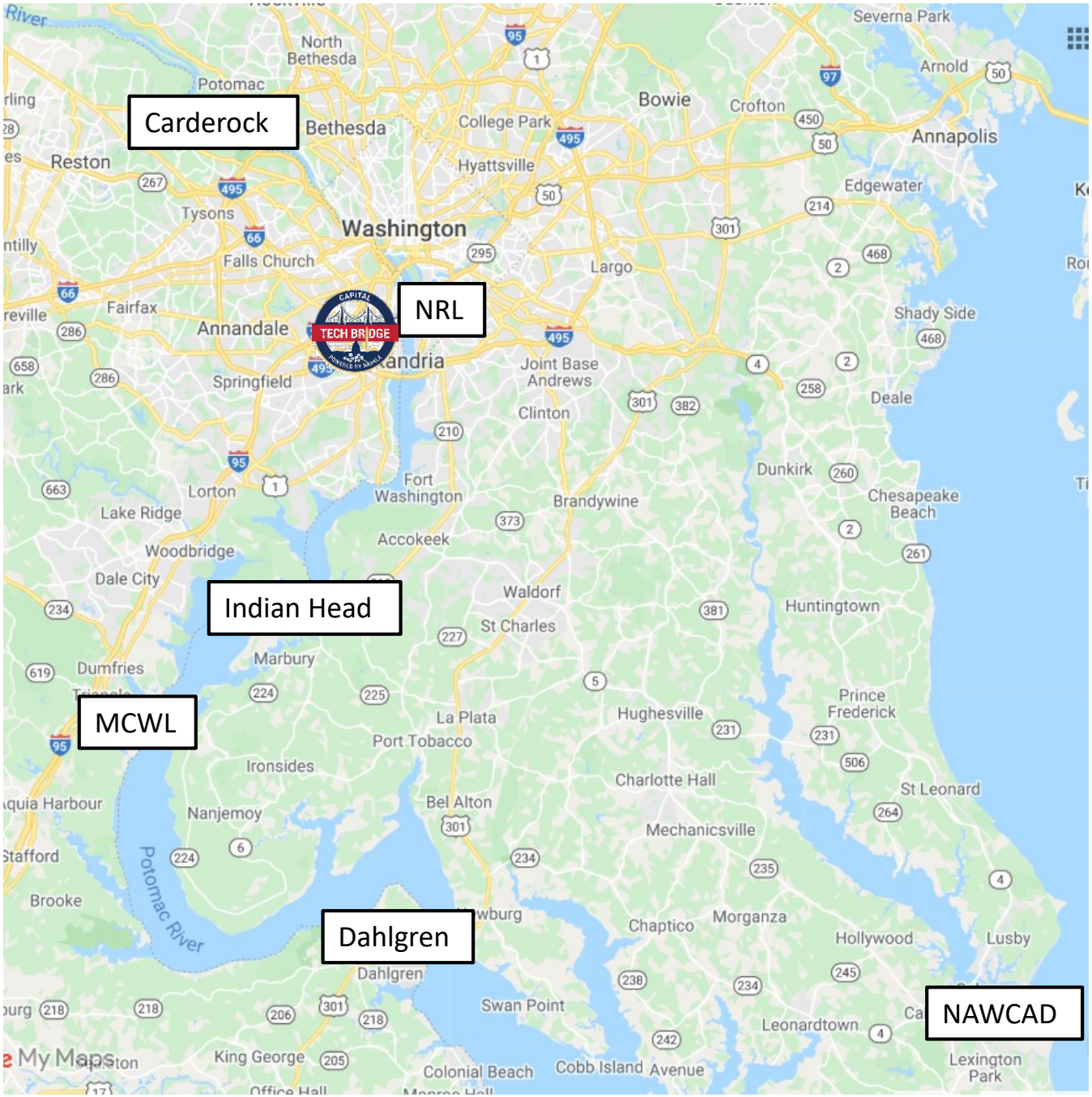
University Day Agenda

5 Aug, 2020

1400-1410	Welcome and Intro	Dr. Krista Michalis Capital Tech Bridge Director krista.Michalis@navy.mil
1410-1420	University Initiatives Overview	Dr. John Barkyoumb NSWC Carderock Director of Strategic Relations john.barkyoumb@navy.mil
1420-1430	NSWC Carderock	Dr. John Barkyoumb Director of Strategic Relations & University Engagement john.barkyoumb@navy.mil
1430-1440	NSWC Dahlgren	Mr. Michael Young Director of Academic Engagement michael.d.young@navy.mil Mr. Randall Tucker randall.tucker@navy.mil
1440-1450	NSWC Indian Head EOD Technology Division	Dr. Chris Wilhelm Customer Advocate for Science & Technology, ORTA christopher.wilhelm@navy.mil
1450-1500	Naval Research Laboratory	Dr. Virginia DeGiorgi Superintendent, Materials Science and Technology Division Virginia.degiorgi@nrl.navy.mil Mr. Victor Chen Corporate Communications, NRL Victor.chen@nrl.navy.mil
1500-1510	Naval Air Warfare Center Aircraft Division	Dr. Theresa Shafer Director of Engineering Education and Research Partnership theresa.shafer@navy.mil
POC Not able to be present at the event: Marine Corps Warfighting Lab		Mr. Steve Eads Deputy, Field Testing Branch, Experiment Division steven.eads@usmc.mil

Map of Navy/USMC Labs



Naval Surface Warfare Center Carderock Division: West Bethesda, MD

Naval Research Lab (NRL): Washington, DC

Naval Surface Warfare Center Indian Head Explosive Ordnance Disposal Technology Division: Indian Head, MD

Marine Corps Warfighting Laboratory (MCWL): Quantico, VA

Naval Surface Warfare Center Dahlgren Division: Dahlgren, VA

Naval Air Warfare Center Aircraft Division (NAWCAD): Patuxent River, MD

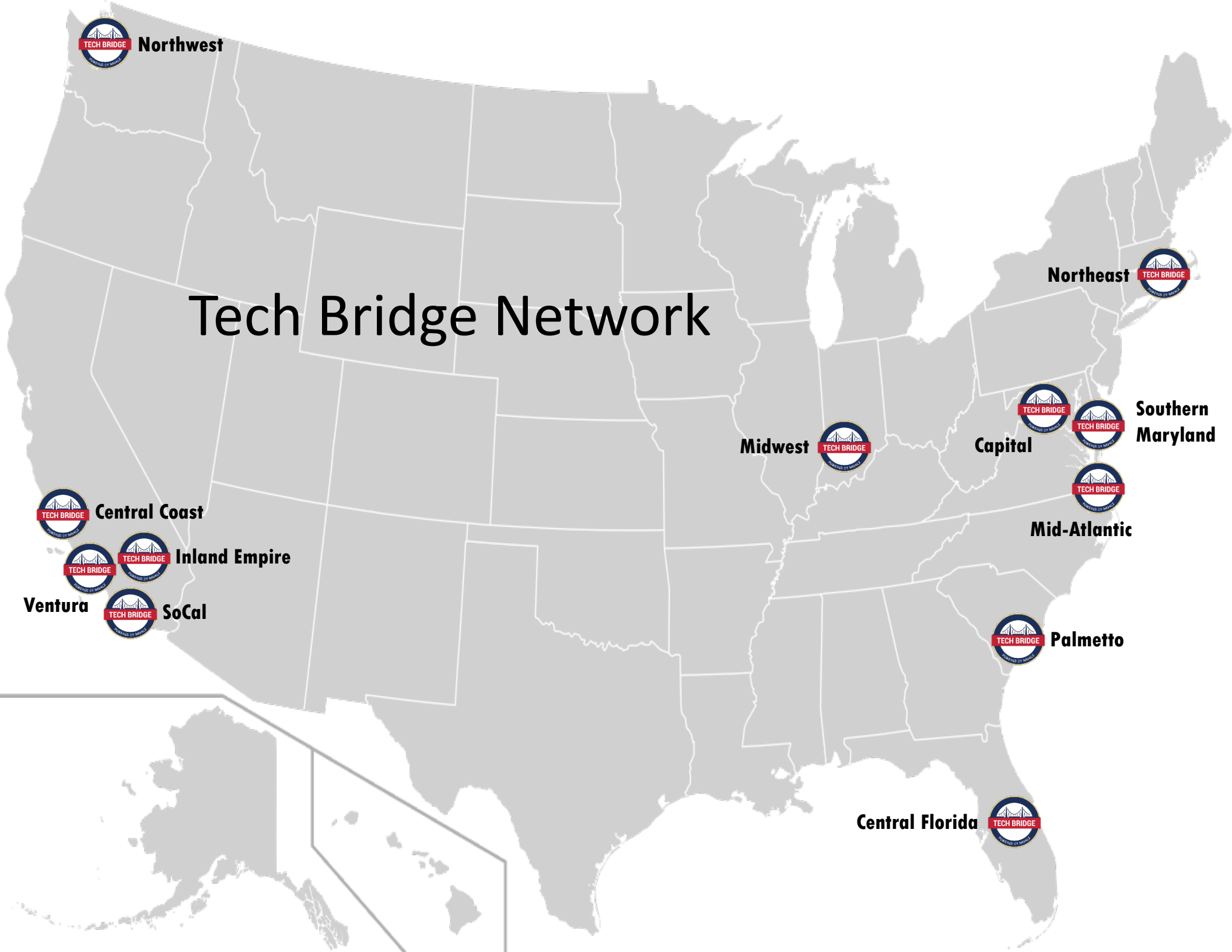
Capital Tech Bridge: Alexandria, VA

What are NavalX Tech Bridges?

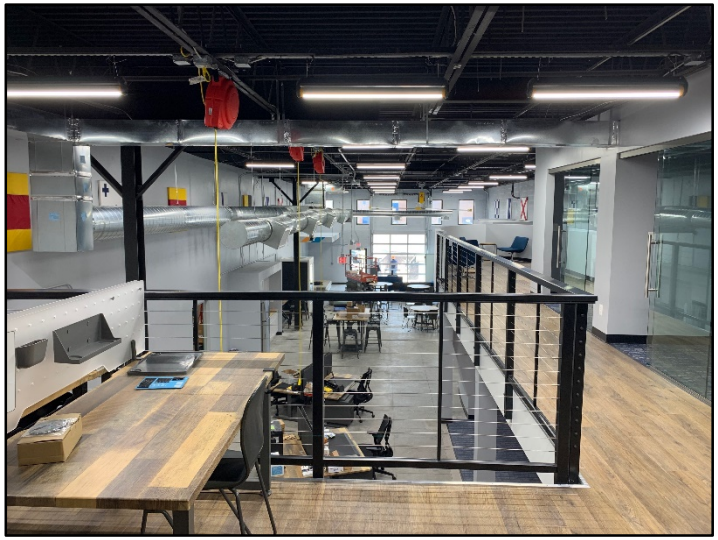
NavalX Tech Bridges **CONNECT**, **REINFORCE**, and **SUSTAIN** innovation clusters across various regions where there is a tightly linked DON partner.

A Tech Bridge is a coordination element and innovation catalyst to connect the DON workforce with start-ups, academia, corporations, small businesses, non-profits, private capital, and government entities to allow for greater collaboration. In order to achieve and maintain a connected innovation cluster, the Tech Bridges will facilitate these engagements in off-base locations.

https://www.secnav.navy.mil/agility/Pages/techbridges.aspx


Tech Bridge Network
Northwest
Northeast
Midwest
Capital
Southern Maryland
Mid-Atlantic
Central Coast
Inland Empire
Ventura
SoCal
Palmetto
Central Florida

Capital Tech Bridge Collaboration Space



NavalX HQ “The Garden” is 4000 Sq Feet and contains one large event space that can hold 150 people, conference rooms, and can provide team building activities & design thinking facilitation through the NavalX PIA partner

University Initiatives Overview

- Encourage collaboration with Academia, Industry through the Tech Bridge Model
- Breakdown the barriers to entry
- Better exploit the facilities and expertise at the Defense Labs
- Encourage student interest in science, mathematics and engineering
- Advance the education of future employees

Ultimately accelerate technology development and speed transition

Faculty Opportunities

- ONR Summer Faculty Research Program (SFRP) – Faculty on our campus to perform cutting-edge research during a 10-week summer period to develop new capabilities supporting existing or new knowledge areas
  https://www.onr.navy.mil/Education-Outreach/faculty/summer-faculty-research-program

➢ Open for application in early September– Deadline 12 December for the Summer 2021 program

- Sabbatical leave program – Faculty spend one or two semesters at the Navy lab in collaboration with the expectation of publication. This is usually combined with a Summer Research Fellow appointment, allowing research to span an entire year.
  http://onroutreach-summer-faculty-researchsabbatical.com

➢ On a continual basis, – Needs to be 6 months in advance of planned sabbatical

- NEEC – Naval Engineering Education Consortium – grants for academic research results and products to resolve Naval technology challenge
  - Establish a partner/mentor relationships with the Scientist/Engineer at the lab
  - Lead to hiring college graduates with Naval engineering R&D experience

  https://www.navsea.navy.mil/Home/Warfare-Centers/Partnerships/NEEC/

➢ FY20 BAA on Grants.gov approximately Mid-Sept.

Add opportunities for faculty/students and widen the aperture for joint funding

Student Opportunities

- Post-doctoral Research Program - http://nrewc.asee.org/
  Recently graduated doctoral students performing basic and applied research under the mentorship of a lab subject matter expert. Post-doc applications are accepted on a continual basis

- Naval Research Enterprise Intern Program - 10 week summer internship program for undergraduate and graduate students to participate in research at a DoN laboratory
  http://nreip.asee.org/
  Application opens on August 03, 2020, and usually closes on November 1

- Science, Mathematics, and Research for Transformation Scholarship (SMART)
  http:/www.smartscholarship.org/
  Online Application opens on August 01, 2020, and closes on Dec 1

- Science and Engineering Apprenticeship Program (SEAP) - 8 week paid summer internship program for high school students as a local lab
  https://seap.asee.org/
  Generally the same as NREIP

FY19 Impact (Carderock)

NAVSEA WARFARE CENTERS Carderock

Community Stewardship

- Hosted and/or participated in over 37 Outreach events
- Hosted 26 SEAP Interns, 86 NREIP Students, 6 new SMART Scholars, and 13 Summer Faculty
- Awarded 3 NEEC Grants to 3 Universities
- Engaged with over 7,450 K-12 students from local schools

Impact to Carderock

- Contributes to Employee Professional Development
- Naval-Relevant Research and Technical Development
- Increased Goodwill
- Increased Exposure

https://www.navsea.navy.mil/Portals/103/NEEC-2020_Brochure_v125_aw-LR.pdf

Naval Surface Warfare Center, Carderock Division

AMERICA'S FLEET STARTS HERE

Naval Surface Warfare Center, Carderock Division

NAVSEA WARFARE CENTERS Carderock

CAPT Todd Hutchison
Commanding Officer, NSWCCD

August 2020

Lawrence Tarasek, SES
Technical Director, NSWCCD

Carderock: Who We Are

NAVSEA
WARFARE CENTERS
Carderock Division

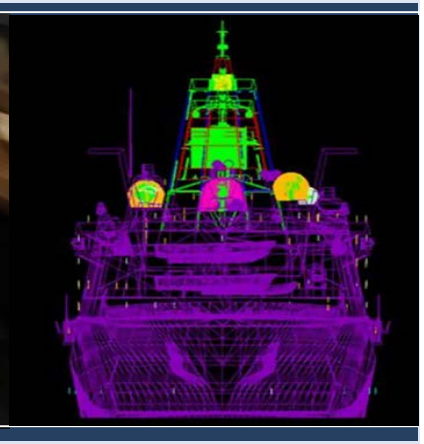
MISSION

Provide full-spectrum research and development, test and evaluation, analyses, acquisition and Fleet support for the Navy's ships, ship systems and associated Navy logistics systems.

- *Provide technical capabilities for surface / undersea vehicles and associated systems*
- *Develop and apply Science & Technology*
- *Support the maritime industry*

VISION

Excellence in Ship Design



CORE EQUITIES

Full-spectrum, life-cycle naval architecture and marine engineering for ship, submarines, boats, craft and unmanned vehicles

- *Ship Design & Integration*
- *Hull Forms and Propulsion Systems*
- *Structures and Material Systems*
- *Environmental Quality Systems*
- *Vulnerability and Survivability Systems*
- *Signatures and Silencing Systems*

Carderock: Where We Work

Southeast Alaska Acoustic Measurement Facility
KETCHIKAN, AK

Carderock Division
HEADQUARTERS
WEST BETHESDA, MD

Puget Sound Detachment
at Naval Submarine Base Bangor
BANGOR, WA

Acoustic Research Detachment
BAYVIEW, ID

Norfolk Detachment
Combatant Craft Division
NORFOLK, VA

Acoustic Trials Detachment
TITUSVILLE, FL

Memphis Detachment
Dr. William B. Morgan
Large Cavitation Channel
MEMPHIS, TN

South Florida Ocean Measurement Facility
DANIA, FL

Carderock: What We Do

NAVSEA
WARFARE CENTERS
Carderock Division

STRATEGIC PILLARS

- Ship and Submarine Design
- Platform Integrity and Performance
- Digital Strategy
- Signature Management
- Unmanned Systems

Platform Integrity Department

Signatures Department

Naval Architecture & Engineering Department

Science & Technology

Research & Development Prototyping

In-Service Fleet Support

NAVSEA WARFARE CENTERS Carderock Division

Multi-physics Modeling & Simulation of Thermal Run-away in Lithium-ion Batteries and Scalable Thermal Management Methods

Summer Faculty

Jiajun Xu, Ph.D.

Jiajun Xu

Dr. Xu is an associate professor in the Department of Mechanical Engineering at the University of District of Columbia. He earned his doctorate in mechanical engineering from University of Maryland-College Park.

His research interests include: 1) in-situ characterization and multiscale modeling of energy transport inside nanostructured materials, 2) thermal management and energy conversion using nanostructured materials, 3) in-situ monitoring and process optimization of direct metal laser sintering based additive manufacturing, and 4) environment-friendly water treatment using nanoparticle infused mesoporous materials.

His current research is sponsored by National Science Foundation, Department of Defense, Department of Energy, and U.S. Department of Agriculture.

Research Abstract

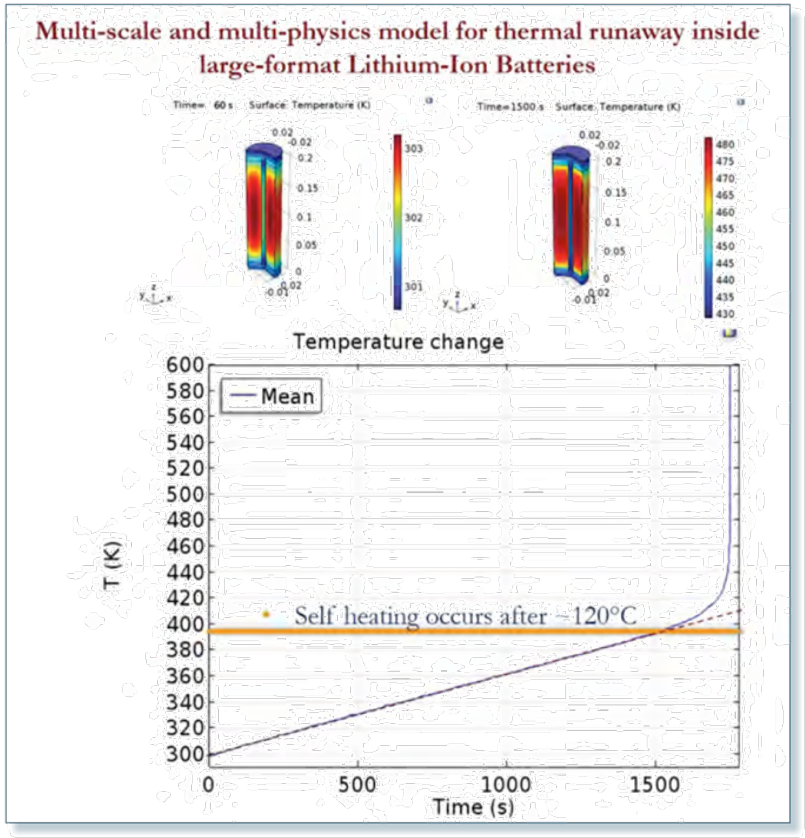
For his Summer Faculty Program Project, Xu explored recently developed multi-physics model (namely: electrochemical and thermal-mechanical processes) for simulating the thermal runway inside a Lithium-ion battery using COMSOL software.

For electrochemical processes, the porous electrode theory was used with contributions coming from exothermic side reactions to model abuse mechanisms, which could lead to a thermal runaway.

For the thermal-mechanical processes, models of thermal abuse reactions that occur at specific elevated temperatures were used.

Prior experimental data on a large-scale lithium-ion battery tested at NSWC Carderock Division was used to construct and validate the model.

Xu also looked at current approaches to obtain a sophisticated understanding of the multi-scale and multi-phase thermal transport processes, and possible scalable and smart thermal management methods.

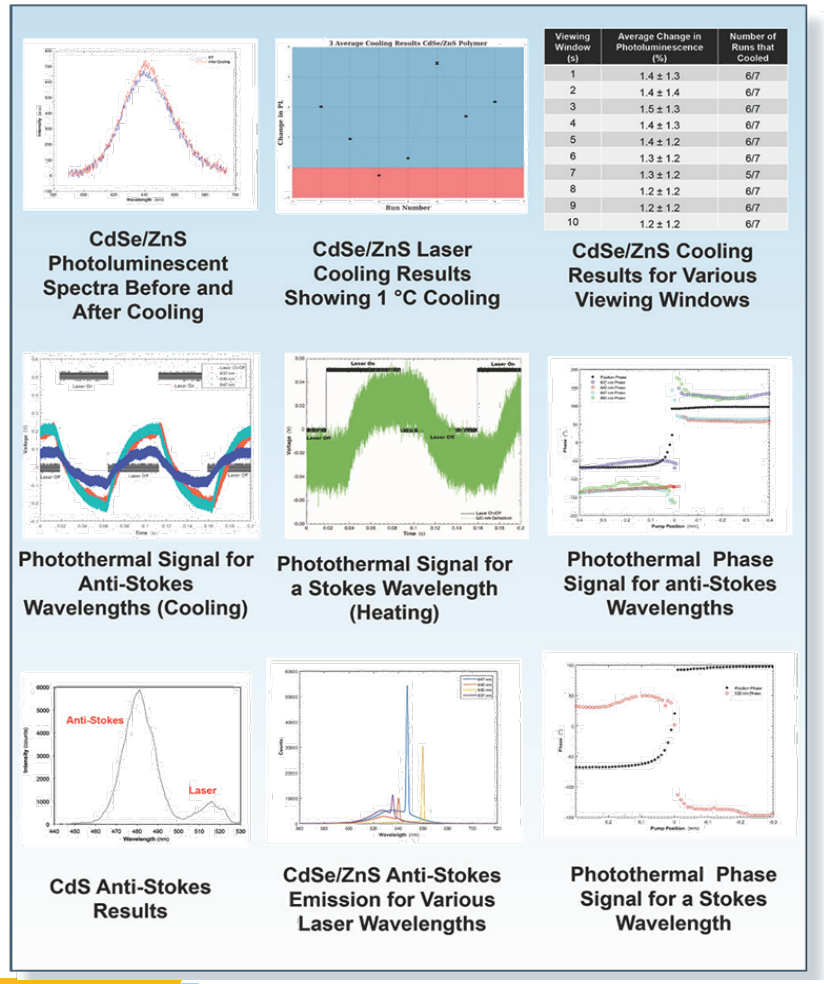


Post-doctoral Research

NAVSEA
WARFARE CENTERS
Carderock Division

Laser Cooling of Solids by Phonon Annihilation

FY15-17



CdSe/ZnS Photoluminescent Spectra Before and After Cooling

CdSe/ZnS Laser Cooling Results Showing 1 °C Cooling

Viewing Window (s)	Average Change in Photoluminescence (%)	Number of Runs that Cooled
1	1.4 ± 1.3	6/7
2	1.4 ± 1.4	6/7
3	1.5 ± 1.3	6/7
4	1.4 ± 1.3	6/7
5	1.4 ± 1.2	6/7
6	1.3 ± 1.2	6/7
7	1.3 ± 1.2	5/7
8	1.2 ± 1.2	6/7
9	1.2 ± 1.2	6/7
10	1.2 ± 1.2	6/7

CdSe/ZnS Cooling Results for Various Viewing Windows

Photothermal Signal for Anti-Stokes Wavelengths (Cooling)

Photothermal Signal for a Stokes Wavelength (Heating)

Photothermal Phase Signal for anti-Stokes Wavelengths

CdS Anti-Stokes Results

CdSe/ZnS Anti-Stokes Emission for Various Laser Wavelengths

Photothermal Phase Signal for a Stokes Wavelength

Objective

To laser cool a direct bandgap semiconducting quantum dot by Anti-Stokes optical emission.

Background

- Thermal energy is available as the vibrational modes (phonons) of the crystal
- The basic principle of optical refrigeration is anti-Stokes fluorescence. Photons of wavelength larger than the mean fluorescence wavelength are absorbed, followed by Anti-Stokes spontaneous emission, i.e., the emitted photons have higher energy (are blue-shifted) relative to the absorbed photons. During the emission process, lattice thermal vibrational energy is carried away by photons, resulting in laser cooling.
- If the nonradiative decay rates of the laser-pumped states are negligible in comparison to their radiative decay rates, then the release of extra energy can be used to cool the solid.

Advantages

- All-solid-state cryocooler that is compact, highly reliable, and has no vibrations, moving parts or cryogenic fluids
- Possibility for noncontact cooling

Impact/Pay-off

- Light weight power and/or sensor systems
- Possible elimination of heat production in high powered lasers (Radiation balanced lasers)
- Noncontact cooling

Accomplishments

- Demonstrated 1 °C of cooling for CdSe/ZnS polymer
- Confirmed microcooling of CdSe/ZnS using photothermal deflection spectroscopy
- Designed an improved photothermal deflection spectroscopy method to see if a medium is being cooling
- Demonstrated anti-Stokes luminescence for CdSe/ZnS and CdS

Future Research

- Extend laser cooling technique to nitrogen vacancy (NV) diamonds for magnetometry applications
- Optimize CdSe/ZnS cooling using different media and concentrations

Educational Partnership Agreement

NAVSEA
WARFARE CENTERS
Carderock Division

Description/Effort:

NSWC Carderock has formalized long-standing relationships with the George Mason Universities (GMU) Volgenau School of Engineering for collaboration in computational fluid dynamics, naval architecture, and materials with an Education Partnership Agreement. This was motivated by GMU's standing up of a new Mechanical Engineering Department

T2 Mechanisms Used:

Education Partnership Agreement (10 USC § 2194) for faculty and students working in Carderock, Office of Naval Research (ONR) visiting Summer Faculty program (SFRP) from GMU in FY19, FY17, FY15, FY13 and earlier. Numerous Naval Research Enterprise Interns, SSEP (Co-op interns) over 15 years.

Signing of EPA with GMU on 4 Nov 2019

Outcomes:

- Naval Architecture concepts introduced into GMU courses
- Carderock co-hosted a workshop on data analytics and Navy SME has served as a guest lecturer in GMU classes
- Evaluated and guided student capstone projects in corrosion
- Served as a reviewer on other student research projects

NSWCCD Educational Partnership Agreements

NAVSEA
WARFARE CENTERS
Carderock Division

University/School	Subject	Date Signed
University of the District of Columbia	Additive Manufacturing, Nanotechnology, Material Science, Robotics and STEM	07/06/2020
Florida Institute of Technology	Naval Architecture & Ship Design, Unmanned Systems, Hydrodynamics, STEM	11/7/2019
University of Idaho	STEM, Unmanned Systems, Acoustics	10/10/2019
George Mason University	STEM, Hydrodynamics, Naval Architecture, Naval Engineering, Science & Technology	8/19/2019
Fairfax County Public Schools	STEM Partnership	2/4/2019
National Intelligence University	STEM Partnership, Vessel Technology, Dynamics, Detection	6/11/2018
Georgetown University	STEM, Radiation Detection, Materials, Naval Science & Engineering	1/11/2018
Old Dominion University	Advanced Materials, Boats and Craft, Naval Science & Technology	12/7/2017
University of Iowa	STEM, Hydrodynamics, Naval Engineering Science & Technology	2/26/2018
Michigan Technological University	STEM, Ship Dynamics & Logistics, Modeling & Simulation	12/7/2017
San Diego State University	STEM, Fluid Mechanics, Naval Science & Technology	12/7/2017
University of Maryland Baltimore County	STEM, Additive Manufacturing, Advanced Materials, Environmental Systems, Cyber	7/27/2017

Naval Surface Warfare Center Dahlgren Division

Command Overview and Introduction to NEEC

Michael Young

Director of Academic Engagement

WELCOME

Capital Tech Bridge University Partners

05-August-2020

The Leader in Warfare Systems Development and Integration

NAVSEA WARFARE CENTERS DAHLGREN

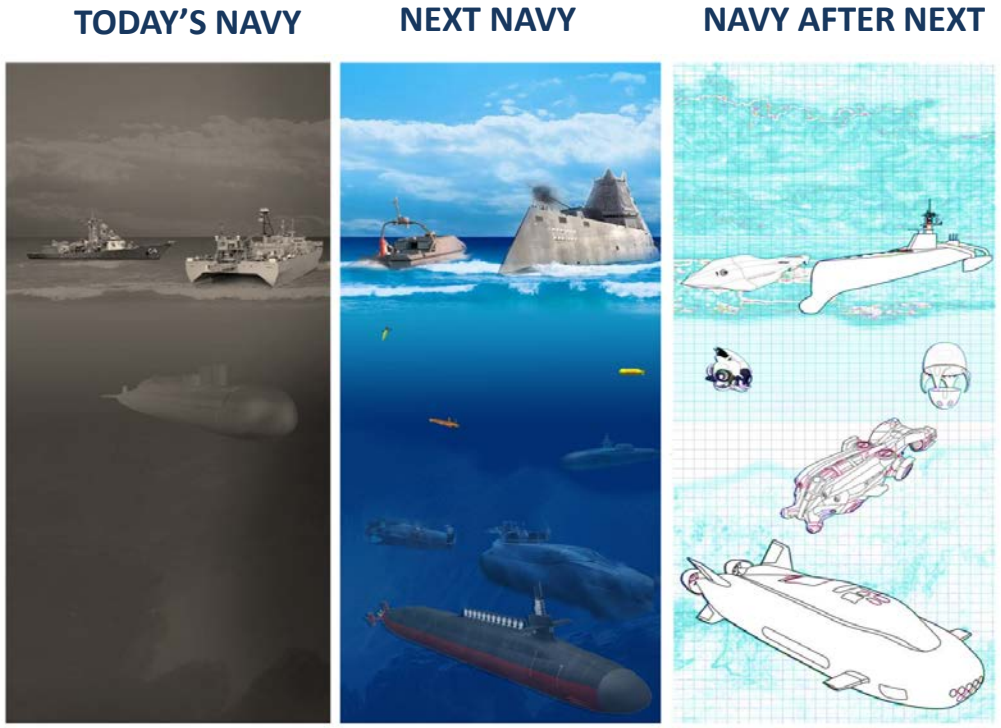
NAVAL SURFACE WARFARE CENTER
DAHLGREN DIVISION
DAHLGREN | DAM NECK

NAVSEA WARFARE CENTERS ONE TEAM EXPAND the ADVANTAGE

Dahlgren Division Overview

Vision

To be the Department of the Navy's leading warfare system architect and system engineer recognized as the technical leader in delivering innovative, affordable, and effective solutions for the Navy and in support of joint and national initiatives.



Mission

Provide research, development, test and evaluation, analysis, systems engineering, integration and certification of complex naval warfare systems related to surface warfare, strategic systems, combat and weapons systems associated with surface warfare. Provide system integration and certification for weapons, combat systems and warfare systems.

The Leader in Warfare Systems Development and Integration

Dahlgren Division Capabilities

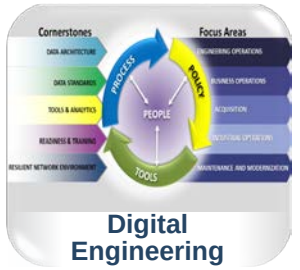
Fire Control Systems

Environmental Testing


Ordnance Testing


Naval Electric Weapons


Naval Automation (AI/ML/Quantum)



Digital Engineering


Integrated Warfare Systems Laboratory


Advanced Combat Systems


RF/EO/IR/OHD Sensors


Cybersecurity Engineering


Test and Evaluation


Integrated Training

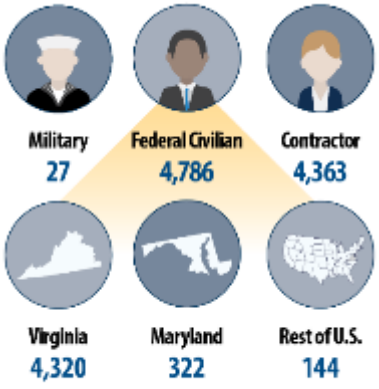
Providing capabilities and innovative solutions in the areas of weapons and sensor systems, and combat systems for over 100 years.

Dahlgren Budget & People

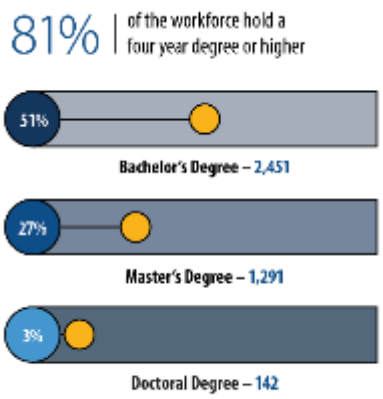
- Annual budget execution = $1.7B
- 100% Working Capital Fund
- NSWCDD is largest Federal R&D employer in the state
- Of our 4,786 government employees, 81%, or 3,884 are part of the technical workforce.

The Navy is the largest single employer in the state of Virginia. NSWCDD has two primary locations; Dahlgren, VA and Virginia Beach, VA.

OUR WORKFORCE

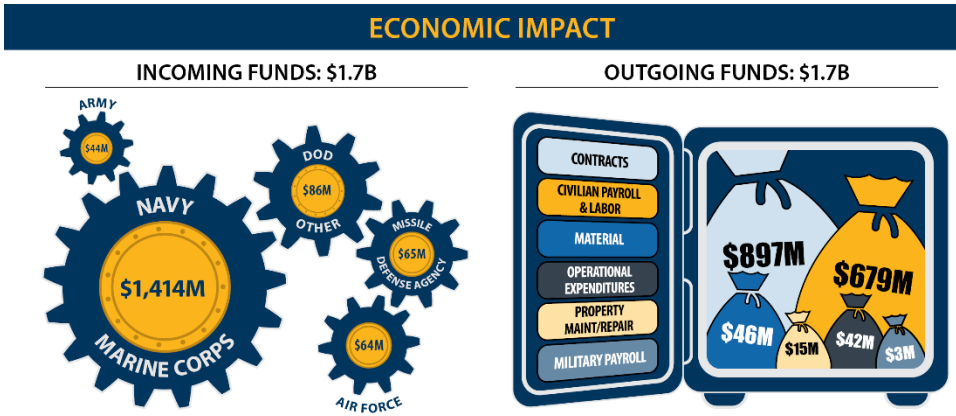


Human Impact: Employee Breakdown and Locations



NSWCDD Education Background

ECONOMIC IMPACT



ACADEMIC & INTELLECTUAL IMPACTS

- **11,337** Outreach: K-12 Students FY19
- **$650K** STEM Education Funding
- **469** Tech Publications by Employees FY13 - FY19
- **578** Patents from FY86 - FY19
- **10** STEM Programs
- **54** Educational Partnerships
- **26** Cooperative Research & Development Agreements
- **16** University Grants & Contracts

Provided by the Chief Technology Office, NSWCDD

Naval Education Engineering Consortium Mission & Objectives

Mission:

The NAVSEA NEEC program employs project-based research and development at US universities to target the Navy's technology challenges and to cultivate the next Naval engineering workforce.

Major Objectives:

- Acquire academic research results to address relevant Naval technology challenges
- Recruit students with Naval Engineering R&D experience into the NAVSEA workforce
- Develop exceptional working relationships with Naval engineering colleges, universities, professors & academicians

Directed energy: Students investigating high temperature plasma behavior at the University of Puerto Rico

Virginia Tech students studying real-time virtualization, scalable operating systems, and transactional memory middleware for multicore applications

NEEC project-based R&D provides students the opportunity to do 'hands on' work solving Navy-related problems

NAVSEA WC Leadership is committed to a long-term investment in R&D at universities

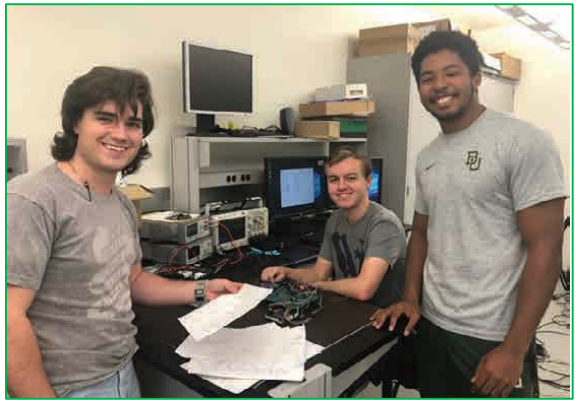
NEEC Process

- Broad Agency Announcement (BAA)
  - Technical Topics are generated by all ten Warfare Centers
  - **Published in Grants.gov the beginning of September**

Awards are generally ~$100k-$150k/year for a total of 3 years (~$300-$450k total)

- Grant Awards to selected universities
  - Funds the research
  - Allows for flexibility in interactions between principals (differs from a contract vehicle)
- Internships
  - Naval Research Enterprise Intern Program (NREIP)
  - STEM Student Employment Program (SSEP)
  - Coordinated events by Warfare Center Divisions
  - Strategic Emphasis
- Hiring
  - Taking advantage of a 'footprint' on campus
  - Direct Hire Authority for Divisions
- Annual Meetings at Divisions or at Universities

Strongly encourage NEEC students to participate in summer internship at their WC



Three Baylor University NEEC students pose in their research lab next to NEEC hardware

Thank You

NEEC Portfolio
FY16- FY19 Grant Awards

VIRGINIA POLYTECHNIC INSTITUTE & STATE UNIVERSITY	Newport	Bioinspired Physical Deep Learning Paradigm for Sonar Sensing in Cluttered Environments
Baylor University	Newport	Improved Robot Autonomy using Neuromorphic-Based Stochastic Computing
University of Tennessee	Newport	Fouling-Resist Elastomeric Coatings based on Self-Organizing Heterogeneous Surfaces
Michigan Technological University	Newport	Localization, Tracking, and Classification of On-Ice and Underwater Noise Sources Using Machine Learning, Michigan Technological
University of Rhode Island	Newport	Performance of Elastomeric Coatings and Coated Structures Subjected to Long Term Seawater Submersion, UV Radiation, and Arctic Temperatures under Extreme Loading Conditions
Florida State University	Panama City	Understanding Cybersecurity Implications of Using and Protecting Unmanned Aerial Vehicles
Pennsylvania State	Crane	Harnessing Quantum Correlations for Quantum
Perdue University	Crane	Visualization of Repair Operations Management for Networked Systems Resilience
Oregon State	Crane	Cost-Aware Defense of Sensors-to-Decisions System against Malicious Data Attacks
INDIANA UNIVERSITY	Crane	Advanced Data Visualizations for Robust Deep Machine Learning
Johns Hopkins University	Dahlgren	Manifold Learning for Subsequent Inference: Structure Discovery and Exploitation in Networks
VIRGINIA POLYTECHNIC INSTITUTE & STATE UNIVERSITY	Dahlgren	Assisted Model-Based Systems Engineering (A-MBSE)
University of Puerto Rico Mayaguez	Dahlgren	Improving Virtualized Data Center Resource Efficiency Using Dynamic Container Placement Strategies
SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY	Dahlgren	Dimensionality Reduction of Streaming Big Data for Clustering, Classification and Visualization via Incremental Multi-Linear Subspace Learning
UNIVERSITY OF SOUTH CAROLINA	Dahlgren	Toward Fully Electrically Reconfigurable Communication System
Perdue University	Carderock	Embedded Sensors and Actuators for Structural Health Monitoring using Enhanced Materials in Additive Manufacturing
University of Michigan	Carderock	Acoustic Testing and Signal Analysis for Noisy and Complicated Environments
Embery-Riddle University	Carderock	Robust Multi-Domain Situational Awareness through Sensor Fusion
UNIVERSITY OF RHODE ISLAND	Carderock	Control of Autonomous Underwater Vehicles in Stratified Fluids and Near Surface Operations
Vanderbilt	Indian Head	Reactive Material Formulations for Additive Manufacturing
BYU	Indian Head	Determination of the Effects of Thermal and Mechanical Stress on PBX Binder Materials and the HE/Binder Interface
University of MD	Indian Head	Mixing and Additively Manufacturing Energetic Material Systems
SAN DIEGO STATE UNIVERSTIY FOUNDATION	Port Hueneme	Building the Foundation for Navy Augmented Reality Supported Maintenance

NEEC Portfolio
FY16- FY19 Grant Awards

University of California Santa Barbara	Port Hueneme	Robust Inside-Out Simultaneous Localization and mapping for Environment Monitoring and Equipment Maintenance
New York State University at Buffalo	Port Hueneme	Computer Vision based Intelligent Assistant for Mistake Proofing of Complex Maintenance Tasks on Navy Ships
UNIVERSITY OF FLORIDA	Panama City	Collaborative Autonomous Maritime Vehicles for MCM Missions
UNIVERSITY OF CONNECTICUT	Crane	Sensor Fusion for Radar and EO Sensors
VIRGINIA POLYTECHNIC INSTITUTE & STATE UNIVERSITY	Crane	Attacking RF machine learning systems
Webb Institute	NAVSEA 05	Hull, Propeller and Control Surface Roughness Effects on Ship Speed and Maneuverability
University of Michigan	NAVSEA 05	Numerical Analysis of Wave Impact Loads on Surface Naval Craft
University of Central Florida	Dahlgren	Enabling Deterministic Behavior in Virtualized Multi Core Environments
PURDUE UNIVERSITY	Keyport	Seamless Manufacturing and Remanufacturing for Foundry Industry via Laser-based 3D Printing and Surface Cladding
UNIVERSITY SYSTEM OF NEW HAMPSHIRE	Keyport	Development of Autonomous Control for Multiple Vehicle Platforms
UNIVERSITY OF WASHINGTON	Keyport	Obsolescence Management: Prediction and Visualization of Lifecycle Stage
UNIVERSITY OF CALIFORNIA, LOS ANGELES	Corona	Metrology & Calibration (METCAL) for Additive Manufacturing (AM)/3D printing technologies
REGENTS OF THE UNIVERSITY OF CALIFORNIA AT RIVERSIDE	Corona	Big Multi-Aspect Data Mining via Scalable and Incremental Tensor Decompositions and Applications to Social Network Analysis
ROWAN UNIVERSITY	Philadelphia	Polymer Nanocomposites with Enhanced Dielectric Strength and Reduced Thermal Contraction for Superconductor Cables
DREXEL UNIVERSITY	Philadelphia	Networked Multi-Converter Power System Instrumentation and Measurement Analysis
UNIVERSITY OF SOUTH CAROLINA	Philadelphia	Distributed Condition Prognostics System for Navy Shipboard Machinery
INDIANA UNIVERSITY	Dahlgren	Network Data Analytics for Predicting the Emergence of Science & Technology Fields
SAN DIEGO STATE UNIVERSTIY FOUNDATION	Port Hueneme	Augmenting Effectiveness of Threat Modeling through Threat Intelligence Attributes

Naval Surface Warfare Center Dahlgren Division

NEEC Success Story: A-MBSE Research

Presented by

Randall Tucker

NSWCDD-DNA, R30 Division Chief Engineer

Dr. Alejandro Salado

Virginia Polytechnic Institute and State University

WELCOME

Capital Tech Bridge University Partners

August 5, 2020

The Leader in Warfare Systems Development and Integration

NAVSEA WARFARE CENTERS DAHLGREN

NAVAL SURFACE WARFARE CENTER
DAHLGREN DIVISION
DAHLGREN | DAM NECK

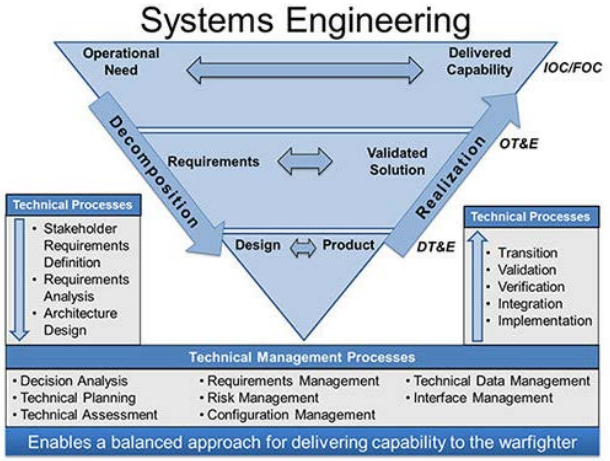
NAVSEA WARFARE CENTERS one TEAM

Bottom Line Up Front: Very Successful First Year

- The NEEC Program broadens Academic Engagement
  - This effort focused on MBSE, in line with the Digital Engineering Transformation
- Efforts characterized by vigorous, collaborative partnership
  - Dr. Alejandro Salado and his VT team have been tremendous partners
- Efforts have uncovered follow on opportunities
  - Internships
  - Additional research to expand the state of the practice.

MBSE Emphasis

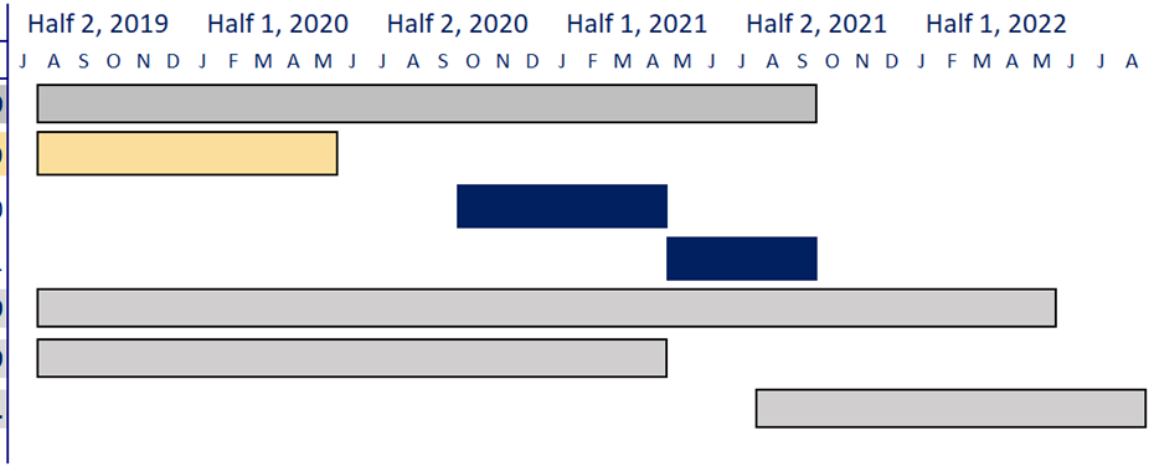
- MBSE is a key focus area for NAVSEA Digital Transformation
  - Digital Twin
  - Virtualization
  - Agility
- Model Based Engineering is more aligned with CI/CD principles
  - Document based engineering impedes agility



"We require overmatch capability at the 'speed of relevance' " RADM Doug Small, PEO IWS

VT NEEC Grant Anticipated Timeline*

Task Name	Start
BLOCK 1: Repository	**8/5/2019**
Identification of Modeling Gaps	8/5/2019
Characterization of Fidelity and Impacts	10/26/2020
Repository Development	3/29/2021
BLOCK 2: AI Agent	**7/22/2019**
BLOCK 3: Infusion	**8/1/2019**
BLOCK 4: Performance Assessment	**8/2/2021**



*Per Virginia Tech Proposal

Senior Design Project Stages *

Stage 1	Define Model Based Systems Engineering and identify drivers for implementation
Stage 2	Create a tool to analyze and compare phases of NSWC's Engineering Process
Stage 3	Assess where MBSE implementation can provide the largest value

*From Virginia Tech Senior Design Project Presentation

Virginia Tech Assisted-MBSE Initial Results

- Successful Senior Design Project
  - 4 person team
  - Gained an understanding of MBSE
  - Bound drivers behind adopting MBSE
  - Elicited and interpreted problem statement
  - Captured current document-centric process with timelines for reviews at Dahlgren
  - Established a protocol for examining processes at Dahlgren
- 2 Papers formally published to date
  - P. Wach, A. Salado. The Need for Semantic Extension of SysML to Model the Problem Space. Conference on Systems Engineering Research (CSER), Redondo Beach, CA, 2020. Submitted.
  - P. Wach, A. Salado. Model-Based Security Requirements for Cyber-Physical Systems in SysML. Systems Security Symposium, Crystal City, VA, 2020. Accepted.
  - More papers anticipated
- Project Stage 2 initiated

Summary

- NEEC program offers significant Academic Engagement opportunities and options
- NEEC research can offer an on-ramp to Other Transaction Authority agreements
  - Expand participation into academia as part of consortium membership
- Great opportunity to expand the recruiting base
- Key ingredients for success
  - Innovative research concept with a dynamic lead investigator
  - Enthusiastic TPOC

Thank You

NAVSEA
WARFARE CENTERS
Indian Head EOD Technology Division

NSWC IHEODTD Introduction

Presented to:

National Capital Region Tech Bridge University Day

Presented by:

Christopher Wilhelm, PhD
Customer Advocate for S&T, ORTA

- 2020 -

Capt. Scott H. Kraft, USN
Commanding Officer

Mr. Ashley G. Johnson, SES
Technical Director

NSWC IHEODTD Mission

Research, develop, test, evaluate (RDT&E), manufacture and provide in-service support of energetics and energetic systems. Provide Soldiers, Marines, Sailors and Airmen with information and technology to detect, locate, access, identify, render safe, recover, exploit and dispose of explosive threats.

Energetics are:

- Propellants
- Explosives
- Fuels
- Pyrotechnics
- Reactive materials
- Warheads
- Rocket motors
- Munitions

FLY FARTHER **HIT HARDER** **SAVE LIVES**

Strategic University Outreach

VISION: In 10 years, IHEODTD will grow 400 work-years stronger by reshaping our industrial complex; capturing research, development, test and evaluation (RDT&E) opportunities in energetic systems; and providing reliable, quality and affordable products and services.

Student Programs	
S&E Student Employment Program (SSEP)	32
Pathways Interns	23
NEEC	5 (15)
Naval Research Engineering Internship Program (NREIP)	5
Science, Mathematics & Research for Transformation (SMART)	7
Naval Acquisition Development Program (NADP)	7
NAVSEA Scholar	1
Workforce Recruitment Program (WRP)	1

Polymer Chemistry Research for Development of Advanced Binder Systems

- **ER Focus Areas : Ingredient Focus**
  - Increased performance:
    - Improve range, speed and lethality
  - Accelerating Tech:
    - Additive manufacturing (AM), improved thermal and mechanical properties for new technologies

- **Long-term technical goals:**
  - Novel curing chemistry for existing binder systems to improve safety and mechanical properties
  - Energetic polymers as novel binders with improved munitions performance
  - Novel polymers to be used as binders in AM applications
  - Novel polymers with improved thermal and mechanical properties for advanced binders

- A collaboration between NSWC IHEODTD, U.S. Naval Research Lab, Naval Postgraduate School, and NAWCWD China Lake, California, to conduct a synthesis-driven approach for the development of new polymer systems, which would be used as novel binders with advanced and improved properties compared to binders in existing munitions.

AM capabilities would allow for improved safety via remote manufacturing, and for on demand production of mission specific items generated in the field.

Joint-Venture Pilot Program

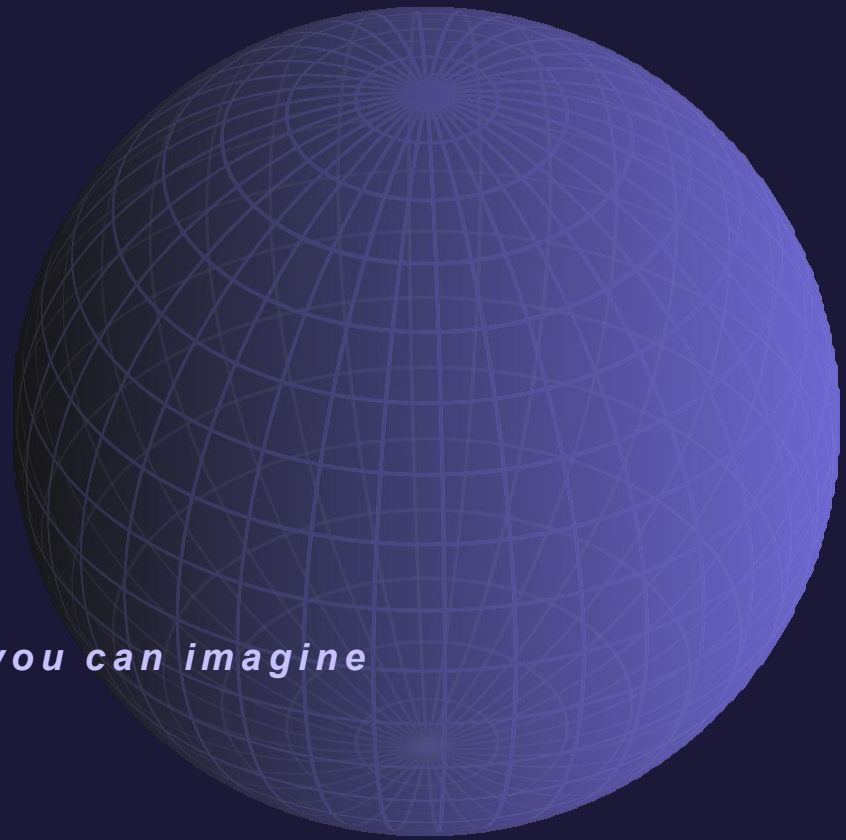
- Funded by the Office of Naval Research (ONR)
- Established a technology focused Joint-Venture
  - College of Southern Maryland (CSM)
  - NSWC IHEODTD
  - Local serial entrepreneur
- Staffing
  - 5 college students
  - 2 NSWC IHEODTD Engineers
- Results
  - New EOD Tool Design (Invention Disclosure)
  - Prototype (Forthcoming)
- Scope
  - ~$115K
  - ~12 Months

NAVSEA
WARFARE CENTERS
Indian Head EOD Technology Division

Questions?

U.S. NAVAL RESEARCH LABORATORY

U.S. NAVAL RESEARCH LABORATORY



Advancing research futher than you can imagine

Dr. Virginia G. DeGiorgi
Washington, D.C.

About NRL

The Department of the Navy's full-spectrum corporate laboratory.

- Broadly-based multidisciplinary program of research and development in materials, techniques, equipment, and systems

- Applications in the maritime environment from the sea floor up into space and cyberspace

U.S. NAVAL RESEARCH LABORATORY

Budget, People, & Facilities

NRL Workforce

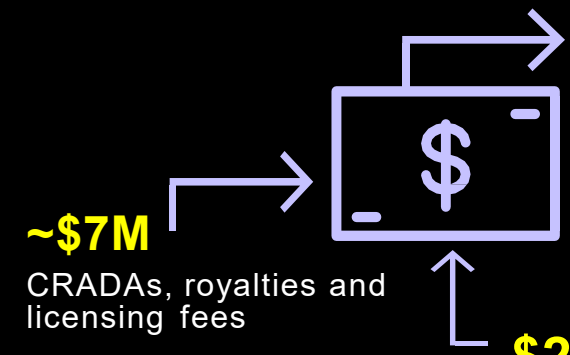
CIVILIAN
2,589

~1800 researchers with almost 900 PhDs

~175 postdocs and summer faculty

MILITARY
93

~ includes VXS-1 scientific aircraft squadron



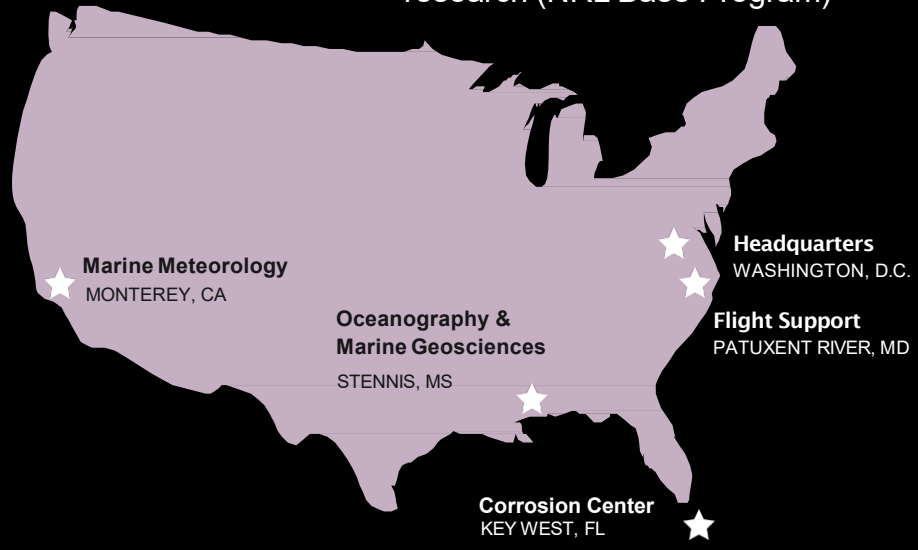
$1.3B executed annually

69% work for Navy & Marine Corps

Other: work for other services and DoD, NASA, and other government

~$7M
CRADAs, royalties and licensing fees

$200M for fundamental research (NRL Base Program)



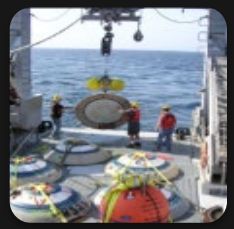
U.S. NAVAL RESEARCH LABORATORY

NRL Base Program

Electronics

New electronic and electro-optic phenomena, materials, theory and techniques for future forces and technological surprise avoidance

Battlespace Environments

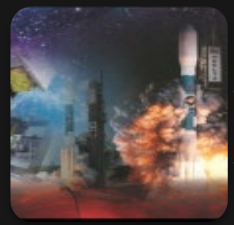


Understand environmental processes & predict environmental variability from the ocean bottom through the middle atmosphere

Electromagnetic Warfare

Technologies for total awareness and dominance of electromagnetic battlespace

Space Research & Space Technology



Understand the space environment and its effects on systems
Conduct unique experiments in space, specific to future DON needs

Undersea Warfare

Research and advanced technologies for undersea sensors for anti-submarine and counter-mine warfare

Information Technology

Networks and Communications, Information Assurance and Cyber Warfare, Decision Support, and Autonomous Systems

Materials & Chemistry

Development of advanced functional and structural materials

U.S. NAVAL RESEARCH LABORATORY

Technology Transfer - Process flow

Assessment

Nondisclosure agreement (NDA) to exchange proprietary information for assessment of a potential partnership or license

Evaluation

Software, material, & biological material transfer agreements

Service & consulting arrangements

Collaboration

Industry & academia –non-FAR: Cooperative research & development agreements (CRADA) funded or unfunded

Industry & academia – FAR: Cooperative Agreements

Agency to Agency: Memoranda of Understanding or Agreement (MOU/MOA)

Licensing

Patent License Agreements (PLAs): Focus on commercial sales (“transfer”) of NRL inventions, may also include government sales (“transfer” to “transition”)

Government Purpose Licenses (GPLs): Permit use of NRL technology in the performance of specific government contracts (“transition”)

Software License Agreements (SLAs): Focus on commercial sales of NRL software meeting trade secret protection requirements, may also include government sales.

Sales

PLAs and SLAs: Both royalty-bearing (commercial) and non-royalty bearing (government). Reporting requirements vary.

GPLs: No reporting requirements; expire with contract expiration

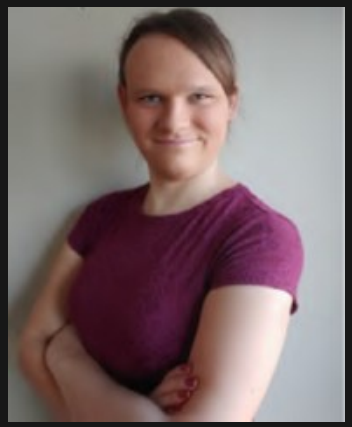
U.S. NAVAL RESEARCH LABORATORY

Engagement Opportunities

Active Educational Partnership Agreements	**11**
Undergraduates	**278**
STEM Student Employment Program (SSEP)	132
NREIP	108
Pathways	9
HBCU/MI	29
Post-Doctoral programs	**191**
Summer Faculty	**17**

U.S. NAVAL RESEARCH LABORATORY

Successes



Emily McDougall

Research internships are valuable for students and organizations. A U.S. Naval Research Laboratory intern with the Naval Research Enterprise Internship Program processed data collected from the Chesapeake Bay in April 2019 using a spiral sonar fitted to an unmanned undersea vehicle.

Emily McDougall, a graduate student at University of New Hampshire and intern with the Naval Research Internship Program (NREIP), enabled the sonar to locate the bay bottom and surface of the water.

Virtual summer students

NRL's Plasma Physics Division is using their own software creation, a Python code called turboPy, to provide their high school interns an opportunity to contribute to computational physics problems, such as creating a software model to predict how an intense beam of electrons turns air into plasma.

"We're giving the students an opportunity to contribute to real physics code," said Paul Adamson, research physicist. "They'll form a team and become a real distributed software engineering group. At the same time, this is an opportunity for us to learn some new collaboration techniques."

$200,000 in Naval STEM funding in 2020

NRL-DC received more than $200,000 in funding for the first time, for three programs. All the NRL STEM projects support the Navy mission, objectives, and assist NRL personnel with bonding Navy research with the scientifically-inclined youth.

"Working with the next generation of engineers and scientists is my way of giving back to the community," said Ivan Galysh, an electrical engineer in NRL's Space Systems Development Division.

Naval Air Warfare Center Aircraft Division (NAWCAD)

5 August 2020

Presented To:

Tech Bridge University Partners

Presented By:

Dr. Theresa Shafer

Director of Engineering Education and Research Partnerships

NAWCAD Role

- We research, develop, test, procure, and support all Navy and Marine Corps aircraft, aircraft systems and integration.
- Increase Navy/Marine Corps capability, readiness, and affordability
- Empower the warfighter

Our capabilities support the unique mission of naval aviation

NAS Patuxent River Statistics

Operations

- Air Operations: 143,492
- NAWCAD Flight Hours: 17,490
- NAWCAD Aircraft: 170
- Airspace (square miles)
  - 2,700 restricted (surface to 85,000 ft)
  - 50,000 controlled (unlimited altitude)

People

- 25,000+ workforce
- St. Mary's largest employer
- 300,000 visitors annually
- Supports dependents and retired military

Facilities

- $3.6 billion current plant value
- 8.2M sq ft of facilities
- 104K sq ft of off-base leasing
- 890 buildings (12 hangars)
- 5 runways (longest is 11,800 ft)

Geography

- 14,553 acres
- 78.6 miles of roads
- 18.7 miles of shoreline
- 65 miles south of Washington DC
- 90 miles north of Norfolk

Flight hours provided by FIST (Flight Info Scheduling & Tracking) Air Ops' info from Air Traffic Control Log Oct 15.
Other stats current as of Feb 16.
Facilities data includes Pax, Webster OLF and NRC Solomons

NAWCAD – The Facts

AIRCRAFT SYSTEMS

- AIR VEHICLES
- PROPULSION & POWER
- AVIONICS & SENSORS
- CREW SYSTEMS
- SUPPORT SYSTEMS
- LAUNCH & RECOVERY

Major Sites

TRAINING SYSTEMS

- HUMAN PERFORMANCE / SIMULATOR SYSTEMS

VALUE PROPOSITION

Workforce
11,000 engineers, flight testers, scientists, and RDAT&E professionals

National Ranges and Labs
Integrated, unique, MRTFB invested, joint facilities - not duplicated by industry

Customer
PEO/PMA, but strong history in Joint, Inter-Service, Inter-Agency, FMS and Industry collaboration

Business Model
Navy Working Capital Fund (NWCF) supply and demand model - incentivizes cost consciousness

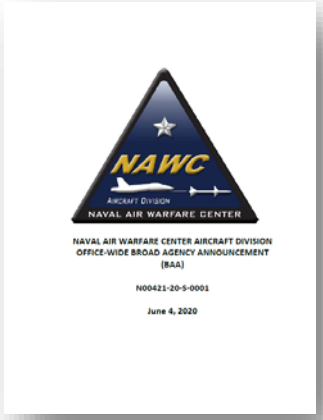
Flag Officer with Command responsibilities (NAWCAD)

The Busiest Flight Test Center in the World

- With four sites, ~400 labs, and >10,000 professionals, NAWCAD has the intellectual capital, laboratories, test infrastructure and aircraft necessary to support the fleet's aviation requirements.
- We provide our services to the Department of Defense, federal agencies, and non-federal customers.
- Integrated with other Warfare Centers and National Labs
- Warfare Centers shaped by BRAC (Indianapolis, Trenton, Warminster closed & consolidated at Pax)
- The only combined Air/Ship/Shore C4I and Interoperability DT&E activity

NAWCAD University Research Engagement

NAWCAD Office-Wide BAA N00421-20-S-001



- Objective: Progress Fundamental Research and build collaborative relationships
  - A mechanism by which contracts, assistance instruments (grant/cooperative agreement, . . . can be competed and awarded for academic basic, applied, and advanced research
- White Papers accepted all year, open continuously

Example Research Project with University of Maryland

Adaptive Helicopter Crashworthy Seat

- Designed, fabricated and tested Magnetorheological materials in a crash attenuating seating system. Tuned to match crash severity and provide optimal shielding from severe deceleration.
- Outcome: MREA damper system incorporated into NAWCAD Dynamic Test Lab and used to test in-service crash attenuating pilot seating systems. Transitioned to a STTR project in conjunction with a small business

ONR Summer Faculty Research Program

- Faculty participate in research activities across NAWCAD for 10 weeks during the summer
- Example Projects:
  - Dynamic control algorithms for autonomous VTOL UAVs
  - Quality Escape and Root Cause identification with Corrective Actions and Effectiveness in Supply Chain

NAWCAD STEM Internship Pipeline Strategy

HS Junior, HS Senior, Rising College Freshman

Science and Engineering Apprenticeship Program (SEAP)

Program Overview
- Students that have completed at least Grade 9
- Funded by ONR
- One year Term (summer only)
- Application once per year (Aug)
- Limited # of allocations per year

Benefits
- Introduce students to NAWCAD and STEM careers
- Managers can screen students
- Does not count towards NAWCAD end strength
- Gives managers an option for hiring HS students
- No long term commitment

Applications
https://seap.asee.org/
- Open Sept for following summer
- Closes November
- Notifications January

Rising College Sophomore and Juniors

Naval Research Enterprise Internship Program (NREIP)

Program Overview
- Students must have 31 credits prior to start of internship
- Funded by ONR/NAWCAD
- One year Term (summer only)
- Application once per year (Aug)
- 10 weeks
- Limited # of allocations per year

Benefits
- Introduce students to NAWCAD
- Managers can screen students
- Does not count towards NAWCAD end strength
- No long term commitment

Applications
https://nreip.asee.org/
- Open Sept for following summer
- Closes November
- Notifications January

Rising College Fresh, Soph Junior, Senior, Graduate

STEM Student Employment Program (SSEP)

Program Overview
- Students are NAWCAD employees
- Eligible for conversion to full-time employment upon graduation
- Student does counts towards end strength when working here
- Return to Duty for subsequent breaks from school
- Eligible for Tuition Assistance (219)
- Eligible for book assistance (Competency)
- Summer labor funded by Competency/Program/Other

Benefits
- DHA allows hire anytime per year
- Can hire rising freshman for targeted majors
- Bring on throughout the year, can work part-time; Flexible

Applications :
http://tinyurl.com/y8d8lum5
- DHA Open Continuous

Recommended for targeted Degrees and Graduate Students

Science, Mathematics And Research for Transformation (SMART)

Program Overview
- Candidates must resign from NAWC if currently an SSEP intern
- Full tuition and education related expenses
- Paid stipend
- Summer research internships 8 to 12 weeks
- Paid Health Insurance
- Given an experienced mentor
- Competitive application once per year
- Converts to full-time employment upon graduation with service obligation
- Limited # of allocations per year

Benefits
- Does not count towards NAWCAD end strength if intern (current DoD employee who are retention SMART scholars do count)
- High quality candidates through rigorous vetting process (14% award rate)

Applications
https://www.smartscholarship.org/smart
- Opens August for scholarship award in September of the following year
- Closes December of upcoming year
- Notifications April of upcoming year

NAWCAD Internships and Student Engagement

Internship Success Story:

Dr. David Illig

2012 NREIP Intern

Developed custom code to enable real-time processing of Lidar data.

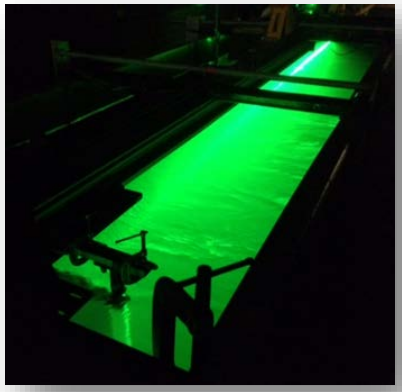
↓

2013-2015 SMART Scholar

Enhanced underwater laser range finders performance in murky water through radar waveform investigation, frequency modulators, and improved processing capability.

↓

Full-time Engineering Position at NAWCAD
Instructor at UMD SMD-E



Southern Maryland Engineering Program (SMD-E)

- Partnership in Southern Maryland between CSM, UMD and NAWCAD

TAILORED CURRICULUM

Mechanical Engineering
Atmospheric Flight
Fatigue & Fracture
Flight Controls
Flight Test Engineering
Structural Mechanics: A/C

Electrical Engineering
USN Mission System Testing
Cybersecurity
Capstone UAS Design
Power Electronics
Navy Wireless Comms

- BS in Mechanical and Electrical Engineering
- Internships at NAWCAD
- Tailored curriculum taught by NAWCAD professionals
- 111 graduates – 33 current students
- 113 work at NAWCAD, 3 at NAVSEA

Providing full spectrum aircraft research, development, test and evaluation and logistics support services

Demand continues for our unique intellectual capital and capabilities

www.navair.navy.mil/nawcad

QUESTIONS?

https://www.secnav.navy.mil/agility/Pages/techbridges.aspx

https://www.secnav.navy.mil/agility/Pages/tb_capital.aspx

https://www.secnav.navy.mil/agility/Pages/tb_southernmaryland.aspx