HMI (VR-AR TACTICAL HMI) (TSD)
			Spatial Augmented Reality Training Utilizing a Transparent Display (TSD: WFD SG)
		Improve manned platform information management and payload, systems, and vehicle control	Impact of Low-Cost Haptic Cueing on User Performance and Workload (TSD:ILIR)
			Methods for Actionable Measures of Absolute Cognitive Workload (TSD:SBIR)
	Instructional Strategies for Training Effectiveness	Improve training outcomes through application of neurophysiological data	Construct Correspondence of Physiological and Subjective Measures of Hypoxia (TSD-ILIR)
			Squad Overmatch (TSD: DHA)
		Improve warfighter performance through application of psychometric theory	Techniques to Adjust Computational Trends Involved Changing data (TACTIC) (TSD: STTR N17B-T032)
			Electronic Warfare (EW) Tactical Decision Aid (TACAID) (TSD-FNC)
			Squad Overmatch and Team Overmatch – Tactical Combat Casualty Care (ATD-Joint)
			Performance Measurement (PM) Engine (TSD-AWTD)
			Personal Assistant for Life Long Learning (TSD-ONR ADV. TECH.)

			Current Programs
CC2 - Optimized Human Performance and Decision Support	Instructional Strategies for Training Effectiveness	Enhanced techniques for individual, team, and multi-team performance assessments	Training Expansion Package - (TSD: ONR Tech Solutions)
			Techniques to Adjust Computational Trends Involved Changing data (TACTIC) (TSD: STTR N17B-T032)
			USMC Adaptive Joint Terminal Attack Controller (JTAC) training (ONR)
			Adaptive Training for USMC Close Air Support Tactics and Decision-Making (ONR30: ATD)
			FAMOUS (Fleet Adaptive Multilevel Measurement for Operators and Unit Systems) (ONR & PMA205)
			EDUCATE (Environment Designed to Undertake Counter A2AD Tactics training and Experimentation) (ONR)
			FleeT2 (Fleet Training Technologies) (ONR34: Pre-FNC)
			Transition of Crew Role-Player Enabled by Automated Technologies to Maritime Patrol Training (TSD: 219TT)
			Construct Correspondence of Physiological and Subjective Measures of Hypoxia (ILIR-17-004)
			Investigation of Micro-Adaptation Schedules to Support Electronic Support Measures Operator Adaptive Training (ONR34-D&I)
			Modular Advanced Technologies Marksmanship Proficiency (MAT-MP) (Tech. Transfer)
		Develop LVC performance assessment technologies and after-action review strategies	Operation Blended Warrior (TSD:IITSEC)
		Develop data analyses to facilitate trainee feedback and identify novel performance trends	Basic Electronics and Electricity Learning Environment (BEETLE) II Transition (NISE-TT)
			Empirical Support for the Benefits of Performance Measurement Tools (TSD-219TT)
			Data Science Driven Aircrew Performance Measurement and Proficiency System (NISE-BAR)
			Data Science Driven Aircrew Perf. Measurement And Proficiency Sys. (SBIR N181-026)
		Develop scenario authoring tool sets that use training network assets and integrated training	
	Advanced Instructional Techniques	Integrate instructional interventions into virtual and mixed reality environments	Investigating Low-Cost Untethered Virtual Reality Technologies and the Role of Affordances on Training Effectiveness in an Immersive Environment (NISE-BAR)
			Distributed Virtual Reality Testbed (NISE-WFD:SG)
			Accelerating the Development of Small Unit Decision Making (ADSUDM) (TSD-FNC)
			Naval Integrated Fire Control- Counter Air (NIFC-CA X) Mission Visualization Tool (ONR34-FNC)
			Mishap Awareness Scenarios and Training for Operatonal Readiness Responses (SBIR)
			Sexual Assault Prevention and Response (SAPR) Virtual Immersive Training (DoN SAPR Office)
			Dynamic Flight Simulation as a Supplement to In-Flight Pilot Training (SBIR N08-012)
		Develop methods to diagnose and deliver instructional interventions to remediate knowledge and skill deficiencies	Post Mission Assessment for Tactical Training & Trend Analysis (PMATT-TA) (AWTD)
			Repurposing Computational Analyses of Tactics for Training Assessments
			Systematic Team Assessment of Readiness Training (START) applied to Medicine: Medic/Corpsman Proficiency Model (MED-PM) (TSD-DoD S&T)
			Augmented Training for Experiential Learning for Signal Officers (NISE-TT)
			Tutoring Effectively: An Assessment of Common Heuristics (TEACH) (ONR D&I)
			Electronic Warfare (EW) Tactical Decision Aid (TACAID) (TSD-FNC)
			Personal Assistant for Life Long Learning (TSD-ONR ADV. TECH.)

			Current Programs
CC2 - Optimized Human Performance and Decision Support	Advanced Instructional Techniques		Learning Continuum and Performance Aid (LCaPA - ONR FNC)
			Measuring Intuition and its Relationship to Somatic Markers and Indivdual Differences (ILIR)
			Team-Based Advanced Resilience Accelerator (TARA) (AWTD)
			Transition of End User Automated Perf. Measurement Tool (N18A-T003)
		Employ game-based training to improve performance	Examining the Effects of Game Features on Learning Scenario Based Training (TSD-BAR)
			Research Exploring Multi Operator Training Environments (REMOTE) (NISE-SG)
		Develop mobile training technologies	Effectiveness assessments of mixed and immersive reality for aviation training (SBIR N171-201)
			Deploying Mobile Devices for Navy Training: Low Cost Mobile Device Management Alternatives (NISE-WFD:SG)
			Proximal Engagement Education Resources (TSD: ONR - STEM)
	Applied Human Behavior Modeling	Develop computational models of human performance	Maintainer – Proficiency Model (MAIN-PM) (TSD-BAR)
			Decision Making for Human Machine Collaboration in Complex Environments (ONR Basic Research Challenge)
		Develop standards for verification, validation, and accreditation (VV&A) of human performance models	
		Develop Semi-automated Forces (SAF) models with human-like performance	CREATE (Crew Role Player Enabled by Automated Technology Enhancement) (SBIR N14-2-090) & CREATE for Maritime Patrol Training (219TT-18-003 - PMA-290)
			Transition of Crew Role-Player Enabled by Automated Technologies to Maritime Patrol Training (TSD: 219TT)
			Adjustable Crewmembers - Accelerating Instructor Mastery (AIM) - SBIR N152-108
			DYADEM (Dynamic Adaptive and Modular Entities for UAS) behavior models for UASSIST (also in CC3)
			Tactics and Speech Capable Semi-Automated Forces (TACSAF) (ONR LVC FNC)
			V&V of higher fidelity constructive entities (TSD: LVC SV)
d Training Systems tEchnologies	High-Fidelity Training Environments	Create repository of assets and metrics to design and maintain high-fidelity trainers	
		Develop real-time flight aerodynamic and visual simulation technologies	3D Interactive Aircraft Carrier Operations Planning Tool Prototype (TSD-BAR)
			Virtual Environment Motion Fidelity Model (TSD-BAR)
			Effective Measures of Training Display System Performance (TSD-SBIR: N142-104)
			Extended Field of View (FOV) Video Aviation Training Aids (PAX)
			Flight Deck Crew Refresher Training Expansion Packs (TEP) (TSD: ONR Tech Solutions
			Dynamic Flight Simulation as a Supplement to In-Flight Pilot Training (TSD: SBIR N08-012)
			Innovative Collimated Displays (TSD: SBIR N121-041)
			Small Projector Array Display System (TSD: SBIR N121-041)
			Variable Accomodaton Head Mounted Display
			Strategic Development of Near Eye Display Perf. Metrics For Naval Aviation Training Application

			Current Programs
CC3 - Advanced Training Systems Technology	High-Fidelity Training Environments	Advanced Training System Prototypes	3D Interactive Aircraft Carrier Operations Planning Tool Prototype (TSD-BAR)
			Immersive Parachute Descent Procedure, Malfunction and Decision Making Training System (TSD: SBIR N161-007)
			Transition of a Pressure on Demand Normobaric Hypoxia Training device for Survival School Houses (TSD: 219BAR)
			Mask-on Hypoxia Training Device (TSD SBIR N132-093)
		Advanced Training Systems Prototypes	H-60R VR ATO Weapons Procedures Trainer prototype (TSD: G0)
			NIFC-CA X Laptop Trainer (TSD)
			Bohemia VR F/A-18 PTT VFA-106 eval (TSD: CRADA)
			Course Rules Part Task Trainer Study (PMA205: AWTD)
			H60S VR HDTS Trainer (TSD: 219-RPC)
			Fire Fighting Trainer Modification and Enhancement (SWOS)
			Aviation Reconfigurable Cockpit for Hypoxia & Hazard Exposure & Recognition (ARCH2ER)
			Oceanography Tactics Training for Employment Readiness
			NATTC Air Traffic Control Fundamentals Lab
		Develop speech recognition, synthesis functionality, and computational methods to recognize the difference between relevant and irrelevant speech	End-User Speech Recognition Support Tools for Crew Resource Management Training Environments (TSD: STTR)
		Develop multi-modal sensory simulation systems and integrate into Tactical Software training applications	Spatial Augmented Reality Training Utilizing a Transparent Display (TSD:219SG)
			Exploration of Kinesthetic and Haptic Technologies in Virtual Training Environments
			11F12 Catapult Launch System Trainer Replacement (TSD: PMA 205)
		Develop multi-touch interaction and 3D models	Flight Deck Crew Refresher Training Expansion Packs (TEP) (TSD: ONR Tech Solutions
			Exploration of Kinesthetic and Haptic Technologies in Virtual Training Environments
	Simulation Interoperability and Distributed LVC Technology	Develop interoperable LVC and Cyber Warfare training simulation and technologies	Crew Role Player Enabled by Automated Technology Enhancements (CREATE) (TSD-SBIR:N142-090)
			Environment Designed to Undertake Counter A2AD Tactics Training & Experimentation (EDUCAT2E) (TSD-FNC)
			Network Effects Emulation System (NE2S) (TSD-BAR)
			Integrated Warfighting Capabilities (IWC) Fidelity Investigation (TSD-BAR)
			Live, Virtual & Constructive (LVC) Training Fidelity (TSD-FNC)
			Real-Time RF Propagation Modeling in Urban Environments for Virtual and Constructive Training(TSD-BAR)
			Verification & Valid. of Higher Fidelity Constructive Entities for UAS Training (NISE-BAR)
			Distributed Virtual Reality Testbed (NISE-WFD:SG)
			Cyberspace Operations Degraded Exercise & Synthetic Training Architecture (CODESTAR) - ONR34
			Future Integrated Training Environment (FITE) - ONR34

			Current Programs
CC4 - Human Systems Analysis, Design, and Evaluation	Simulation Interoperability and Distributed LVC Technology		Automated Software Testing Capability (NISE)
			Computer Defense Network
			Distributed Simulation Data Monitoring, Analysis and Verification
		Develop Multi-Level Security Methods to safeguard classified information in the LVC environments	Enterprise Network Guard (ENG) CT&E - NSA certification test and evaluation (LVCt)
			Enterprise Network Guard (ENG) TENA and HLA extension efforts (LVCt)
			Distributed Training Network Guard (DTNG) (AWTD: JSF)
			Multi-Intergrated Domain Administrative Support Solution
		Develop Mission Rehearsal Enabled Database Methods for collecting and packaging authoritative data feeds	Distributed Synthetic Environment Correlation Architecture and Metrics (SBIR:N141-006)
		Develop tools for Enhanced Constructive Environments	Cross Domain Maritime Surveillance and Targeting (CDMAST) (DARPA)
			Dynamic Adaptive and Modular Entities for UAS (DYADEM) (ONR34-FNC)
		Develop Information Load Management methods, technologies, and tools	
		Develop Navy Continuous Training Environment (NCTE) voice communication technologies to support FST exercises for distributed environments	
	Content Design	Develop advanced technologies and methodologies for training delivery	Utility and effectiveness of using Fleet produced maintenance videos as job performance aids (NISE:BAR-18-049)
			Spatial Augmented Reality Training Utilizing a Transparent Display (NISE-SG)
			Advanced Instructional Media Attribute and Interactivity Model (Sailor 2025)
			Explosive Ordnance Disposal maintenance videos effort
			Multi-media Knowledge Capture (MKC) Engine (SBIR ONR181-111)
			Total Learning Architecture (TLA) Learning Technology Roadmap with Concept Pilots (DHA: Applied Res.)
			Defense Health Agency (DHA) Total Learning Architecture (TLA) Learning Technology Roadmap with Concept Pilots
			Complex Knowledge Vizuation Tool (N17A-T004)
	Training Optimization Analysis	Optimize training event sequencing and media utilization	Medical Training Validation 2 (MTV2) (TSD - DOD S&T)
			Investigation of Training Fidelity for Carrier Qualification and Precision Landing Modes (NISE:BAR)
		Develop Improved Tools and Techniques for Training Requirements Analysis	Requirements Traceability Tool /Systems Engineering Test Tool (RETT / SETT)
			MEDPM (Medical Proficiency Measurement Model) (DHA)
	Training Effectiveness Evaluation (TEE)	Determine level of training effectiveness and outcome improvement strategies	Multi-purpose Reconfigurable Training System (MRTS) Effectiveness (TSD Overhead)
			Effectiveness Assessments of Mixed & Immersive Reality for Aviation Training (TSD:SBIR N171-021)
			Course Rules Part Task Trainer Study (PMA205: AWTD)
			Office of Naval Research Technology Candidate: NOTORIOUS
			Investigation of Training Fidelity for Carrier Qualification and Precision Landing Modes
			CNATRA T-45 VR-PTT Training Evaluation

			Current Programs					
	Evaluation (TEE)		Mask-on Hypoxia Training Device (TSD SBIR N132-093)					
						CNATRA TH-57 Virtual Reality Training Evaluation		
						Evaluating And Improving The Naval Aviation Survival Training Program: Evaluation Of Spatial Disorientation Curriculum Enhancement		
						Evaluating and Improving the Naval Aviation Survival Training Program: Initial Operational Evaluation & Upgrade for the Normobaric Hypoxia Trainer (9A19)		
						Evaluating and Improving the Naval Aviation Survival Training Program: Virtual Reality Parachute Decent Trainer (Device 9C4/9C4A) Evaluation		

INDEX OF PRINCIPAL INVESTIGATORS (PI)

INDEX OF PRINCIPAL INVESTIGATORS (PI) (CONT)

INDEX OF PRINCIPAL INVESTIGATORS (PI) (CONT)

INDEX OF PRINCIPAL INVESTIGATORS (PI) (CONT)

INDEX OF PROGRAMS

INDEX OF PROGRAMS (CONT)

INDEX OF PROGRAMS (CONT)

INDEX OF PROGRAMS (CONT)

NAVAL AIR WARFARE CENTER
TRAINING SYSTEMS DIVISION
12211 SCIENCE DRIVE
ORLANDO, FL 32826-3224

Phone: (407) 380-8218

Email: NAWCTSD_Research_TechnologyProgram@navy.mil

www.navair.navy.mil/nawctsd