WAVES

May/June 2014

The official online publication of Naval Surface Warfare Center, Carderock Division

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President Barack Obama greets NSWCCD Materials Division Head Johnnie DeLoach in the Blue Room of the White House, Feb. 25, DeLoach met with the President as part of his duties as head of the Lightweight and Modern Metals Manufacturing Innovation Institute (Official White House Photo by Pete Souza/Released).

FROM THE TOP

Capt. Richard Blank

NSWC Carderock Division Commander

May is the month we recognize our nation's public servants during Public Service Recognition Week (this year May 4-10).

One special group of Carderock employees supporting our warfighters through their creativity and innovative work are the engineers in the Facilities and Model Fabrication Division. They help lead Carderock in energy awareness and energy project initiatives from the facilities perspective. The team consists of Greg Cancila, electrical engineer; David Heller, mechanical engineer; Raynard Alexander, industrial engineer; and Robert Smargiassi, electrical engineer. They have developed and executed numerous projects and initiatives to increase the use of alternative energy and steadily reduce our energy usage.

Recent projects contributing to this reduction include energy enhancements in two of our military construction (MILCON) projects, including repairs to major building heating/cooling systems, steam decentralization and building envelope repairs. Both of these energy management accomplishments contributed to the Secretary of the Navy recognition received over the past 11 years in the form of energy and water management awards.

The first MILCON energy enhancement project in Philadelphia provides high-pressure natural gas infrastructure to the newly constructed Electric Drive Test Site. This enables the site to operate on natural gas, which is considerably less expensive than the petroleum fuel alternative and significantly reduces particulate, nitrogen oxide (NOx) and sulfur oxide (SOx) emissions.

The second project was part of the American Recovery and Reinvestment Act. A 187-kilowatt (kW) photovoltaic array and two solar walls were installed at NSWC in West Bethesda, Maryland. Elements provided in the MILCON energy enhancements included Leadership in Energy and Environmental Design (LEED) Gold certification. The building is equipped with a 21-kilowatt (kW) photovoltaic array, solar domestic hot water and a vegetative roof.

Additionally, the efforts of this group were recognized by the U.S. Department of Energy (DOE) with a DOE Federal Energy and Water Management Award in July 2013. Continued implementation of new energy projects, the installation and maintenance of Direct Digital Control Systems to optimize climate control energy usage, and the pursuit of future alternative energy and conservation projects will remain top priorities for our Facilities and Model Fabrication Division. Making Carderock more energy efficient reduces our overhead costs, ultimately allowing us to deliver more affordable technology support to the fleet and our warfighters whom we honor this month.

Thank you to this group for being technically excellent AND judicious.

May is also the month we pay tribute to those in the armed forces, particularly those who lost their lives fighting for our great nation. I would like to take this opportunity as an active-duty Sailor to thank the Carderock workforce for the work you do every day of the year to keep our Sailors safe, our fleet strong and our military the best in the world. Often our Sailors, Marines, Soldiers and Airmen are sent into harm's way, far from their families. I know firsthand that part of the strength we draw upon to keep us going is the knowledge that our DOD civilians are not resting either.

President Barack Obama takes part in a wreath laying ceremony with Belgian Prime Minister Elio Di Rupo and King Philippe at the Flanders Field American Cemetery and Memorial, a World War I cemetery in Waregem, Belgium, March 26, 2014 (Official White House Photo by Pete Souza/ Released).

In communities across our nation this month, Americans will pay tribute to the sacrifices of our men and women in uniform. Since 1950, the third Saturday in May has been designated as Armed Forces Day, a day on which our troops are recognized and thanked for their service. On May 26, Memorial Day, we will pause to honor those who fought for our country's freedoms, but did not come home. They have made the ultimate sacrifice, and we shall not forget them.

Many Naval Surface Warfare Center, Carderock Division employees have served our country, in all branches of the U.S. Armed Forces. Some are serving today, as members of the Guard or Reserve. It is appropriate we take time to thank them whenever we see them.

I'd like to leave you with a poem to reflect upon which honors those who have fought the valorous fight and paid the ultimate sacrifice.

In Flanders Fields

In Flanders fields the poppies blow
Between the crosses, row on row,
That mark our place; and in the sky
The larks, still bravely singing, fly
Scarce heard amid the guns below.

We are the Dead. Short days ago
We lived, felt dawn, saw sunset glow,
Loved and were loved, and now we lie,
In Flanders fields.

Take up our quarrel with the foe:
To you from failing hands we throw
The torch; be yours to hold it high.
If ye break faith with us who die
We shall not sleep, though poppies grow
In Flanders fields.

The poem "In Flanders Fields" was written by Canadian physician Lt. Col. John McCrae (1872-1918) in May 1915 after the funeral of a fellow Soldier at the Second Battle of Ypres in Belgium. To this day, the red poppy is worn as a symbol of remembrance of those who have died in war.

TECHNICAL DIRECTOR'S CORNER

Dr. Joseph T. (Tim) Arcano Jr.
NSWC Carderock Division Technical Director

Innovative strategic planning process

I expect to find innovation in our science, technology, design and fabrication areas of Carderock, but it also appears in an unexpected place – our strategic planning process. (Note I said "process," not "plan.")

A strategic planning process is vital to any technology-related business as it moves to execute current work and prepare for future challenges. My goal is to prepare Carderock for future challenges.

A useful strategy invokes a planning and execution process – it outlines where we want to go, what we need to get there, a route to get us there and some ways we can measure our progress. Strategic planning processes invoke the thought on how to efficiently and effectively use highly valued but limited human, technical and financial resources.

This is where the Carderock strategic planning process now being developed is different: It will be an iterative process. Instead of only defining a specific set of goals, ticking off each box when it is completed, and then starting the process all over again with new goals, our planning process will replace completed goals with already defined new ones, so the process never really ends, rather, it is dynamic.

Our strategic planning process, the first iteration of which I hope to share with you this month, looks ahead for the next three, five and even 10 years. Program needs and associated budget forecasts are included, asking questions such as "Will this technical capability area grow in the next few years, stay the same, or perhaps decline?" These technical and business area "environmental scans" will look at political, economic, social and technology (PEST) aspects and catalyze us to weigh investment needs in people, science and technology, and tools and facilities.

As I said in a message to our department heads, this follows very closely the Technical and Business Capability Health Assessments (TCHA/BCHA) construct and provides a way to thoughtfully develop and briefly articulate what we think we should be doing, as well as help us plan for future needs.

The planning process also includes "triggers." Will more people be needed? With what specialties? New equipment? Upgraded facilities? Other areas where we may need to invest? Changing situations?

This flexibility will allow us to respond to changing environments and situations while still focusing on our core mission.

This planning process will also be performance based. It is linked to our mission as well as aligned to the NAVSEA Strategic Business Plan. For each of the objectives, we are going to have performance-based measures with associated metrics.

It has been said that if everything is a priority then nothing is. With that in mind, a select number of meaningful metrics will be displayed so that managers and leadership can look at and easily see how the objectives are being met and if there are any trouble spots that demand more attention. You have seen some information about the upcoming Inspector General's visit in June and the review process in place to prepare for that visit. As with the IG review process, the strategic planning process is intended to enable all of us to perform with technical excellence. Like the IG review, I hope our innovative strategic planning process sets a new standard for other Navy commands.

You'll be hearing more from me about the strategic planning process and the IG inspection. You'll also be hearing about technical excellence, which is the foundation of everything we do here every day.

Aerial photo of Naval Surface Warfare Center, Carderock Division in West Bethesda, Md., Mar. 29, 2012 (U.S. Navy photo by Devin Pisner/Released).

President Barack Obama greets guests in the Blue Room prior to a Manufacturing Innovation Institutes announcement in the East Room of the White House, Feb. 25. NSWCCD Materials Division Head Johnnie DeLoach (to the left of the president) will manage the president's initiative (Official White House Photo by Pete Souza/Released).

NSWCCD'S DeLoach tapped to head White House's Innovation Institute

By Nicholas Malay, NSWC Carderock Division Public Affairs

Naval Surface Warfare Center Carderock Division Materials Division Head Johnnie DeLoach was selected to manage President Barack Obama's Lightweight and Modern Metals Manufacturing Innovation Institute. The institute kick-off was held April 9.

Obama announced, at the White House, the awarding of the LM3I Institute – a five-year, $140 million effort, to a Michigan consortium led by Edison Welding Institute (EWI), which brings together companies that include aluminum, titanium and high strength steel manufacturers; leading materials providers; and critical end-users with universities on the cutting edge of technology development and research, all in a vibrant and entrepreneurial region that can serve as the foundation for ongoing U.S leadership in this important technology.

The institute is chartered with advancing the state of processing and fabrication technologies for lightweight and modern metals by facilitating the transition between basic/early research and full-scale production of associated materials, components and systems. DeLoach's overarching function is to develop, establish, and provide ongoing direct government oversight of the LM3I Institute. "It's a tremendous honor and a significant responsibility to work on an initiative of this importance and visibility," DeLoach said. "I and the rest of the team that will be supporting the effort truly appreciate the confidence that NSWCCD, OSD and ONR have shown in us."

DeLoach has more than 30 years of naval engineering service in a broad variety of materials-related engineering and research and development programs. His primary technical areas of concentration have been high strength steels (including castings), filler metal development, friction stir welding, nondestructive evaluation, and weldability assessment and procedure development for ferrous and non ferrous metals used in U.S. Navy ships and submarines.

He served as the head of the Welding, Processing, and Nondestructive Evaluation Branch since 2001. The branch's mission is to provide technical expertise and develop technology in the areas of joining, materials fabrication/processing and nondestructive testing/evaluation. The branch engages in a full-spectrum of technical and programmatic activities (basic research, applied research and engineering, test and evaluation, in-service engineering, contract oversight and direct acquisition program support). As manager, his primary function was to enable staff success by providing vision, supervision, coaching, mentoring, oversight and leadership.

He has been responsible for staffs of approximately 25 engineers and scientists located at up to five sites. The branch has operated and been custodian of approximately 20,000 square feet of laboratory space containing welding (conventional and automated/robotic/friction stir), cutting, coating/surfacing, forming, casting and inspection equipment. Due to the broad scope of technical activities, his branch directly supports four technical warrant holders within NAVSEA Ship Integrity and Performance Engineering Group NAVSEA OP52. As a manager, he focused on developing a highly-capable staff and provided them the tools and processes required to successfully meet and exceed customer expectations. He emphasized technical development activities, enabled several employees to gain advanced degrees, technical certifications and engage in career-broadening assignments within and outside of NSWCCD.

DeLoach continues to participate in and provide leadership to a variety of technical initiatives. He is the U.S. National Representative on Technical Panel 1 (Metals and Ceramics Technology and Performance, MAT-TP-1) of The Technical Cooperation Program (TTCP). TTCP is a technical collaboration between defense departments from five nations (Australia, Canada, New Zealand, U.K. and U.S.).

Carderock conference provides foundation to exchange new materials technologies

By Nicholas Malay, NSWC Carderock Division Public Affairs

Naval Surface Warfare Center, Carderock Division (NSWCCD) hosted the third Navy Materials Community of Interest (NMCOI) Materials Forum at the Maritime Technology Information Center in West Bethesda, Maryland, April 29-May 1.

"Creating effective teaming and sharing technical information within our community are two of our goals," said Johnnie DeLoach, NSWCCD materials division head. "Over the past six years, participation in the Navy Materials Community of Interest has grown in both the number of participants and the significance of collaborations."

"It's great to see the depth of engagement by materials scientists and engineers representing the warfare centers, systems commands, the Naval Research Laboratory and the Office of Naval Research, and wealth and breadth of knowledge brought to be shared through the NMCOI forum," said Dr. Julie Christodoulou, Office of Naval Research (ONR) director of Naval Materials Division and keynote speaker.

Dr. Julie Christodoulou, Office of Naval Research (ONR) director of Naval Materials Division and keynote speaker, discusses new and existing materials technologies across the warfare centers, systems commands, the Naval Research Laboratory and the Office of Naval Research with NSWCCD Materials Division Head Johnnie DeLoach at the third Navy Materials Community of Interest Materials (NMCOI) Forum in the Maritime Technology Information Center, April 29 (U.S. Navy photo by Nicholas Malay/Released).

The Naval Sea Systems Command (NAVSEA) Warfare Centers initiated the NMCOI to address the current and future materials needs for naval systems. The goals of the NMCOI are to:

1. Create an efficient and effective teaming between the various warfare centers' materials science and engineering initiatives.

2. Provide a forum to share technical information and leverage resources in a coordinated environment aimed at enhancing the warfare centers' capabilities and exploitation of technology advancements.

3. Expand collaborative initiatives with academia, industry and other government agencies to accomplish development and transition of technology in a rapid, cost-effective manner.

The scope of the NMCOI is to encompass all NAVSEA warfare centers' activities that provide the foundation for exploring, developing and applying new and innovative materials technologies. Each warfare center contributes unique "application-oriented" technical capabilities specific to their mission area. These unique applications contribute to the common good through the associated material science, engineering, development efficiency, enhanced performance, enhanced safety/survivability, reduced life-cycle costs, systems integration, transition to industry and interface with the fleet.

The primary benefit of the initiative is the assurance of effective application of materials technologies to naval systems by networking those participating in the broad materials community. The NMCOI also provides the benefit of identifying technology gaps and creating technology road maps necessary to meet future needs and will enhance the leveraging of resources and exchange of ideas.

"We recognize the merit of these opportunities for information exchange and we hope that the warfare centers find great value in the 2014 Materials Forum," DeLoach said.

Naval Surface Warfare Center, Carderock Division's (NSWCCD) Extreme Materials Group member Danielle Gerstner conducts basic science, applied research and development of materials with high melting points, hardness and oxidation/corrosion resistance in the Carderock Division Ceramics Laboratory. The group has a broad knowledge base encompassing many types of materials including ceramic composites, refractory metals, technical ceramics, carbon/carbon composites, and ablating polymer composites (U.S. Navy Photo by Nicholas Malay/Released).

NAVSSES partners with Drexel University's STEM cyber security program

By Kate Hogarth, NAVSSES Public Affairs

It is the beginning of April in Center City Philadelphia and the signs of spring are finally beginning to sprout. The Science Leadership Academy (SLA) high school is buzzing with activity at nine in the morning with students working on cyber security experiments.

In the lobby waiting to sign in is volunteer Sara Schlenker, a mechanical engineer with the Sail Systems Engineering Branch at the Naval Ship Systems Engineering Station (NAVSSES).

Schlenker is at SLA to help construct Faraday cages with Stephanie Dunda's ninth grade bio-chemistry class. Faraday cages are enclosures made out of a conductive material used to block electrical fields. The 9th graders' Faraday cages are being constructed of cardboard, foil and duct tape to form an enclosure over a cellphone. The cages are being built to block radio signals from reaching the cell phone inside.

Sara Schlenker, mechanical engineer with the Sail Systems Engineering Branch at NAVSSES talks to a Science Leadership Academy student about how his Faraday cage works, April 2 (U.S. Navy photo by Kate Hogarth/Released).

The Drexel University Science, Technology, Engineering and Mathematics (STEM) Cyber Security Program partners Drexel PhD fellows and Philadelphia teachers with NAVSSES volunteers. The program is designed to highlight the National Academy of Engineering Grand Challenges and to introduce students from local high schools to the world of cyber security.

According to the Grand Challenges Scholar's website, the National Academy of Engineering Grand Challenges Scholars Program is a combined curricular and extra-curricular program with five components designed to prepare students to be the generation that solves the grand challenges facing society this century. The five program components are research experience, interdisciplinary curriculum, entrepreneurship, global dimension, and service learning.

There are 13 challenges in all, ranging from solar energy to engineering better medicine to preventing nuclear terror. This year's grand challenge is secure cyberspace.

Sara Schlenker, mechanical engineer with the Sail Systems Engineering Branch at NAVSSES holds a student's Faraday cage at the Science Leadership Academy in Philadelphia, April 2 (U.S. Navy photo by Kate Hogarth/Released).

Schlenker of Glen Mills, Pennsylvania, earned her bachelor's degree in mechanical engineering from Johns Hopkins University and went on to get her master's from Villanova University. She is paired up with Kamau Wright a fellow working on his PhD in mechanical engineering. Together they are working with Dunda's students to refine the Faraday cages using the engineering design process. The students are using their creativity to make the cages both fashionable and functional, Schlenker explained.

"I think these outreach programs are very important, the earlier the better," Schlenker said. "Some kids will have to make choices fairly early in high school, like whether to take physics or high-level math classes, which will impact their options for pursing science or engineering in college."

The collaboration between NAVSSES volunteers, Drexel and Philadelphia high schools would not be possible without Tristan Wolfe, a mechanical engineer with the Advanced Machinery Systems Integration Branch at NAVSSES.

"We want to get the NAVSSES name out there, get exposure and make this collaboration better and better each year," Wolfe said.

Working alongside Wolfe to help coordinate the volunteering efforts are Sean Gallagher and Patrick Violante, engineers with the Advanced Machinery Systems Integration Branch, and Pinkesh Bharatia a mechanical engineer with the Sail Systems Engineering Branch.

Wolfe is passionate about volunteering and making sure children understand engineering. For instance, one time Wolfe and colleague Gallagher had to teach a class about buoyancy. Wolfe looked around his office area thinking, "How can I illustrate buoyancy?"

Wolfe looked up and saw some Styrofoam and an idea clicked. Wolfe and Gallagher went to

the mess area and grabbed some big empty coffee cans and filled them with water, then went outside with a zip lock bag and filled it with gravel.

Wolfe and Gallagher went to the school with their mini science experiment and with a little bit of creativity, the students managed to illustrate the concept of neutral buoyancy for themselves.

With no budget for supplies, the teacher gladly kept all the materials that Wolfe and Gallagher foraged. “They were like gold to her and she will use them in future demonstrations,” Wolfe said.

Wolfe said the Drexel University STEM Cyber Security Program is a pilot program with the goal of getting kids interested in cyber security.

Each school is different and they are all approaching their projects from different angles. Some are approaching the problem quite literally and some are drawing from similarities. Central High School is focusing on the similarities between material science and cyber security – comparing a composite wall to a firewall, Wolfe explained.

At SLA, in the next classroom over, volunteer Caitlin Markey, a computer scientist with the Scalable Integrated Skills Systems Branch at NAVSSES, meets with Matthew Van Kouwenberg’s senior engineering class.

Nuri Bracey a student at the Science Leadership Academy in Philadelphia explains his circuit board to his teacher Matthew Van Kouwenberg and STEM volunteer Caitlin Markey, a computer scientist with the Scalable Integrated Skill Systems Branch at NAVSSES, April 2 (U.S. Navy photo by Kate Hogarth/Released).

Markey said Van Kouwenberg’s class is really enjoying learning about encryption. Half the students in the class are working on encrypting a message, while the other half are working on decrypting a message.

Brandon Morton, a graduate student at Drexel who is working on his PhD in electrical engineering, joins Markey in Van Kouwenberg’s classroom.

Morton is helping students build circuit boards to test their encryption. The students use their circuit boards to play a spy game in the halls of SLA. One team of students sends a message to another team. If the team decrypts the message correctly they live. At the end of the class, one team was left standing.

It is not all about science and engineering, said Markey a graduate of Rowan University with a bachelor’s in computer science, who also plays the role of a mentor. She talks with the students about applying for college and about available scholarships.

"It is amazing to see what the students are capable of,” Markey said. “They learn quickly and are great at coming up with creative solutions to problems they find while working on their projects. Working with the students at SLA has reminded me to think outside the box and to not be afraid to try different approaches on work projects.”

This is the first time NAVSSES has been involved in the ongoing project from the National Academy of Engineering Grand Challenges. In addition to the Science Leadership Academy, NAVSSES has volunteers in the Girard Academic Music Program and Central High School. NAVSSES will also have one-day speakers volunteering at the Philadelphia High School for Girls and Haddonfield High School.

STEM volunteer Caitlin Markey, a computer scientist with the Scalable Integrated Skill Systems Branch at NAVSSES and Drexel PhD fellow, Brandon Morton talk with Nuri Bracey a student at the Science Leadership Academy, April 2 (U.S. Navy photo by Kate Hogarth/Released).

Autonomy is a must for ship systems

Intergrating and automating systems will free personnel for other tasks and help manage increasingly complex ships.

By Anthony Seman, Future Force: Spring Edition 2014

Jim Blesse, standing, from the Office of Naval Research (ONR), explains project BlueShark to Lt. Col. John Moore from the Marine Corps Warfighting Laboratory. Project BlueShark is an ONR effort to create a high-tech, futuristic environment to demonstrate what operational work environments might look like and what emerging innovative technologies might provide in the next decade (U.S. Navy photo by John F. Williams/Released).

Future naval superiority depends on the need to control the tempo of combat operations, rather than merely to act and react rapidly. The quality and speed of decisions must be superior to those in an adversary's decision cycle. To maintain and improve this capability within the context of a rapidly advancing technological landscape, the Navy must implement new advanced capabilities into its shipboard systems. Future naval ship systems—combat as well as hull, mechanical, and electrical—will embody a much deeper level of integration of functionality. This integration is crucial to achieve greater combat power. Most important, optimizations will be in the context of mission, condition, and environment—all of which evolve dynamically in real time. These systems will not be realized or affordable within the current approach to naval machinery systems design and construction.

Operational characteristics of these "systems of systems" will embody greater interactions and interdependencies, and therefore manifest greater complexities in operation. This complexity will be such that human operators will not be able to implement optimal configurations—especially cross-platform—through traditional direct manipulation. The level of integration of these systems creates a set of possible configurations and states so large it is impractical to identify and evaluate completely, either at design time or during operation. Implementation of autonomy in monitoring and control, which feature predictive and adaptive approaches, will be required.

Capability Assessment

Effective mission planning and execution monitoring not only requires increased state awareness, but also the ability to assess future capability in terms of mission. This capability assessment must be present at the platform level and decomposable down through all ship systems and subsystems. A capabilities-based readiness assessment uses in situ modeling and simulation—again decomposed to the lowest levels—by being embedded into monitoring and control. This capability is constantly running in the background: monitoring, reasoning, performing simulation projection over operational and situational information, and developing options. This reduces the burden on operators so they can focus on critical tasks and decisions. With this intrinsic capability, more effective and timely dynamic planning, replanning, and reconfiguration are possible. Across the spectrum—from battle group mission planning to low-level subsystem control—optimal configurations will be based on mission intent and system capability predictions.

Capability assessments should take the form of an "analysis of alternatives"—including multiple configurations/alignments (plans), their predicted effectiveness against mission over time, and the costs, risks, and confidence level in the analyses. The scope of possible alignments can and should include the options of "run to failure" and "perform mainte nance." The idea of assessing capability against mission— reporting out quality of those capability assessments—is not new to warfighters. Embedding this capability into all levels of shipboard machinery control, however, and implementing it using autonomy, will provide the Navy with a leap-ahead capability.

Shipboard Control

Naval shipboard control can be grouped in terms of reasoning into three levels: platform (multisystem) control, system control, and device control. Platform control is performed by human operators, based on mission inputs, to plan a series of tasks the platform needs to accomplish. It is strategic in nature, controlling platform effects over time. System control, currently performed by operators, plans and executes a series of plant configurations over time. This executes the planned platform tasks according to the planned schedule. It is tactical in nature, controlling configuration over time. The lowest level, device control, maintains operation of the machinery in support of the planned tasks. It is operational in nature, controlling physics over time.

Autonomy in System Control

The goal of current research efforts at the Office of Naval Research (ONR) in machinery control is to apply autonomy to the middle layer—system control. This autonomy will perform some of the human reasoning functions to determine optimal system configurations rapidly. The challenge is that the number of possible configurations and states in systems of systems control becomes so large that prior calculation and evaluation of all possible states becomes impractical or even impossible. The large amount of system states also can lead to emerging system behaviors and complexity that would be unaccounted for with traditional control system design. It is an objective of autonomy to address this behavior, as well. Effective control of complex systems can be produced by "intelligent control," which, unlike feedback control, uses reasoning techniques to identify a solution for the current situation.

A primary function of naval ship machinery systems is to supply resources to loads. The nature of these systems is largely distributed and heterogeneous. The supply of these resources—such as air, fluid, thermal, power, and information—must be maintained through a range of possible accidental or deliberate perturbations in a very dynamic environment. The supply of resources is finite, and in the context of

new, energy intensive combat systems there will not be excess capacity to service all priority loads simultaneously. Resource distribution throughout the platform will require a sophisticated management approach.

Ideally, the control system should enable a configuration that effectively supports the successful execution of a predetermined goal, within specified constraints, and in context of the environment. In this case, it is to supply a resource to a load to achieve a combat objective. The constraints, or optimizations, could be speed of execution, energy used, efficiency, safety, or impact on future combat capability. Today, this type of reasoning is performed by human operators, including how to set and maintain control system inputs to achieve the desired goals. In the context of multiple, large-scale, interconnected, heterogeneous, distributed systems, human operators will not be manipulating these systems at a representation similar to a local machine control panel. Because of the level of integration, the human would not have the state awareness, or the time to amass and assess it, to provide optimal control actions from a larger perspective.

The autonomy required for machinery systems has an added dimension that makes it different from autonomy for remote unmanned vehicles. Unmanned vehicles are primarily coupled together only through information flow—machinery systems are much more complicated because of the strong physical couplings between the subsystems. Systems that have these complex couplings between subsystems are known as cyber-physical systems.

Intelligent Agent-Based Distributed Control

A multi-intelligent-agent-based, distributed-control-system approach is a viable solution for implementation of autonomy in shipboard systems control. An intelligent agent is an independent software entity that manages subsets of the physical plant. Agents are capable of responding very rapidly to devices within their spheres of control. Agents collaborate by communicating observations and commands. In an agent-based system, in which multiple agents work together to address a complex problem, agents address local issues while also communicating and deliberating with other agents to create global solutions. Intelligent agents would be hosted on programmable logic controllers. ONR has invested in agent-based research for shipboard machinery systems for many years and is moving toward transition to full- scale hardware implementation.

This distributed control approach mirrors the distributed nature of the systems themselves. By moving away from a centralized control approach (but not away from top- level directives), there are two advantages: the control system's ability to avoid or mitigate faults and disruptions is improved, and real-time evaluation of a greater set of possible control actions can be performed within practical time and resource constraints. This local optimization, bounded by top-level mission directives, context and constraints, would help achieve better and more timely global optimizations.

A key component to optimal control decisions is accurate and timely state awareness. It is a given that no system will have complete state awareness all of the time, especially at all-system scales. There can be sensor faults, communications channel noise, accidental and malicious disturbances, etc. The control system will always have only an estimate of system state, whose usefulness is affected by many factors, including the timeliness of information. This is being addressed by ONR investments in advanced sensors and sensor networks, data and knowledge fusion algorithms, as well as communications technologies and topologies.

System control autonomy will perform some of the human reasoning functions to rapidly determine optimal system configurations and to free up human operators to concentrate on the platform control (U.S. Navy photo by Eric Anderson/ Released).

Another intrinsic piece to this architecture is in situ modeling and simulation of the systems of systems under control. Mission directives and system condition and health would be provided as system inputs. Simulations would be run forward in time to assess capabilities. Optimal solutions would be selected based on simulation results. This pervasive modeling and simulation exists at all levels of the machinery control system, at appropriate levels of accuracy and granularity because of time and resource constraints.

Future Development and Acquisition

Naval machinery systems autonomy is planned for full implementation aboard the next future surface combatant platform. This vessel will have multiple high-power weapons and sensors, such as the Free Electron Laser and the new Air and Missile Defense Radar. Each of these systems requires unique types of (pulsed) power that is different from what current ships' power generation will provide.

The Navy cannot afford to have each system bring its own storage and conversion because of size, weight, and cost constraints. The future ship's power system must provide all required storage and conversion, as currently planned for in Naval Sea Systems Command's Electric Ship Architecture and Energy Magazine concept. This new architecture will contain multiple types and multiple quantities of energy storage and conversion technologies, spatially distributed throughout the platform. A new control system is required that will manage power from these multiple shared energy generation and storage devices, as well as concurrently control all other associated resources, such as cooling and information systems.

The system will have to anticipate and pre-position power to where it needs to be—the right type, at the right time, and to the right weapon. It will use the concepts and technologies discussed here to execute optimal configurations of resources to loads, from a total ship perspective. Autonomy in ship machinery control systems will be a capability enabler for the future surface combatant.

Frigate harvesting effort to benefit remaining U.S. fleet and foreign navies

By Joseph Battista, NAVSSES Public Affairs

Engineers at Ship Systems Engineering Station, Naval Surface Warfare Center Carderock Division (NAVSSES) in Philadelphia are combatting the problem of obsolete parts and systems needed to maintain the U.S. Navy's remaining fleet of guided missile frigates (FFGs) by embarking on a harvesting effort of five decommissioned frigates to keep its active ships sailing and ready.

The Navy recognizes that not everything lasts forever as it methodically decommissions its fleet of Oliver Hazard Perry class frigates, which are nearing the end of their extended service life (ESL) of 30 years. The frigates remaining in the U.S. fleet, as well as those sold to foreign navies, still need to function at a high level. This becomes more difficult as parts and systems become obsolete and more expensive to replace and repair.

E. Alan Karpovitch, P.E., the Navy's propulsion program manager from NAVSSES' Major Programs Branch, and Ashley Ferguson, mechanical engineer at NAVSSES, are the architects of a recent successful harvesting of three decommissioned cruisers, and are leading the frigate harvesting that started Nov. 5 with the former USS Hawes (FFG 53). The Hawes and USS Doyle (FFG 39) were brought into dry dock April 22. What is unique is the ships are in the same dry dock – something rarely done.

"Due to other contractor commitments and some bad weather this winter, the harvesting project fell a little behind, so putting two ships in the same dry dock at the same time will help us get back the time lost," said Karpovitch.

The Navy built a class of 51 guided missile frigates from 1975-1989 with an expected service life of 30 years. Five of the decommissioned ships located in Philadelphia are designated as logistics support assets with many serviceable parts. These parts include the more expensive items, referred to as 2S Cog items, such as marine gas turbines, propellers, hubs, oil distribution (OD) boxes, and propeller and stern tube shafts.

The decommissioned USS Hawes (FFG 53) (foreground) sits in front of the decommissioned USS Doyle (FFG 39) in dry dock 3 at the Philadelphia Navy Yard, April 22. Both ships were brought into the same dry dock so Engineers at Naval Ship Systems Engineering Station, Naval Surface Warfare Center Carderock Division (NAVSSES) in Philadelphia can combat the problem of obsolete parts and systems needed to maintain the U.S. Navy's remaining fleet of guided missile frigate (U.S. Navy photo by Joseph Battista/Released).

"These items are centrally managed," said Karpovitch. "This means when a ship needs to replace a marine gas turbine, we send them a replacement, and they send us back the broken one so we can fully refurbish it and place it back into our inventory."

Other parts slated for removal are rudders, auxiliary propulsion units, clutches, pumps, motors, controllers, valves, coolers, oily water separators, sonar domes, and purifiers.

With only a small number of the original 51 still in service, and most of those slated for decommissioning in the next several years, some of the harvested parts can be used to support frigates owned by foreign navies.

There are currently 34 Oliver Hazard Perry class frigates in use by Australia, Bahrain, Egypt, Turkey, Poland, Spain, Taiwan and Pakistan. These countries, along with the U.S. Navy, make up the International Frigate Working Group (IFWG). The group was formed in 2009 to address hull, mechanical, and electrical (HM&E); logistics; and combat systems issues of the ship class.

The decommissioned frigates USS Hawes (FFG 53) (right) and USS Doyle (FFG 39) sit in the same dry dock. Engineers at Naval Ship Systems Engineering Station, Naval Surface Warfare Center Carderock Division (NAVSSES) in Philadelphia are combatting the problem of obsolete parts and systems needed to maintain the U.S. Navy's remaining fleet of guided missile frigates (FFGs) by embarking on a harvesting effort of five decommissioned frigates to keep its active ships sailing and ready. Editor's note:This image is two separate images put together (U.S. Navy photo by Joseph Battista/Released).

Annual Greater Philadelphia SeaPerch Challenge attracts record numbers

By Joseph Battista, NAVSSES Public Affairs

Demetrios Pousatis, from Corporate Information Services Division, listens to the middle school team from STEMnasium Learning Academy explain how they built their underwater remotely operated vehicle (ROV) for the 9th Annual Greater Philadelphia SeaPerch Challenge at Drexel University, April 25. Naval Ship Systems Engineering Station, Naval Surface Carderock Division (NAVSSES) employees volunteered as judges, helped organize the competition, or mentored a competing team (U.S. Navy photo by Joseph Battista/Released).

More than 60 middle and high schools from the Philadelphia region gathered poolside at Drexel University to compete in the 9th Annual Greater Philadelphia SeaPerch Challenge April 25-26. The yearly underwater remotely operated vehicle (ROV) competition is a joint effort by Naval Ship Systems Engineering Station, Naval Surface Warfare Carderock Division (NAVSSES), the Delaware Valley Section of the American Society of Naval Engineers (ASNE DV), Office of Naval Research (ONR), and the Drexel University College of Engineering to increase student interest in science, technology, math and engineering (STEM).

The main event this year was an underwater mission called "The Heist." The scenario – six communication boxes of great value to the United States were lost at sea. An enemy submarine found the boxes and put them in a secure holding area at the bottom of the Baltic Sea. The task for students was to clear an underwater minefield, maneuver the ROV through a small security access door, and retrieve the communication boxes.

Teams were also judged on moving their ROVs through an underwater obstacle course, as well as their design notebook, which chronicled their entire build process, and a team poster presentation. Each team made a 10-minute presentation to a panel of judges to show their understanding of the naval engineering principles behind their design.

Once again, NAVSSES employees volunteered as judges, mentors and volunteers for the challenge.

"Thanks to all the committee members, mentors, judges, divers, and other volunteers who helped once again to make the Greater Philadelphia SeaPerch Challenge an educational, rewarding, and fun event," said Stephen Michetti, Weapons Handling and Stowage Systems Branch head and SeaPerch Program chair. "This is truly an amazing event that provides significant value to the students who participate."

The first and second place pool performance winners qualified for the National SeaPerch Challenge scheduled for May 16-17 on the campus of the University of Southern Mississippi in Hattiesburg, Mississippi.

One of the teams making the trip is a team of home-schooled high school students, The Sinkers, mentored by Tom Luchay from Solid Waste and HAZMAT ISE Branch. The Sinkers finished first overall, second in the engineering design notebook and first in the pool performance challenges.

In addition, as the overall winners the team was invited as guests at the STEM Teacher Awards and CBS 3 Station Tour on May 28, hosted by CBS 3 Chief Meteorologist Kathy Orr and Richard Paleski, director of Broadcast Operations for CBS in New York.

Paleski made the trip from New York to volunteer as a judge at SeaPerch. In an email to Michetti following the event he wrote, "I wanted to tell you how impressed I was with the way the SeaPerch STEM event was organized and with the skill of the participating schools. The students were exceptionally focused on the various tasks and it was a joy to share their experience. It was clear they are learning project management, the engineering process, and teamwork. Those life skills will serve them well in a competitive world."

Over the last nine years, more than 8,000 students have competed in the Greater Philadelphia SeaPerch Challenge and expanded from a one-day to two-day event. Michetti is excited to start work on the 10th anniversary competition coming up next spring.

"As we approach our 10-year anniversary of the Greater Philadelphia SeaPerch Challenge in 2015 it gives us great pride that the model that started here in Philadelphia nine years ago has been used to develop a nationwide SeaPerch program over the past four years," said Michetti. "Today, over 60,000 students in over 40 states have participated in SeaPerch."

Michetti said the competition is not perfect, but it seems to get better every year.

Morgan Watson (back right), from Sustainment and Modernization Branch, judges the Delcroft School team during The Heist portion of the 9th Annual Greater Philadelphia SeaPerch Challenge at Drexel University, April 25. Watson, along with other Naval Ship Systems Engineering Station, Naval Surface Carderock Division (NAVSSES) employees, volunteered as judges, helped organize the competition, or mentored a competing team (U.S. Navy photo by Joseph Battista/Released).

NHHC's Howell torpedo takes trip into computer-generated third dimension

By Mass Communication Specialist 2nd Class Eric Lockwood, Naval History and Heritage Command Communication and Outreach Division

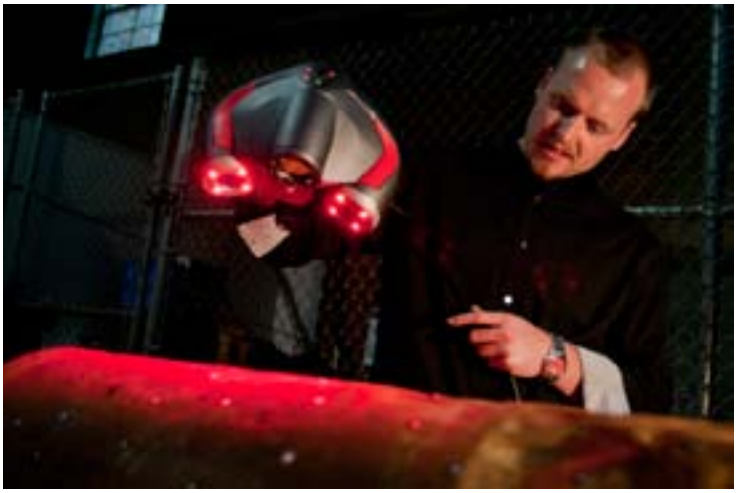
The Machinery Research and Engineering Department at Naval Ship Systems Engineering Station, Naval Surface Warfare Center Carderock Division (NAVSSES), established Naval Innovation for Science and Engineering (NISE) funding to conduct workforce development and basic research for the use of laser metrology for forensics machinery applications. The NISE program provides DoD science and engineering organizations the capability to develop and transition technology, as well as develop the workforce and enhance laboratory facilities and equipment.

The 3-D scanning of the Howell Torpedo for Naval History and Heritage Command's Underwater Archeology Brancy (UAB) presents a unique opportunity for engineers with NAVSSES' Advanced Data Acquisition, Prototyping Technology & Virtual Environments (adapt.ive) Lab to explore the use of laser scanning techniques to document damage to a component with less than ideal surface conditions. The lessons and expertise gained can be applied to support new research opportunities.

Advances in data acquisition by means of laser metrology have enabled new methods in reverse engineering and forensic analysis. Using laser tools to perform forensic analyses of damaged components allows engineers to gain highly detailed information to help determine causes of failure. The information can be used to improve future designs and mitigate risks.

According to the Patrick Violante, from Advanced Machinery Systems Integration Branch, the less than ideal material condition of the torpedo will allow the evaluation of various laser-scanning methods to determine the optimal type of scanner to obtain the most accurate results.

Conservators and scientists from Naval History and Heritage Command's Underwater Archeology Branch (UAB) and Naval Surface Warfare Center Carderock Division (NSWCCD) collaborated to begin a three dimensional laser scanning of the Howell Torpedo, April 30.



Scott Storms, a project engineer at NAVSSES, makes a 3-dimensional scan of the number 24 Howell Torpedo at the Underwater Archeology Branch (UAB) of the Naval History and Heritage Command (NHHC) on the Washington Navy Yard. Lost from the Iowa (BB 4) during a training mission and found by a dolphin in the U.S. Navy Marine Mammal Program off the coast of San Diego last year, UAB has been desalinating the torpedo since May 2013 (U.S. Navy photo by Eric Lockwood/Released).

"[The torpedo] was lost in 1899 during a training exercise on board USS Iowa and recovered in May 2013 by the Navy's marine mammal program," said Kate Morrand, UAB's senior conservator and laboratory manager. "It is now undergoing treatment at the archaeology and treatment lab."

3-D laser scanning is a non-contact, non-destructive technology that digitally captures the shape of physical objects using light. The scanner captures a physical object's exact size and shape into the computer world as a digital 3-dimensional representation.

"We used the Creaform 3-D scanner to gather dimensional data on the surface of the torpedo in addition to the Faro Focus scanner for supplemental and color data," said Nicholas Cifelli, a member of the NSWCCD team. "[The scanner] shoots a laser beam out and cameras detect the distance of the scan and once that's done the software will create a mesh of the points to create a digital model."

The 3-D imaging project is a joint undertaking and serves as an exercise to train NSWCCD engineers in the use of this highly advanced scanning equipment while providing NHHC with a finely detailed, fully interactive 3-D scan of the artifact. 3-D images are helpful in analyzing the dimensions of an artifact and also observing any physical changes that may occur during conservation treatment.

"It's good for visualization," said Cifelli. "We can also compare this torpedo to how it's supposed to be designed to see deformations and see how it's changed over the last 115 years."

Once the scan is complete UAB plans to use it as an online interactive education and outreach tool.

The Naval History and Heritage Command, located at the Washington Navy Yard, is responsible for the preservation, analysis, and dissemination of U.S. naval history and heritage. It provides the knowledge foundation for the Navy by maintaining historically relevant resources and products that reflect the Navy's unique and enduring contributions through our nation's history, and supports the Fleet by assisting with and delivering professional research, analysis, and interpretive services. NHHC is composed of many activities including the Navy Department Library, the Navy Operational Archives, the Navy art and artifact collections, underwater archeology, Navy histories, nine museums, USS Constitution repair facility and the historic ship Nautilus.

Caitlin Swec, a project engineer at NAVSSES, makes a 3-dimensional scan of the number 24 Howell Torpedo at the Underwater Archeology Branch (UAB) of the Naval History and Heritage Command (NHHC) on the Washington Navy Yard. Lost from the Iowa (BB 4) during a training mission and found by a dolphin in the U.S. Navy Marine Mammal Program off the coast of San Diego last year, UAB has been desalinating the torpedo since May 2013 (U.S. Navy photo by Eric Lockwood/Released).

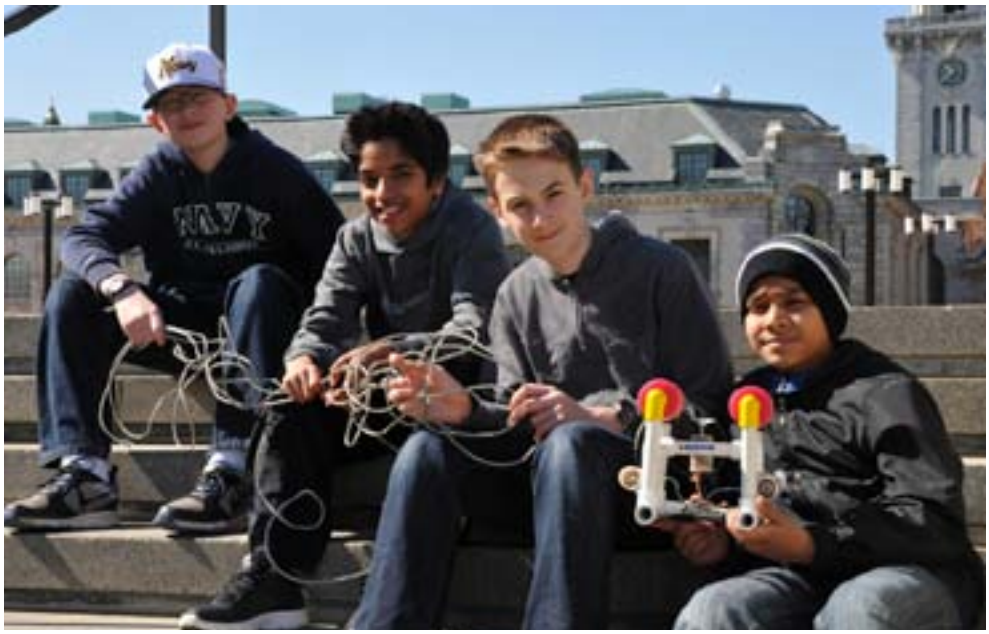
Students hone STEM skills at Maryland Regional SeaPerch Challenge

By Nicholas Malay, NSWC Carderock Division Public Affairs

Competitions like the Maryland Regional SeaPerch Challenge at the U.S. Naval Academy help students begin to understand the engineering design process and become aware of possible careers with a science, technology, engineering and math (STEM) focus, said Toby Ratcliffe, an ocean engineer and the Naval Surface Warfare Center, Carderock Division (NSWCCD) STEM educational outreach coordinator.

The district-wide one-day challenge, sponsored by the Naval Academy and held at Rickover Hall's hydro lab tow tanks April 5, was an opportunity for middle and high school students to maneuver and control their SeaPerch remotely operated vehicles (ROVs) for Academy midshipmen, who served as competition judges. The SeaPerch Program is funded by the Office of Naval Research as part of the National Naval Responsibility for Naval Engineering to jumpstart the next generation of naval and marine architects and engineers.

(From left) Megan Hui, Jade Guaio and Ariana Rivas, Team Panda eighth-graders from Montgomery County, Maryland, test their SeaPerch ROV at the Maryland Regional SeaPerch Competition in Rickover Hall at the U.S. Naval Academy, April 5 (U.S. Navy photo by Nicholas Malay/ Released).



(From left) Seventh-grade team members Nicholas Vencill, Wafeeq Iqbat, Matthew Spear and Zeeshan Anam show their SeaPerch ROV at the Maryland Regional SeaPerch Competition at the U.S. Naval Academy, April 5 (U.S. Navy photo by Nicholas Malay/Released).

"It is so encouraging to see so many SeaPerch teams from public, private and homeschool settings at this year's Maryland Regional SeaPerch Challenge," Ratcliffe said.

"The Naval Academy is a place where we educate next year's Navy leaders and our next generation of engineers to be a part of the Navy mission," said mechanical engineering professor and event coordinator Dr. Angela Moran. "Science and engineering is certainly important for tomorrow and very important to the Navy. We engage more than 15,000 students each year through our STEM outreach programs. The Academy has taken it as part of their mission to incorporate STEM activities and to involve as many midshipmen as possible in that process."

The SeaPerch program curriculum teaches students principles such as buoyancy, propulsion, design, electrical water proofing, tool safety and usage and career possibilities. The Regional SeaPerch Challenge builds on what students have learned in school and in after-school clubs and takes it to the next level. The challenge fosters an end goal and rewards sportsmanship, spirit and presentation skills, as well as mastery of the concepts.

At the challenge, students were interviewed during the morning session on vehicle performance, maneuvering and recovery, innovative design, team presentations, design notebooks and team spirit.

"When I heard about STEM judges scoring my team on design and creativity I thought that I could really step out of the box for structure," said Jade Guaio an eighth-grader on Team Panda from Montgomery County, Maryland.

"STEM influences me by showing new ways to think and create new engineering ideas," said Tori Bird, an eighth-grader on Team Sparkly Unicorn from Montgomery County. "The inventions created through STEM make engineering appealing to me for my future in deciding on college and my career path."

Basic ROVs were timed during the speed and maneuverability trials. The students used a remote control to drive their SeaPerch across an 8-foot tow tank and return to the other side. Throughout the challenge, the ROVs could move only under the student's own power source - the thrusters. Students were not permitted to pull on the tethers or lead the ROV by the tether. The scores were based on the fastest time to successfully complete the mission.

"I have been involved in a number of STEM outreach programs at the Academy. For me, it is a great opportunity to share the opportunities that the Navy in general and Academy in particular offer for technical education," said Wade Coffer, a junior majoring in computer engineering and an event judge. "One of the main reasons I decided to attend the Academy was the strong undergraduate engineering program. I think facilitating STEM outreach programs at the Naval Academy provides a larger picture for aspiring engineers and scientists across the region."

For more information about SeaPerch, please visit **www.seaperch.org**, where students and teachers can blog, post videos and pictures and view training video segments of the build process.

NAVSSES Holocaust Remembrance Observance

By Kate Hogarth, NAVSSES Public Affairs

"What you are going to hear this morning is the truth about what happened, and I was the one who survived," Michael Herskovitz said as Naval Ship Systems Engineering Station, Naval Surface Warfare Center Carderock Division (NAVSSES) employees settled into their seats. Over the next hour Herskovitz, author and public speaker, told the audience his story of surviving the Holocaust.

The Equal Employment Opportunity Advisory Committee (EEOAC) had the privilege of hosting Herskovitz at NAVSSES's Holocaust Remembrance Observance. This year's theme – Confronting the Holocaust: America's Response.

According to the United States Holocaust Memorial Museum's website, "This year marks the anniversaries of two seminal events in Holocaust history that raises questions about the responses of the United States to the widespread persecution and mass murder of the Jews of Europe. What can we learn today from American action and inaction in the face of the refugee crisis in the spring of 1939 and the deportation of the Hungarian Jews five years later? What are the warning signs we should look for to help prevent future genocides? What is our responsibility as a nation or as individuals when confronted with such crimes?"

Herskovitz was born in Czechoslovakia in 1929. One Saturday morning in April 1944, when Herskovitz was 15, his family awoke to the knocks of German soldiers at their door. They were taken out of their home and sent to Uzhorod ghetto and later shipped by train to Auschwitz-Birkenau.

The Herskovitz family had no idea what was going to happen to them.

Herskovitz said when they arrived at Auschwitz-Birkenau the doors to the train opened and all you could hear were, "people screaming, kids crying, dogs barking and gun shots."

Men were directed to the right when they were pushed off the train, women to the left and "undesirables" to the far left. Herskovitz was separated from his mother and three-year-old brother, but was able to stay with his father. "I was holding on to my father, I must have been tall enough or maybe looked big enough to work, they let me hold onto my father's hand," Herskovitz said.

Herskovitz and his father, along with the other men, were moved to barracks where they were told to undress. A doctor came around and inspected each prisoner. If the doctor didn't like what he saw, the prisoner would be taken away, never to be seen again. "I want you to remember that they did not have to have a reason or excuse to kill, to hit, to beat you to death," Herskovitz said.

Holocaust survivor Michael Herskovitz speaks to Naval Ship Systems Engineering Station, Naval Surface Warfare Center Carderock Division (NAVSSES) employees at the Holocaust Remembrance Observance, April 30 (U.S. Navy photo by Joseph Battista/Released).

The prisoners were given the infamous striped jackets, striped pants and shoes. As they walked out to the yard a German soldier announced, "If your clothes don't fit you, and you see someone with clothes that fit you, walk up to them and exchange."

"My clothes were big. I looked around and saw a gentleman about 20 feet away trying to button his shirt. I walked up and gave him my clothes and he gave me his. I turned around and didn't see my father, I couldn't find him," Herskovitz said.

Surrounded by German soldiers, Herskovitz could not shout his father's name. "My father, when I left his hand, that was the last time I saw him," Herskovitz said.

After six months in Auschwitz, Herskovitz was moved to two other concentration camps – Mathausen and Gunskirchen – where conditions were worse than he had ever experienced. Herskovitz spent a total of two years in Nazi concentration camps, survived malnutrition and Typhus fever.

After the war, Herskovitz reconnected with his uncle and learned that his mother, father and younger brother were killed by Nazis. Herskovitz went home to find his parent's home occupied, all his family's possessions taken. With nothing left for him in Czechoslovakia, he moved to Israel were he trained and fought as a solider.

In 1959 Herskovitz, then married, came to America. He found work at a transmission repair shop for $30 dollars a week. After two months he earned enough money to bring his family to America.

One day two men came into the transmission repair shop and offered him a job working at a gas station on City Line Avenue in Philadelphia. Every week the owners paid Herskovitz a little extra for his hard work. Eventually he earned an opportunity to buy the gas station.

After 35 years, he passed down the business to his son.

Herskovitz, one the few remaining Holocaust survivors, has been telling his story since 1994. Last year he went to 71 places to tell his story, "I go into any school, church, synagogue, wherever," Herskovitz said.

"Why do we tell their stories?" Patricia Woody, Machinery Research and Engineering Department head, asked. "By telling their stories we deny the perpetrators the ultimate victory they sought, that their victims be forgotten."

Herskovitz has written two books about his experience, "Early One Saturday Morning" and "Our Cherry Tree Still Stands."

NAVSSES engineers participate in Women's Empowerment Workshop

By Joseph Battista, NAVSSES Public Affairs

Four female engineers at Naval Ship Systems Engineering Station, Naval Surface Warfare Center Carderock Division (NAVSSES) spent a few hours speaking to local high school girls about their experience working in STEM related jobs on May 2 at the Philadelphia School District's Women's Empowerment Workshop – part of the district's 3rd Annual STEM Awareness Week.

Ashley Ferguson, Jamie Gates, Cleao Henderson, and Cara Mazzarini described their engineering journeys for students from the Philadelphia Military Academy and Mathematics, Civics and Sciences Charter School at the school district's headquarters. The workshop included a panel discussion and group mentoring breakout sessions.

According to Kendrick Davis with the School District of Philadelphia's Office of Communications, the goal of the event was to positively affect the number of female students entering and succeeding in the post-secondary STEM environment.

Cleao Henderson, with Power Transmission Branch at Naval Ship Systems Engineering Station, Naval Surface Warfare Center Carderock Division (NAVSSES) talks to students from Mathematics, Civics, and Sciences Charter School at the School District of Philadelphia's STEM Week Women's Empowerment Workshop, May 2. The goal of the event was to postively affect the number of female students entering and succeeding in the post-secondary STEM environment (U.S. Navy photo by Joseph Battista/Released).

Each NAVSSES engineer, along with Lt. Cmdr. Tiffany Scott and Lt. Jessica Fahl from the Navy Recruiting District in Philadelphia, led a breakout session with five or six students in each group. It gave participants an opportunity to actively engage each other.

"I always love speaking to the youth, especially young women, about STEM-related topics," said Henderson, from Power Transmission Branch. "When it comes to young women, I see myself at that age dreaming and envisioning who I wanted to be in the STEM world. So, it's very inspirational talking to kids and teens who see themselves becoming a professional scientist or engineer someday."

Henderson used an exercise she learned about in a training course during her breakout session. She called it STEM to STEAM: The making of the Renaissance woman. Every student received an index card with an item written on it. They were paired up and given one minute to come up with as many ideas in which their items could be combined – being as creative as possible and disregarding all rules of science.

"I wanted this exercise to show them they have the ability to think in and outside the box," Henderson said. "All that is impossible became possible for this exercise."

Ferguson, a mechanical engineer with 2S Cog/Gas Turbine Life Cycle Support Branch, took the opportunity in her session to teach the students the history of women in engineering – from a woman overseeing the design and building of the Brooklyn Bridge, to recent accomplishments in her own career. Despite the inroads of women into STEM fields, Ferguson presented a chart showing a slight decline in the number of women entering STEM occupations since 2005.

"That's why I'm here today," Ferguson said. "If I want to work with more women in engineering, I have to do things like this to encourage young women to go into this field."

Ferguson, who intended on following her long family tradition of a career in the medical field, discovered her interest in engineering when her brother convinced her to join a robotics club in high school. Henderson talked about her dream of making crayons when she was a child, which led her to pursue a degree in chemical engineering.

Although many of the students professed their desire to go into fields other than engineering – doctor, nurse, photographer, Mazzarini said she was impressed by how much direction the girls already had. She told about reluctantly going to an engineering camp one summer as what gave her the push to become an engineer.

"I never thought I would become an engineer," said Mazzarini from Sustainment and Modernization Branch. "All I ask is you give it a fair shot. You may not like it, but give it a try," she told the students during the panel discussion.

"I wanted all of them to know and understand there is nothing to fear in doing all that you set out to do," Henderson said. "I have been through my personal struggles – regretting choices I've made and saying my 'shoulda, coulda, wouldas.' I understand how it feels at times when you think you've lost your way, but my risky steps happened to be my most successful. So, I desire to encourage every young woman to make wise choices, but also allow themselves to take the daring steps in life and never fear the success awaiting in the future."

Maureen Edozie, with the Office of Grant Development and Compliance for the School District of Philadelphia, told the students that everyone needs a person in their life to look up to, and that is why the NAVSSES engineers and Navy recruiters were participating in the workshop and the school district was committed to funding the event.

When Henderson asked the students, "How do you find a mentor?" no one responded. "You have to ask people," Henderson said. "If you want someone to help you, you have to ask them."

"I thought the workshop was a great way to inspire girls to pursue STEM careers," Mazzarini said. "If it is our goal to increase the underrepresented demographics in engineering, it is absolutely essential to mentor and encourage the next generation."

Mazzarini believes the breakout sessions were important to dispelling the misconception of engineering being an unattainable goal for women.

"I could tell that the girls' idea of what it takes to be an engineer had shifted after our time together," Mazzarini said. "The discussion within our small group allowed me to connect with the girls on a personal level. They realized that a few years ago I was just like them, and if I could become an engineer – they could too."

Kids see Carderock parents in action

By Nicholas Malay, NSWC Carderock Division Public Affairs

Children of employees at Naval Surface Warfare Center, Carderock Division (NSWCCD) got the opportunity to see first-hand some of what their parents do for the U.S. Navy; explore careers at Carderock Division; and experience hands-on science, technology, engineering and math (STEM) activities with their parents during Take Our Daughters and Sons to Work Day April 24 in West Bethesda, Maryland.

"This is what we do day in and day out," said Capt. Rich Blank, Carderock Division commander, during welcoming remarks at the Maritime Technology Information Center (MTIC) auditorium. "Your parents are the ones who help the ships and submarines go to sea. They develop the early technologies and keep the ships safe and environmentally sound so that we keep our earth friendly and the seas fresh. It's a great job that they do and a very important one."

Roslynn Johnson, a Carderock Human Resources employee, watches as her granddaughter Sierra Barnes (right) and Sarah Jeffries (left) work the controls for an underwater remotely operated vehicle outside the MTIC Building in West Bethesda, Md., April 24 during Take Our Daughters and Sons to Work Day (U.S. Navy photo by Nicholas Malay/Released).

Van Lien, a mechanical engineer in the criteria and assessment branch, and her daughter, Kayla, stand beside the boat Kayla constructed during Take Our Daughters and Sons to Work Day outside the MTIC Building in West Bethesda, Md., April 24. Children were given several common household materials to make a boat with the instructions it should hold as many marbles as possible without sinking.The project was designed to demonstrate the concepts of buoyancy and gravity (U.S. Navy photo by Nicholas Malay/Released).

Children of parents who work at NAVSEA at the Washington Navy Yard were also invited to attend the annual event, which included a conversation via an audio hook-up with oceanographer Dr. Robert Ballard who found the Titanic wreck. Dr. Ballard told the audience he became interested in his career after reading "20,000 Leagues Under the Sea." He encouraged the children to study math and physics, calling the subjects "mental push-ups."

Ocean engineer and NSWCCD's Educational Outreach Coordinator Toby Ratcliffe told the more than 125 children, "If you're a young person, please ask a lot of questions today. This is a really special time, both for your moms and dads to be able to share what they do, and for you to interact with some other engineers and scientists to hear what they do."

The itinerary included tours of the Maneuvering and Seakeeping (MASK) Basin; the Friction Stir Welding Lab; the Rubber Lab; the Plastic Waste and Solid Waste Lab; the Composites Lab; the Fire Lab; and a 3-D printing demonstration.

"Coming to work with my dad showed me how everybody at Carderock supports the Navy, and the 3-D printer can make models out of thin strands of polymer into 3-D models of ships and other things like that," said 4th-grader Emma Grant, daughter of David Grant, NSWCCD program manager for propulsors. "Thank you Carderock for supporting the Navy and helping them fight the wars they fight."

The day's activities featured hands-on challenges for the children such as a calculator-controlled robot workshop, a SeaPearch Remotely Operated Vehicle (ROV) for the children to drive, and an unsinkable boat challenge outside the MTIC building. The challenges gave the children an opportunity to strengthen their problem-solving skill sets and to interact with NSWCCD subject-matter experts.

"I learned about buoyancy and gravity," said 9-year-old Kayla Lien, daughter of Carderock engineer Van Lien, at the unsinkable boat challenge, where children made boats out of common household items such as tinfoil, straws and styrofoam peanuts. "Gravity pushes down and buoyancy pushes up."

The Naval Surface Warfare Center, Carderock Division has a broad outreach program goal to increase youth awareness and understanding of careers in STEM and to bolster interest of today's youth for the future maritime industry.

Fourth-grader Emma Grant, daughter of David Grant, NSWCCD program manager for propulsors, carefully analyzes the additive manufacturing process right before her eyes at the Take Our Daughters and Sons to Work Day event in the Survivability, Structures and Materials Department's Annapolis Room, April 24 (U.S. Navy photo by Nicholas Malay/Released).

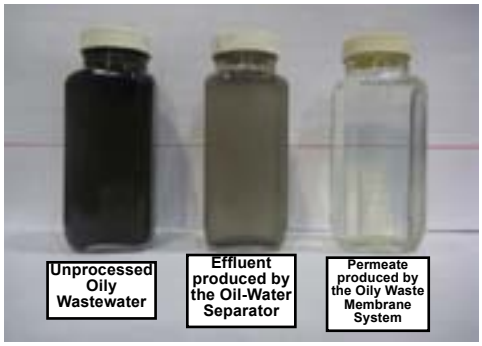
Chemical regeneration procedure tested on CVN 77 saves equipment, reduces costs

By Nicholas Malay, NSWC Carderock Division Public Affairs

A team of engineers and scientists at Naval Surface Warfare Center, Carderock Division (NSWCCD) has developed a novel regeneration procedure to remove oily waste foulants from ceramic membranes used in oily waste membrane systems (OWMS) on ships – decreasing the number of times the membranes need to be replaced and saving the Navy procurement costs and future maintenance costs.

The regeneration procedure was tested and found successful on the 50 gallons-per-minute (GPM) OWMS aboard USS George H.W. Bush (CVN 77) in April during broader efforts to repair and recertify the ship's oil pollution abatement system prior to and during the ship's Fiscal Year 2014 deployment.

Thomas White, NSWCCD senior project engineer, led the oil pollution abatement system effort, while Lead Engineer Syed Shamim performed the chemical regeneration procedure on the OWMS. Both engineers work in Carderock's Environmental Quality Division.



The permeate produced by the oily waste membrane system is cleaner than the effluent produced by the Oil-Water Separator as demonstrated by the visibility of the red line behind the samples shown. The OWMS can produce permeate that meets the 15-ppm legal discharge limit in accordance with OPNAVINST 5090.1D.

"The Environmental Quality Division at Carderock has chemically restored the hydraulic performance of the oily waster membrane system's 15 ceramic membranes to levels experienced by new, clean membranes, enabling them to postpone the requirement for membrane replacement," Shamim said.

The oily waste membrane system uses ceramic membranes to clean and separate water (permeate) from oily wastewater. The membranes have small molecular openings in their walls (pores), which allow particles less than five nanometers (such as water molecules) to pass through. The molecules of foulants (such as oil molecules) in the oily wastewater are typically larger than these pores and are prevented from passing. However, these foulants can clog the pores over time and restrict membrane throughput, a condition known as fouling.

The oily waste membrane systems membranes are considered fouled and in need of maintenance when the permeate flow rate has decreased to less than half of the system's maximum rated flow rate for processing oily waste water, along with declines in the system's other hydraulic parameters. The fleet has typically replaced the membranes when this occurs. The oily waste membrane system aboard CNV 77 had 15 ceramic membranes that were believed to have been fouled and required replacement.

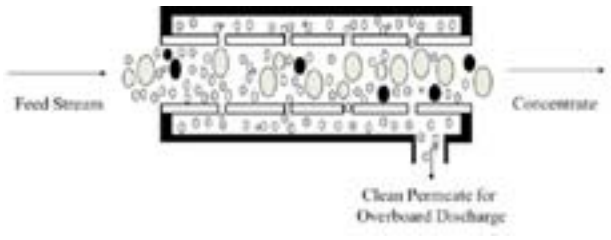
Pictured is a 50 gallons-per-minute oily waste membrane system (OWMS) aboard the USS Iwo Jima (LHD 7).The OWMS uses ceramic membranes to clean and separate high-quality water (permeate) from oily wastewater (U.S. Navy photo/Released).

To reduce costs, Shamim, along with other engineers and scientists in the Environmental Quality Division, developed a novel regeneration procedure to chemically recover the membranes' hydraulic performance. Regeneration accomplishes this goal through the use of an alkaline chemical cleaner that removes foulants from the membranes' pores. The alkaline cleaner's efficacy was successfully demonstrated in a previous laboratory evaluation conducted by the Environmental Quality Division. Regeneration has the potential to save significant costs for the Navy during a ship's life cycle by decreasing the number of times the membranes need to be replaced.

Subsequent operational tests were performed on the oily waste membrane system aboard CVN 77 after regeneration. These tests indicated the hydraulic performance to be restored. Among the OWMS's hydraulic parameters, the permeate flow rate was restored to the OWMS's maximum rated flow. The performance of the novel regeneration procedure has extended the life of the OWMS's membranes and postponed membrane replacement.

This effort represented an estimated cost avoidance of more than $285,000 in membrane procurement costs for the Navy on the CVN 77. The Environmental Quality Division also trained approximately 75 members of ship's force on the operation, maintenance and troubleshooting of the OWMS and on policy and regulations governed by OPNAVINST 5090.1D, DOD Regulation 4715.6, and NAVSEAINST 9593.2A. The training was attended by officers and enlisted personnel. The enlisted personnel also received hands-on training on operating the OWMS with CVN 77's oil pollution abatement treatment system.

"We are pleased that we could have a positive impact on CVN 77's ability to process wastewater during their deployment while also helping to protect the environment," said NSWCCD Wastewater Management Branch Head Stephan Verosto. "The Environmental Quality Division will continue to work on improvements not only on the treatment systems themselves, but also on the maintenance procedures that are used on our wastewater systems, including the novel regeneration procedure used aboard CVN 77."



The membranes in the oily waster membrane system physically separate oil (concentrate) and permeate.

Weinblum Lecture held at Carderock Division

By Nicholas Malay, NSWC Carderock Division Public Affairs

NSWCCD keynote speaker, Emilio F. Campana who has been conducting research in numerical methods for hydrodynamics and design optimization for more than 20 years and in 2011 was appointed Director of INSEAN-CNR delivered an international lectureship established to honor individuals who exemplify the spirits and ideals of George P. Weinblum in the Taylor Room May 2 (U.S. Navy photo by Nicholas Malay/Released).

Naval Surface Warfare Center, Carderock Division (NSWCCD) held an international lecturership established to honor individuals who exemplify the spirits and ideals of Georg P. Weinblum in the Taylor Room May 2.

NSWCCD keynote speaker Emilio F. Campana received the honors degree in Mechanical Engineering (1984) and the PhD on Theoretical and Applied Mechanics at the University of Rome "La Sapienza" (1991). After two years at the IBM-ECSEC (IBM - European Centre for Scientific and Engineering Computing) he joined the Italian National Maritime Research Centre (INSEAN), now part of the National Research Council of Italy (CNR).

Campana has been conducting research in numerical methods for hydrodynamics and design optimization for more than 20 years and in 2011 was appointed Director of INSEAN-CNR. He is the author of about 140 papers and publications in naval hydrodynamics, and his most recent research topic is the development of algorithmic tools for simulation based design, using multidisciplinary and robust design optimization approaches. He is the recipient of the American Bureau of Shipping award for the best technical paper presented at the 2009 U.S. Society of Naval Architects and Marine Engineers (SNAME) annual meeting, the 2012 NATO (Research and Technology Organization) - Scientific Achievement Award and in 2013 was appointed "George Weinblum Memorial Lecturer" jointly from the German Institut für Schiffbau (Hamburg University), the SNAME and the Naval Studies Board of the National Research Council (USA).

Inaugurated in 1978 by a group of German and American scientists and friends of the late Georg Weinblum, the Memorial Lecture is presented each year by an internationally recognized authority and is sponsored in Germany by Institut fur Schiffbau of the University of Hamburg and in the United States by the Society of Naval Architects and Marine Engineers and the Naval Studies Board of the National Research Council. The lecturers are chosen by a selection committee representing the Institut fur Schiffbau, the Fachausshuss Schiffhydrodynamik der Schiffbautechnischen Gesellschaft, and the Journal of Ship Research Committee and Analytical Ship Wave Relation Panel (H-5) of the SNAME. The lectures are offered for publication in the Journal of Ship Research or Schiffstechnik.

NSWCCD keynote speaker, Emilio F. Campana delivered an international lectureship established to honor individuals who exemplify the spirits and ideals of Georg P. Weinblum in the Taylor Room May 2 (U.S. Navy photo by Nicholas Malay/Released).

Georg Weinblum began his lifelong work on ship hydrodynamics as a student in St. Petersburg, Germany. He completed his studies in Danzig, Germany and in 1921 he joined the Technical University of Berlin, where he became a professor and worked part of the time at the Preussiche Versuchsanstalt fur Wasserbau und Schiffbau. He left in 1938 to become a director of a firm engaged in the development of hydrofoil boats. In 1943 he became a professor of naval architecture at the Technical University of Danzig.

After the war he worked for the British Admiralty for a year, and from 1948-1952 he worked at the David Taylor Model Basin in the United States. In 1952 he became director of the Institut fur Schiffbau at the University of Hamburg, where he worked for the rebirth of German research and education in naval architecture. At the same time he was a professor at the Technical University of Hanover.

Georg Weinblum's important scientific contributions covered several aspects of ship hydrodynamics: wave-resistance theory, maneuvering, ship motions, and hydrofoils. Throughout his work he exploited theory to discover what useful information it could give for ship design.

This began with an investigation of ships of minimum wave resistance for his doctoral dissertation in 1929 and an early recognition of the importance of analytical representations of ship hulls. In other pioneering research he correctly stressed the importance of considering hydrodynamic, in addition to hydrostatic, forces when evaluating ship motions in a seaway.

The lecture is given in Europe and in the U.S. by invitation from the selection committee.

NSWCCD West Bethesda Earth Day spotlights environmental protection and conservation

By NSWC Carderock Division Public Affairs

Naval Surface Warfare Center, Carderock Division (NSWCCD) celebrated Earth Day April 22 with events across the West Bethesda campus that focused on reminding employees of their role in environmental protection and conservation.

"As Navy employees, we plan and monitor our actions to ensure we comply with environmental regulations, and we implement pollution prevention strategies in all aspects of our business," said Joe Barger, head of NSWCCD's Environmental Branch, which organized the day's events along with Naval Facilities Engineering Command (NAVFAC) Environmental staff. "Earth Day is an opportunity to focus not only on what we do for the Navy, but what we can do as citizens to protect our natural resources, which enrich our lives every day of the year."

The day-long celebration started with a natural resources walking tour around the base, which highlighted the cultural and historical aspects at Carderock, including the flora and fauna that coexist with Carderock's operations and some of the actions taken to protect them. Division Commander Capt. Rich Blank led a "fun run" inside the base perimeter, and several food trucks were set up outside the Maritime Technical Information Center (MTIC) to encourage employees to stay on base for lunch rather than drive off campus. Representatives from NSWCCD, NAVFAC, the National Marine Fisheries Service and Montgomery County Recycling set up displays inside the MTIC about environmental protection, and were available to answer employees' questions.

Volunteer activities included removing sections of invasive species (climbing vines) from trees near one of the base's storm water management ponds. The invasive species, if uncontrolled, can damage and even kill healthy trees. Additionally, goose repellant materials were installed around the pond to reduce excessive nutrient content in the storm water from the pond.

"A lot of work went into making this Earth Day successful," said Mike Phillips of the Environmental Branch who helped plan the day's events. "Thank you to everyone who volunteered and who turned out for our activities."

Carderock Division Commander Capt. Rich Blank (front, right) and Carderock employees cool down after a "Fun Run" around base in West Bethesda, Md., April 22. The run was part of several activities planned by the Environmental Branch for Earth Day (U.S. Navy photo by Nicholas Malay/Released).

NSWCCD-West Bethesda employees take time for a lunch break April 22 at one of the food trucks on base for Earth Day. Events planned by the Environmental Branch also included informational displays inside Building 40, a fun run, nature walk and volunteer events (U.S. Navy photo by Nicholas Malay/Released).

NSWCCD engineers awarded 2013 CREATE-SH BEST PAPER AWARD from HPCMO

By Nicholas Malay, NSWC Carderock Division Public Affairs

An article authored by Naval Surface Warfare Center Carderock Division's (NSWCCD)'s Hull Response and Protection Branch and Dr. Thomas Moyer of the Survivability, Structures and Materials Department, entitled "Prediction of the Sandia Fracture Challenge Using a Shear Modified Porous Plasticity Model," was awarded the 2013 CREATE Ships Outstanding Paper award from the High Performance Computing Modernization Office (HPCMO) during the annual CREATE Program Annual Developers meeting held March 18-19.

The article was co-authored by Dr. Ken Nahshon, Michael Miraglia, Jamie Cruce, Raymond DeFrese of the Hull Response and Protection Branch, and Dr. Thomas Moyer of Survivability, Structures and Materials Department under funding from both the CREATE Ships (CREATE-SH) program and the ONR Structural Reliability Program.

The CREATE-SH project, part of the HPCMPO CREATE Program, is a 6.3 research and development program tasked to develop a suite of ship design and analysis tools for specific technical applications utilizing High Performance Computing (HPC) resources. These resources allow for the introduction of more complex physics into the ship design cycle so that reduced cost and acquisition risk can be achieved.

Each year the CREATE-SH project selects for award a peer reviewed publication that has made outstanding use of both CREATE-SH tools and HPC resources. The submissions are reviewed by the CREATE Product Leads Dr. Douglass Post, chief scientist of the DoD High Performance Computing Modernization Program, and subject matter experts chosen by Dr. Post. The review panel chooses the paper based on technical merit, technical value to the DoD acquisition community and use of CREATE developments. This year the article by Dr. Nahshon and co-workers that describes numerical predictions of ductile fracture performed for the Sandia Fracture Challenge (SFC) was selected for the award.

The article, which appears in a special issue of International Journal of Fracture devoted to the Sandia Fracture Challenge (SFC), describes numerical predictions of ductile fracture that were performed as NSWCCD's submission to the SFC. The SFC was a challenge issued by Sandia National Labs to the solid mechanics research community to predict, in a blind manner, the deformation and fracture behavior of a unique steel specimen with arbitrarily placed holes loaded in tension. Participation was open and included 14 separate industry and academic teams from institutions including NASA, Sandia National Labs, Halliburton, MIT, The University of Texas, University of Illinois, Northwestern University, and Cornell University.

NSWCCD's SFC predictions, which were among the most successful, were performed using the Navy Enhanced Sierra Mechanics (NESM) software suite along with an advanced void-mechanics based material model developed as part of Dr. Nahshon's dissertation under an ONR Multi-University Research Initiative. NESM, jointly developed by NSWCCD and Sandia National Labs under NSWCCD Senior Scientist Dr. Moyer's leadership, is the CREATE-SH product for predicting ship structural response to weapons effects.

NSWCCD's participation in the SFC allowed them to highlight the technical capabilities at NSWCCD to the external research community and generate increased confidence in the use of a fracture-prediction methodology that is continually applied to the evaluation of ship protective systems subjected to weapons effects loads. Dr. Nahshon said, "While the specimen design appears deceivingly simple, blindly predicting the fracture behavior of such a specimen is a fundamental test of the modeling techniques, mathematical assumptions, and analyst experience and practice that we employ on a daily basis in performing calculations of structural performance under weapons effects loads."

Figure 1: Comparison between experimental and numerically simulated profiles of tension test coupons used for model calibration.

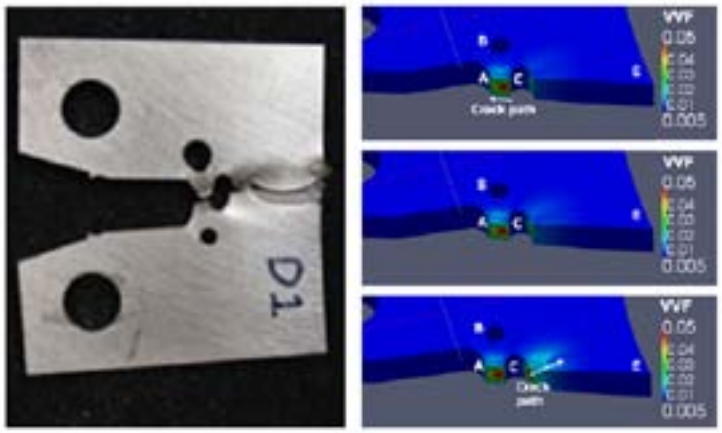


Figure 2. Example of Sandia Fracture Challenge coupon fracture pattern (Left) and blind numerical predictions illustrating correct prediction of fracture path (Right).

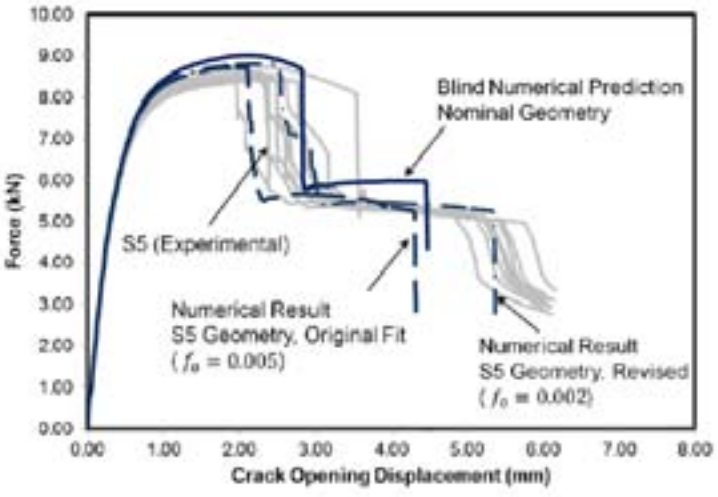


Figure 3. Response of Sandia Fracture Challenge coupon tests and corresponding numerical predictions computed using both nominal and out-of-tolerance as-machined geometry.

NSWC Carderock Division bolsters STEM outreach through LEGO Robotics

By Nicholas Malay, NSWC Carderock Division Public Affairs

Student teams from six local elementary and middle schools tested their science, technology, engineering and math (STEM) skills during a natural-disasters themed LEGO robotics competition at Naval Surface Warfare Center, Carderock Division on May 2.

Carderock employees, who have mentored the students throughout the year, supported the event by judging presentations, serving as referees for the LEGO challenges and providing technical expertise to the aspiring young scientists and engineers.

"For many students, we are the first scientists or engineers they have ever met," said NSWCCD mechanical engineer and LEGO outreach lead Jonathan Hopkins. "This program is an excellent vehicle to show them applications for STEM and how they translate into careers."

"It was very impressive to watch the focus and energy that the students put into their projects," said NSWCCD mechanical engineer Yared Amanuel, an event judge and mentor. "The kids were given the challenge details ahead of time, and they really worked well together to design their robots and polish their presentations."

This 2nd annual NSWCCD sponsored competition is modeled after the FIRST LEGO League international robotics program, which occurs in the fall. Teams of 10 can be formed from schools, a group of friends, clubs or organizations. Each group has an adult mentor and students range in age from 9-16 years old.

"Our goal in the LEGO competition is to give kids hands-on opportunities to get them excited about STEM careers, particularly with the U.S. Navy," said Nathan Hagan, a naval architect at NSWCCD and a LEGO mentor and event coordinator with Jonathan Hopkins, an NSWCCD mechanical engineer.

Nathan Greenidge (left) and Kevin Shan (middle) collaborate with Nathan Hagan, NSWCCD naval architect, mentor and NSWCCD LEGO robotics event coordinator for the natural-disasters themed LEGO robotics competition in the Maritime Technology Information Center in West Bethesda, Md., May 2 (U.S. Navy photo by Nicholas Malay/Released).

"As someone who visited Carderock in high school, the visit changed my world and confirmed my interest in becoming a naval architect," Hagan said. "I hope to see kids here at Carderock after they graduate from college, because I was once in their shoes, and now I couldn't be prouder to call Carderock my home."

Toby Ratcliffe, an ocean engineer and NSWCCD's educational outreach coordinator, welcomed the students to Carderock. Division Commander Capt. Rich Blank gave an overview presentation to the students, who also were given tours of several of the base's facilities and labs.

Approximately 120 students from Wood Middle School in Rockville, Maryland; Argyle Middle School from Silver Spring, Maryland; Eagle Ridge Middle School in Ashburn, Virginia; Pyle Middle School in Bethesda, Maryland; Burning Tree Elementary School in Bethesda, Maryland; and Forest Edge Elementary School in Reston, Virginia took part in the competition.

NSWC Carderock Division is a full-spectrum research and development, test and evaluation, engineering and fleet-support organization for the Navy's ships, submarines, military watercraft, and unmanned vehicles. Carderock employs a large number of scientists and engineers and has a robust outreach program goal to collaborate with local schools to expand students' and teachers' awareness and understanding of STEM careers.

NSWCCD Commander Capt. Rich Blank delivers the opening remarks at the LEGO competition in the Maritime Technology Information Center, May 2. He shed light on how Carderock employs a large number of scientists and engineers and has a robust outreach program goal to collaborate with local schools to expand students' and teachers' awareness and understanding of STEM careers (U.S. Navy photo by James Contreras/ Released).

Elementary school students Kevin Shan (left) and Nathan Greenidge collaborate during the natural-disasters themed LEGO robotics competition in the Maritime Technology Information Center in West Bethesda, Md., May 2 (U.S. Navy photo by Nicholas Malay/ Released).