



NAVAL POSTGRADUATE SCHOOL

IN REVIEW

MAGAZINE

SUMMER 2018

GAME ON

From wargaming to virtual reality to serious games, NPS is helping the Navy, DOD utilize concepts of play to advance the mission in more ways than ever.

INSIDE:

NPS Inducts Tighe Into University Hall of Fame

University Librarian Leaves a Legacy of Change

Bowman Scholar's CubeSat Research Gets a Boost from NPS

PRESIDENT'S MESSAGE



Ronald A. Route
Vice Adm., U.S. Navy (Ret.)
President, Naval Postgraduate School

“What also continues to this day is an evolved portfolio of educational programs and curricula, supported by relevant, advanced research, not just in the field of virtual reality, but in a broad base of concepts that capitalize on gamification.”

While it may seem like good, old-fashioned fun, the powerful impact of gaming has extended well beyond the massive commercial success of consoles and Fortnite Battle Royale, or whatever craze of the year happens to be captivating the youth of the world.

Virtual reality (VR), serious games, and wargaming are not new concepts or activities, but the means by which they are employed by the Navy and DOD continues to evolve and expand. In fact, a recent piece in U.S. News and World Report noted that DOD investments in virtual reality training could exceed \$11 billion by 2022.

Globally, VR is on a staggering growth curve. According to a 2017 report by Greenlight Insights, what was a \$7 billion industry in 2017 is estimated to be a \$75 billion industry by 2021, and a significant portion of that future growth will be in training and simulation.

Here at the Naval Postgraduate School, we literally began on the ground floor of virtual reality. More than three decades ago, students and faculty in the university's computer science department began developing innovative simulations and virtual environments. In fact, one of our first VR theses on record is the student-developed FOG-M anti-tank missile virtual simulator, developed in 1986.

Over the next several years, NPS developed a robust capability in virtual environments and simulation, creating the educational curriculum to support a cadre of military professionals well-versed in this burgeoning field. By the turn of the millennium, NPS developers were on par with the best in the world, and the proof came in 2002 with the release of America's Army, an NPS-developed combat-simulation recruiting game that has since become one of the most successful online games ever, with several million users and development across multiple platforms that continues to this day.

What also continues to this day is an evolved portfolio of educational programs and curricula, supported by relevant, advanced research, not just in the field of virtual reality, but in a broad base of concepts that capitalize on gamification, or the application of gaming principles to better accomplish something else, such as learning, training or advancing productivity.

In the realm of 'serious games' – or games developed for a purpose other than just entertainment – NPS has a near equally impressive history of achievement that continues to pay dividends. In fact, one of the university's counter-terrorism games, Dark Networks, was honored with a silver award in the 2018 Serious Play competition. And our long-standing wargaming program continues to provide students with a foundational education in table top gaming applications, directly applied to some of the DOD's most vexing security challenges.

Throughout this issue of In Review, we introduce you to NPS' robust history, current programs and advanced student research in the world of gamification. While these concepts may sound like fun, they are indeed preparing the warfighter of the future, for the future.

Ronald A. Route



10 University Librarian Leads an Era of Change for Dudley Knox Library

University Librarian Eleanor Uhlinger and her team look back at the past 12 years, transforming Dudley Knox Library into a vibrant hub of teaching and learning for the university's faculty and students.



12 GAME ON: Virtual Reality

From the early days of America's Army to current applications in augmented reality and synthetic training, NPS' Modeling, Virtual Environments and Simulation (MOVES) Institute has been a pioneer in VR for the Navy, DOD for more than 30 years.



14 GAME ON: Serious Games

Through their master's thesis, two NPS graduates helped bridge a training gap in military cyber operations by designing and developing CyberWar 2025, a computer-based strategy wargame which challenges players to navigate through the core concepts of operations in the cyber realm.



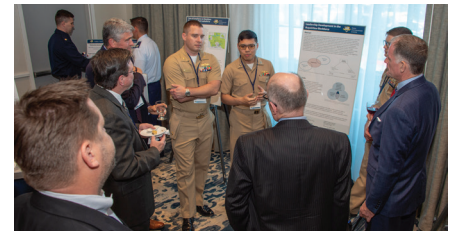
16 GAME ON: Wargaming

Decades of instruction into the craft of wargaming at NPS have evolved into a dedicated course in Wargaming Applications, where student teams rigorously design, develop and execute games for DOD sponsors that provide analytic input into the nation's most pressing security issues.



20 NPS Students Put Their Research to the Test in Impossible City

Systems Engineering students are taking advantage of the nearby Military Operations in Urban Terrain (MOUT) facility on the former Ft. Ord, to test and evaluate their research in ad hoc networking with unmanned systems.



25 Acquisition Professionals Return to Monterey for Annual Symposium

NPS held its 15th annual Acquisition Research Symposium, May 9-10, 2018, bringing together leading defense acquisition experts from across the nation to exchange ideas, and to benefit from NPS student-led acquisition research.

4 University News

7 Faculty Showcase

18 Bowman Scholar's USNA CubeSat Research Gets Help from NPS

21 Annual NRWG Connects Navy's Issues to NPS Researchers

22 NPS Lecture Series Offers Students Access to Our Nation's Top Minds

24 NPS Physics Professor's Patent Could Have Significant Applications in Treatment of Cancer

26 NPS Inducts Newest Member into Esteemed Hall of Fame

IN REVIEW

President
Ronald A. Route
Vice Admiral (Ret.), U.S. Navy

Provost
Dr. Steve Lerman

**Director of Communications
In Review Managing Editor**
Dale Kuska / dmkuska@nps.edu

Graphics Designer
Andre Adams

Contributing Writers / Photographers
MC2 Brian Abel, Javier Chagoya, MC2 Patrick Dionne, MC2 Michael Ehrlich, Dale M. Kuska, MC2 Nathan Serpico, Matthew Schehl



Naval Postgraduate School
1 University Circle
Monterey, CA 93943
(831) 656-1068 / pao@nps.edu

**Published by the
Public Affairs Office**

On The Cover

U.S. Marine Corps Capt. Jennie Bellonio, a student in NPS' Information Systems and Technology curriculum, sports virtual reality gear from the university's MOVES Institute. Thanks to decades of continued research and study in relevant fields, the Naval Postgraduate School boasts robust programs in serious gaming, virtual reality and simulation, and wargaming, providing an invaluable resource for the DOD to capitalize on advancing the mission through concepts of play.

For more information about the Naval Postgraduate School, visit NPS on the web at www.nps.edu. For free subscription information or to submit your comments or suggestions on "In Review" magazine, contact dmkuska@nps.edu.

JIFX Proves Perfect Sandbox for Marine Corps' Latest UAS

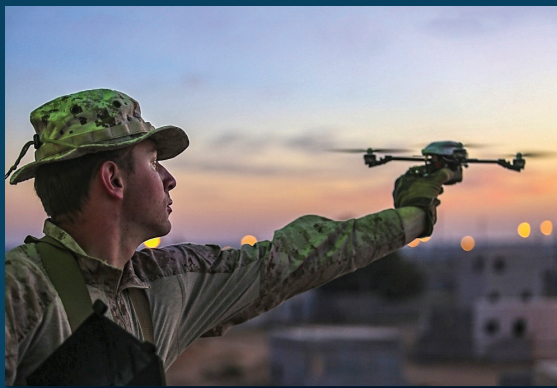
Since 2002, NPS' quarterly Joint Interagency Field Experimentation (JIFX) program, and its predecessors, have brought together leading minds from academia, industry and the military to explore new technologies, and new ways existing technologies might prove beneficial in other applications ... often with surprising results.

"We like to think of this event as a tech-oriented 'Burning Man' for government," said Dr. Ray Buettner, JIFX director and associate professor of Information Sciences at NPS. "It's a collaborative learning environment with minimal rules where producers can get direct feedback from their consumers."

JIFX is not about acquisition, Buettner emphasized. Rather, the event offers a chance to sandbox these systems in a pseudo operational field environment at Camp

Roberts, an austere California National Guard base in central California.

The Marine Corps' effort to outfit infantry squads with portable, organic surveillance capabilities as part of its "Quads for Squads" program is a perfect example of exactly what JIFX intends to do.



Years back, InstantEye Robotics field tested its quadrotor, unmanned aerial vehicle (UAV) at a previous JIFX event, and got the kind of user feedback they needed to further develop the system. Flash forward a few years, and the Corps just placed an order for 800 more of these systems as a lightweight, low-cost intelligence, surveillance and reconnaissance (ISR) solution.

MOU Provides New Opportunities for Army Acquisitions

A Memorandum of Understanding signed in May 2018 between NPS President retired Vice Adm. Ronald A. Route and Lt. Gen. Paul Ostrowski, director of the Army Acquisition Corps, establishes two new NPS master's programs in systems management for Army civilians and officers, providing this community of potential NPS students greater exposure and training across multiple career fields and domains.

"There are very few accredited institutions that can provide Department of Defense (DOD) experience via the practitioner faculty that NPS has; they've worked inside the DOD system and understand the pitfalls," said Craig Spisak, Army Director of Acquisition Career Management. "It's their faculty's operational relevance that sets NPS apart and makes it unique."

The new interdisciplinary



NPS Senior Lecturer John Dillard, right, and Craig Spisak, Army Director of Acquisition Career Management, hold the MOU recently signed by their respective institutions establishing two new NPS curricula in systems and program management for Army acquisitions officers and civilians.

master of science degrees will expand the technical knowledge and skills beyond the currently available MBA program at NPS.

Beginning this summer, the first-designated curriculum 522 will train Army officers with non-technical backgrounds to manage and lead acquisition programs for complex combat systems and to work with DOD suppliers through contracts.

The second curriculum 722 will teach Army civilians the finer points of the systems engineering process, from establishing system requirements through testing and evaluation, and how to manage, schedule and budget programs.

"The true power that NPS can provide is that it brings operational relevance to this education," Spisak added. "You

can send anybody anywhere for a systems engineering degree or an MBA – there are great institutions all over the world – but there are very few places that can provide real-world operational experience via practitioners that have walked in the shoes you will be walking in as an acquisition professional."

The six-quarter curriculum 522 course of study will lead to a Master of Science in Systems Engineering Management, as well as Level III certification in program management, engineering and contracting.

Students in the eight-quarter curriculum 722 program will earn a Master of Science in Systems and Program Management, including certification in Level III program management, engineering as well as test and evaluation; Level II production, quality and manufacturing; and Level I life cycle logistics.

Marine Corps Students Share Their Big Ideas During Latest BIX

Students, staff and faculty packed NPS' Glasgow Hall for the latest Big Ideas Exchange (BIX), May 22. A departure from the typical BIX format, the latest event served as a forum for NPS students, six Marine Corps officers, to share their thesis research in an effort to promote awareness, receive feedback, and offer their own solutions to the grand challenges facing American national security.

Senior Marine Corps Representative and Associate Dean of Research Col. Todd Lyons kicked off the exchange that would go on to see the six students give de-



tailed, 10-15 minute presentations on their individual research topics.

"This format demonstrates not only what they have learned in their education here, but also the research they can deliver in terms of value back to the Marine Corps," said Lyons. "The vast majority of the Marine Corps does not come to NPS, and they don't know what our students can do ... This was a great way of showcasing that."

The speakers for the event included Capt. Andrea Witt, who spoke on high-altitude balloons and small satellites for space resilience. Also presenting was Capt. Matthew Audette, who spoke on counter swarm operations, and Capt. Adrian Felder, who spoke on revolutionizing tactical networks with free space optics. Capt. Anthony Vanderzee presented on predicting the spread of terrorist organizations; Capt. Caleb Wu spoke on wireless sensor networks for tactical ground defense; and finally, Maj. Andrew Reaves spoke on Marine Corps exercises in the Baltic.

"This is the first Big Ideas Exchange that we have done where the students are center stage and the feedback they received was that it was pertinent to what the students in the audience were studying," added Lyons. "In the long term, this will help students think about how their research can take advantage of what has already been done and build a continuum of research, instead of a one-off thesis."

Internship Program Offers Students Invaluable Industry Experience

A new program launched by NPS' Dean of Students office is providing university students with an invaluable experience with leading industry and technology companies. Coined the NPS Industry Internship Program, the effort has sent two small cohorts of students on internships to date, and is growing quickly.

"The Department of Defense is very interested in better un-

derstanding how the private sector operates and how the DOD can leverage the innovation that is occurring across industry," said then NPS Deputy Dean of Students Cmdr. Paul Rasmussen. "These internships allow students to better understand how industry interacts with the DOD and brings requirements to capabilities by complementing a specific area of the student's studies, research or development."

A recent cohort sent students to Cubic Corporation in San Diego, Creare LLC in Hanover, New Hampshire, and to Boeing in Saint Louis, Missouri.

"This is a unique opportunity to see firsthand how business is conducted on the other side of the table," said U.S. Air Force Capt. Stephen Flansburg prior to his internship with Creare LLC, an engineering research and development firm created in 1961. "This experience will allow me to better

»» continued on page 6

Senior IW Alumna Reviews Student Research

Rear Adm. Kathleen M. Creighton, Deputy Commander, Joint Force Headquarters-DOD Information Networks, visited the NPS campus, June 7, to meet with junior officers in the information warfare community. During her visit, Creighton took the opportunity to sit in on final project presentations for Dr. Alex Bordetsky's tactical and wireless networking class.

"The presentations and research these students have done is amazing," said Creighton. "I was so impressed with the students and how relevant what they were presenting is to military operations, whether it was a [humanitarian assistance and disaster relief] scenario or an unmanned vehicle scenario. I can very easily see its applicability to today's operations."



repurpose that to a humanitarian assistance and disaster relief scenario," he explained.

Creighton herself is a graduate of NPS, earning a Master of Science in Information Technology Management in 1997.

senior leaders of their community, and to get invaluable feedback on their efforts.

"It was great to have her sit in with us during our presentations," said Lt. Cmdr. Santhosh Shivashankar, an IW student in the Network Operations and Technology curriculum. "We're looking at using the remote, advise and assist system – which is generally used downrange with our special operations forces and ground troops – to help with host nation partnerships, guiding those troops to whatever mission target they are going to. We are trying to

« continued from page 5

understand industry's business operations, business decisions, and considerations in doing business with the government."

"The internship program will be a rewarding personal and professional experience," added Navy Lt. Michael Johnson just prior to his internship at Boeing. "This will enhance my educational experience by seeing a different side of engineering that I don't as a user of the technology."

Conrad Scholars Present Their Theses to Navy FM Leadership

As part of their selection as NPS Graduate School of Business and Public Policy Conrad Scholars, NPS students Lt. Cmdr. Matthew Lorge and Lt. Tim Whitney traveled to Washington, D.C., to provide briefs on their research to members of the Navy's Financial Management and Budget Directorate.

Lorge and Whitney's research is in direct support of the Office of the Assistant Secretary of the Navy (Financial Management and Comptroller), and their thesis topics were selected to address issues of importance to DOD's financial management community.

Lorge's thesis, "A Comparison of Acquisition Efficiency Between the U.S. and China," was based on a topic provided by NPS' Acquisition Research Program. His research examined China's substantial investments in their modern naval systems, and its role in the execution of the nation's strategic goals.

"In order to understand how successful China has been in its efforts to modernize its growing shipbuilding facilities, an understanding of its acquisition system is required," Lorge said.

He pointed to a lack of standard methods for comparing the efficiency of acquisition systems for China, or others for that matter. One of the goals of Lorge's research was to develop a framework that can be used to accomplish this, and to then apply that framework to the U.S. and China ship-building programs.

"My results have identified ten key factors that affect a country's acquisition efficiency. While the U.S. shipbuilding program outperforms China in seven of these areas, China leads in two key factors ... cost and schedule performance," he said.

Whitney's presentation highlighted his thesis, "The Impact of Direct Man-Days Executed on Submarine Maintenance Availability Delays," a topic provided by Submarine Forces Pacific Command (COMSUBPAC).

As a submariner, Whitney served more than three years on USS Pittsburgh (SSN-720) as Reactor Control Assistant, Main Propulsion Assistant and Operations Officer. He was also hand-selected to fill a department head role, a rarity as a junior officer.

"My thesis analyzed data from submarine maintenance, engineering, planning and procurement in the form of 'Autopsy Reports.' It is the second in a series of MBA projects that will aggregate into a greater COMSUBPAC research project," said Whitney.

"The purpose of this iteration of the project is to determine what factors impact 688 Class submarine maintenance costs and delays. By analyzing how the amount of direct man-days executed during an availability changes with respect to time, hull age, availability length, and operational interval length, my the-

sis establishes a way forward for follow-on analysis in the greater research project," added Whitney.

Future Ph.D. Student Earns Navy League Award

NPS student U.S. Navy Cmdr. Chris Angelopoulos has been recognized with the Spring Quarter's top academic honor, receiving the Monterey County Navy League Award for Highest Academic Achievement during the 2018 Spring Awards Ceremony in Herrmann Hall, June 5.

"This represents a lot for me personally ... I am very thankful to be nominated, and to accept the award," said Angelopoulos.

The Navy League Award is achieved through outstanding

nance Domain."

Augmented reality is an interactive experience that takes computer-generated images and incorporates them into the real world through an eyepiece. For Angelopoulos, it could be utilized to provide visual, hands-on instruction, rather than the basic instructional manual that some find to be ineffective.

"How annoying is it when you open a manual to learn how to do something and you just want to try to do it?" Angelopoulos said. "That's kind of the core of my thesis ... To look at the communication pathway between the engineer or the designer and me as a person, and try and help that communication become clearer and less error prone."



academic performance, pre-eminent thesis research, motivation and the ability to possess the qualifications of a leader.

"It was a lot of work," continued Angelopoulos, "It ended up being a lot of weekends getting in the material and just trying to incorporate it."

In addition to the Navy League Award, Angelopoulos was also acknowledged for community involvement, as well as the research performed for his thesis, "Augmented Reality in the Mainte-

Following graduation, Angelopoulos will remain at NPS, working in the university's information technology sector while he continues his education.

"I think I'm going to work in ITACS [Information Technology and Communications Services] in the cyber operations center," Angelopoulos said, "And at the same time, I will be simultaneously working on my Ph.D."

NPS Professors Honored With Navy's Distinguished Service Award



Two Naval Postgraduate School professors have received the highest honorary award bestowed on Navy civilians by the Secretary of the Navy.

Operations research (OR) professors Gerald Brown and Nita Shattuck were presented with the Navy Distinguished Civilian Service Award (DCSA) at the 86th Military Operations Research Society Symposium in King Auditorium, June 19, in recognition of their research which has had a significant impact on the naval service and the Department of Defense.

"I am so honored and humbled by this," Shattuck said. "It's a once in a lifetime kind of achievement, I never expected to receive something like this. I have a wonderful team. They're really the reason I received this because they work so hard alongside me."

For Brown, an icon in the field, this is the second DCSA for the emeritus distinguished professor. With an operations research career at NPS dating back to 1973, he is regarded as a "true giant" in the field of military operations research.

"It's gratifying to be recognized for this most-recent work," Brown said. "The DCSA is customarily awarded to select retiring senior Navy executives, so to receive this award as a less senior civilian employee – a mere academic with no

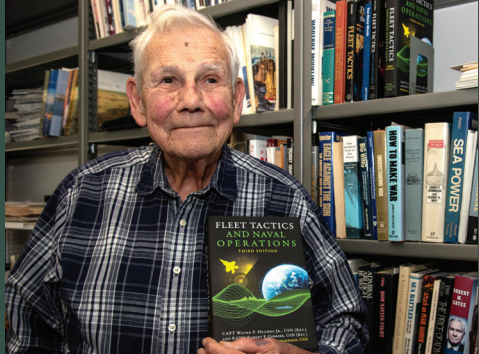
Legendary Naval Strategist Hughes Releases New Edition of Fleet Tactics

Naval Postgraduate School Dean Emeritus Wayne Hughes, renowned as a foremost authority on naval tactics, has just published a new edition of his seminal book, "Fleet Tactics and Naval Operations."

Co-authored with retired Rear Adm. Robert Girrier, and with a forward by Adm. John Richardson, Chief of Naval Operations, the new third edition traces the historical evolution of tactics, analysis and operations from the age of sail to the present, including an expanded understanding of how emerging technologies are impacting battles at sea.

"This edition emphasizes information warfare, including unmanned vehicles, cyber warfare, modern means of deception, and artificial intelligence," Hughes explained. "There is a whole new chapter on information warfare and its influence on tactics."

"Fleet Tactics" has long been considered a go-to resource for Navy officers on battle planning and tactical thinking since it was first published in 1986. Its relevance has not waned over the last four decades, and continues to be a 'wheel book' for freshly-minted junior officers and seasoned leadership alike.



"I am sure that I am not alone when I say that my copy of 'Fleet Tactics' is one of the most consulted, most dog-eared, most underlined, most marked-up books in my library," Richardson wrote in his forward. "The book filled an important void, providing an up-to-date treatise on the importance and execution of tactics in modern naval warfare."

"Wayne Hughes' 'Fleet Tactics' is one of the most widely-read books on naval warfare," added retired Navy Capt. Jeff Kline, NPS Professor of Practice in the operations research department. "This new edition maintains the foundational lessons of the first two editions, while addressing the emerging impact of cyber and robotics on naval tactics."

particular managerial responsibility – at a command far from the Pentagon is recognition of the importance and influence of the work we do at NPS."

NPS Partners With Naval Aviation to Establish Air Warfare Chair

The Naval Postgraduate School recently welcomed U.S. Navy Capt. Ed "Tick" McCabe to the university campus as its first-ever Air Warfare Chair. Much like similar warfare chair positions at the school, the NPS Air Warfare Chair will serve as a mentor to the cadre of aviator students on campus, as well as a liaison between the Naval



Aviation community, and the NPS community.

"There is a great deal of value in the critical thinking and devel-

opment that you obtain here, but historically, the aviation community has gotten little return on that value," said McCabe. "We have not

»» continued on page 8

NPS Data Science and Analytics Group Launched

The Naval Postgraduate School stood up a new interdisciplinary working group to streamline the way data science is developed, taught and shared at the university and beyond. The formation of the Data Science and Analytics Group (DSAG), announced June 22, will enable NPS faculty and students to transcend traditional academic boundaries to better provide education, research and advising across the DOD in this critical area.

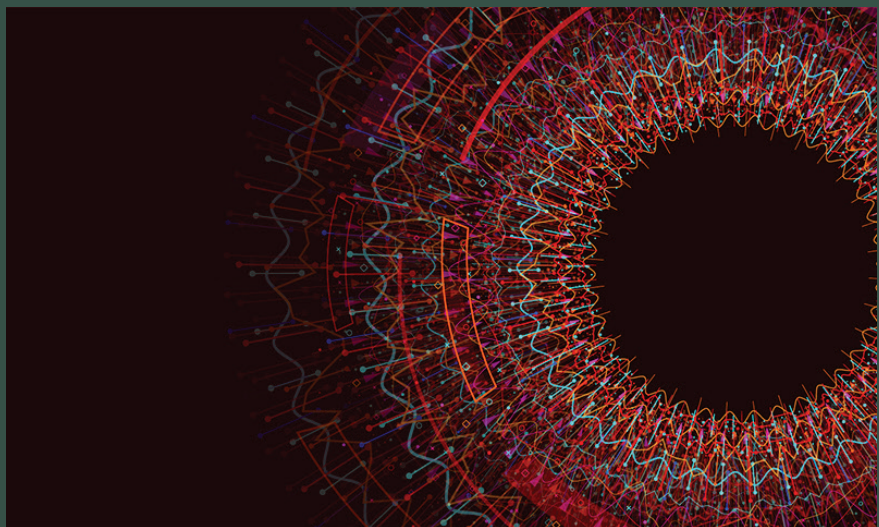
“Through the DSAG, NPS will establish itself as the thought leader, educational nexus, and primary research coordinator for data science and analytics in the DOD,” said Dr. Robert Dell, a professor in the Operations Research (OR) department tasked with leading DSAG. “There is an incredible demand for DSAG research and education.”

NPS faculty across campus have been making significant data science and analytics research contributions for many years. Since 2013, the OR department in the Graduate School of Operational and Information Sciences (GSOIS) has offered a track focused on data science, and since 2016, has added a graduate certificate in the discipline.

“We have embraced the growing demands for data science and analytics, but OR by itself is too narrow,” Dell said. “The field is truly interdisciplinary and must involve many departments.”

The founding of DSAG was introduced in NPS’ new Strategic Plan: 2018-2023, which called for the establishment of a data science working group which could organize existing data sources, provide an analytic capability to take on some of the nation’s most pressing issues, and cultivate the human capital necessary to integrate data science into future decision-making.

“Our biggest challenge will be deciding when to say ‘no,’” he said. “The demand is far greater than our initial ability to deliver, so we need to select carefully and continue to build successes that enhance our reputation.”



cracked the code of how to send an Aviator here without taking them off track for command.

“I am an exception to the rule, I continued on with a prosperous career after coming here as my first shore term as an Aviator,” McCabe continued. “And that’s what establishing an Air Warfare Chair is all about, addressing that problem so that we can send Aviators here for the valuable education that NPS provides, and still keep them on track for future leadership roles.”

The chair position was established by an agreement with the Navy’s previous “Air Boss,” now retired Vice. Adm. Mike Shoemaker.

As then Commander, Naval Air Forces, Shoemaker advocated for the position in hopes of emulating the success U.S. Naval Surface Forces had with the establishment of the Surface Warfare chair.

“We have some perplexing issues facing Naval Aviation and we have to be able to ask the right questions, because we can’t afford to be wrong. NPS gives you the critical thinking skills and insights to do that,” said McCabe. “This position will help provide great mentorship and leadership roles for the Aviators on campus, which helps provide the means for the Aviation community to send their people here and keep them on due course.”

ECE Professor Recognized with Annual Schieffelin Award

The 2018 Rear Adm. John J. Schieffelin Award for Excellence in Teaching at NPS was awarded to



FACULTY SHOWCASE

Dr. Frank Kragh, Associate Professor in the Department of Electrical and Computer Engineering.

“When you are a professor, you go into a classroom and you don’t take any of your management with you. Obviously, there are performance reviews and things like that, but it’s mainly students that you have the most interaction with,” Kragh said. “It means a lot to me to get this type of recognition from the students because it means that they feel like I am doing a great job and their opinion matters the most to me.”

Kragh got his first taste of NPS when he came here as a military instructor for the Department of Electrical and Computer Engineering in 1990. After his four-year stint at NPS, Kragh decided to take the next step in his education by becoming a research assistant and working toward his Ph.D.

After receiving his doctorate from NPS, Kragh spent several years putting his knowledge to work for the Space and Naval Warfare Systems Command (SPAWAR) in San Diego. Kragh once again found an opportunity to come back to NPS in 2003, something he had always wanted to achieve.

“I came back to the Naval Postgraduate School because I really enjoy teaching military students ... They are all very motivated and have a real need and desire for the education,” Kragh said. “I didn’t get my Ph.D. and immediately start looking to teach at a university. I only applied once I found out about an open position here because it has the military mission that is the important ingredient.”

Cyber Endeavour Tackles Future of Cyber in Military Affairs

The DOD Information Operation (IO) Center for Research at the NAVAL POSTGRADUATE SCHOOL

Naval Postgraduate School (NPS) held its annual Cyber Endeavour conference, this year hosted by the University of Texas, San Antonio on June 19-21, 2018.

Since 2011, Cyber Endeavour has been held annually, bringing together top military and civilian practitioners from across government, industry and academia to address the nexus of cyberspace and national security. The event is comprised of presentations and panel discussions that focus on a central theme, this year’s focus is cyber and the future of military affairs.

“Cyberspace is becoming more and more important to our everyday lives,” said DOD IO Center Director and NPS Professor of Defense Analysis Dr. Hy Rothstein. “Whether it’s the transmitting of information, or dealing with banks and finances, or power plants and weapons systems, they all have computers involved that link to the outside world, making them vulnerable. From the military perspective, since we are so technical, we have to be able to harden these systems and take advantage of enemy cyberspace.

“Technology is evolving so rapidly today that 2025 is as far as we can predict, so it is important to understand how cyberspace will affect the ways the military will operate, even in just a few short years from now,” he continued.

The event included detailed panel discussions on the future of global cyber operations, including a robust discussion on how cyber can support combatant commanders that was attended by several key leaders from those very same combatant commands. Industry discussions, legal and ethical issues, and more were also part of the program.

In addition to the three-day Cyber Endeavour conference, the

related Cyber X-games, an exercise involving teams simulating the protection and exploitation of networks through a variety of scenarios, was held the week prior, June 10-17.

NPS Alumnus Returns to Lead HR Center of Excellence

The Graduate School of Business and Public Policy’s Human Resources Center of Excellence (HRCOE) recently welcomed new director, Capt. George Werenskold. A 1998 NPS alumnus and seasoned Navy HR officer, Werenskold says he is looking forward to giving back to the Navy HR community through the center’s one-of-a-kind programs.

“In uniform, the HR community is not like exactly like HR in the civilian world ... We are experts in the entire process, from developing requirements of billets, in addition to the processes of recruiting, retaining, advancing, promoting, separating and retiring personnel,” explained Werenskold.

In an environment where change is frequent, with new leadership and new priorities, Werenskold says the role of the HRCOE is to ensure the Navy’s HR community is prepared.

“A lot of what NPS teaches is very valuable to the Navy in terms of doing the analysis, and therefore defending your investments,” he noted.

As Werenskold sets his sights on evolving the HRCOE curricula to meet current needs, he says he’s looking forward to continuing the efforts of his predecessors.

“There has been a long line of HR O-6’s that have had this job,” said Werenskold. “This office has only been here since around 2008, but every new director that has come in has been building and building the center and its role at NPS.

“Capt. Theresa Lewis did a fantastic job, and in handing it over to me, I know I’ve got big shoes to fill,” he continued. “I look forward to the opportunity.” **IR**





University Librarian Eleanor Uhlinger retired from her position in May of this year, leaving the award-winning Dudley Knox Library (DKL) well recognized as the heart and soul of the NPS campus. Uhlinger was presented several honors prior to her departure, including her prestigious designation as University Librarian Emerita in addition to the Navy's Superior Civilian Service Award. Uhlinger served the university for a dozen years at the helm of DKL.

University Librarian Leads an Era of Change for Dudley Knox Library

By Matthew Schehl

To step into the Dudley Knox Library (DKL) at the Naval Postgraduate School (NPS) today is to enter a busy, vibrant world. Throughout the library, students are diligently absorbed in their work; groups meet to hash out class projects; writing coaches guide students as they craft their theses; friends and faculty grab a cup of joe at Starbucks.

Retiring in May of 2018, Eleanor Uhlinger has every reason to be proud of this. Since becoming NPS' University Librarian in 2006, she and her staff have vigorously steered DKL well into the 21st century, and transformed the facility into the heart and soul of the NPS community.

"When I first walked in for my interview, all I saw were books and journals crowding the entry, and not a whole lot of students," Uhlinger recollected. "Over the past 12 years, we've spent a lot of time peeling back the books and moving very aggressively into online resources and creating lots of study spaces for students.

"We have completely retooled the library from a warehouse of books into an interactive place for teaching and learning," she added, proudly.

"The way students work now is not just going into the library, reading a book, or putting your head down and working. They work in teams, they problem-solve, they interact with a diverse group outside of their classrooms, and we've made a lot of spaces for them to do that."

Uhlinger is insistent that she accomplished none of this alone: the 'we' she refers to is her team of library staff, all working closely with faculty and students, combining their range of skills, experiences and a pervasive interest in advancing graduate education.

"There's not a lot of 'I' in her verbiage; it's really more 'we,'" said Greta Marlatt, DKL outreach and academic support manager. "Her care for the staff, her willingness to let people try to reach beyond their comfort zone and her encouragement to do so ... She always emphasized that we're team players and we need to get things done as a team, and I'll miss that."

It's a common theme amongst DKL staff. Since day one, Uhlinger set the standard for open communication, transparency and a strong

corps d'esprit, driven by an underlying desire to serve the NPS community. One of her first actions upon assuming her new duties in 2006 was to ask the staff to set up new offices with their desks facing the door, recalled Sam Hornbeck, DKL resources assistant.

"She's very open, you can walk in any time," he said. "Even if she's piled up with work, she'll say 'yep, door's open, come on in, let's talk' and she'll listen. If you have a good idea, she'll say, 'Do it. If you have any problems or need assistance, let me know.'"

Dramatic physical changes to the library soon followed. New paint and carpeting, and new mobile, collapsible book stacks that opened up large tracts of space for students to study and gather.

"We found the space for students and opened the place up to have more of an information commons approach," Marlatt recalled. "She was able to get the funding to purchase electronics and get rid of the print things nobody wanted anyway. She was aware that we needed to pay attention to the distance students and the fact that people learn differently: students need 24/7 access and not to physically have to come into the building."

Student services such as the Graduate Writing Center and the Thesis Processing Office were administratively brought under the library, and DKL increasingly became a focal point of the NPS student experience.

"Eleanor's a very forward-thinking kind of leader and really provided us with the tools and time to sort of play with those things," noted Stacy DeMatteo, DKL systems manager. "Most of what we've done is self-learned, so she gives us the time to learn whatever we need to learn in order to implement."

DeMatteo was brought in to DKL in 2011, and was tasked with exploring new ways to improve accessibility and services for users, and digitally bring DKL into the 21st Century. With Uhlinger's backing and encouragement, DeMatteo and her team implemented a very successful cloud-based suite of library search tools that brought together several different library applications: catalog systems, journals search, e-mail and others.

Another resounding success for NPS made possible by the DKL team has been the establishment of its digital content archive, Calhoun. The Calhoun Institutional Archive is a free, publicly available digital repository of every student thesis, dissertation, faculty publication, technical report and NPS research data set. Since going live in 2012, Calhoun has burgeoned into upwards of 60,000 searchable documents, dating in some cases back to 1923.

"It's become a huge success; the statistics for use are just off the map," said Irene Berry, DKL digital services librarian. "It's one of our most head-and-shoulders popular features online when we do our monthly reports of the things we offer; it's amazing to me."

"I think that was a remarkable, visionary idea to have public access to the work we're doing at NPS," she continued. "We raise the profile of what we do in providing our content to the world, for free. I don't think anybody else in the Department of Defense had done that, but that was Eleanor's idea ... We're going to get it out, we're going to hand it back to the community that paid for it."

Uhlinger's leadership has moved the library's presence and relevance forward at NPS, according to DKL reference librarian Kathy Norton.

"I feel like the library is, because of her initiative, the heart of this academic institution," she said. "She's not afraid to take on projects that she thinks will benefit the campus, the institution or the library ... Sometimes library cultures tend to be more status quo. In contrast, when you have a director like Eleanor who isn't just satisfied with the way things are, who's always looking for new ways to improve, it really stands out."

Uhlinger's success has been magnified by her ability to work within the NPS administration and culture, unique in the academic world with its blend of military, federal and civilian entities and requirements.

In recognition of DKL's seismic transformation, Uhlinger received the prestigious 2009 Federal Librarian of the Year award. From over 2,000 federal libraries worldwide, she was selected for her innovative leadership and professionalism in providing information services to the NPS community.

Now nine years later, and Uhlinger has not relented. Amongst other things, for example, she has built a design space in the library basement, where students and faculty can come to creatively experiment with new ideas. But thinking in new and exciting ways is par for the course with Uhlinger.

"We've been pretty creative," she laughed. "It really gets people thinking differently. We've got pulleys; we've got Playdoh; sometimes you can mock up a really quick prototype of something that you're thinking about, and that's the point: you've got an environment to help them design on the fly and think creatively."

Uhlinger officially stepped down May 17, and her duties were assumed by associate university librarian Edward Corrado, who serves as acting university librarian. Her departure will open up worlds of opportunities for her successor, she said, especially in enhanced learning and teaching, and data manipulation, visualization and analytics.

"I would just urge my successor to continue to make DKL an integrated part of the campus team," Uhlinger said. "We're not a school, we're not a department, but we're here for everybody and we reach out to everybody and participate as much as possible in their activities... I'd like to see my successor continue that." **IR**

"We've been pretty creative. It really gets people thinking differently. We've got pulleys; we've got Playdoh; sometimes you can mock up a really quick prototype of something that you're thinking about, and that's the point: you've got an environment to help them design on the fly and think creatively."

University Librarian Eleanor Uhlinger



GAME ON: VIRTUAL REALITY

A group of MOVES Institute faculty, students and staff don a variety of VR headsets created over the last 30 years. At center left, MOVES Institute founder Dr. Michael Zyda holds the VPL EyePhone, one of the oldest devices dating back to the early days of VR in 1989. Zyda currently runs the well-known GamePipe Laboratory at the University of Southern California.

NPS' MOVES Institute Reflects on 30 Years of VR

By Matthew Schehl

For the past 30 years, virtual reality has proven to be a foundational technology, one that has completely changed the way humans interact with machines, opening new doors and possibilities that are still being discovered to this day.

Within the DOD, the impact has been equally powerful, with VR technology fundamentally changing major functions across the department. At the forefront of this advanced technology, first coined 'virtual reality' now 30 years ago, is the Naval Postgraduate School (NPS) and its Modeling, Virtual Environments, and Simulation (MOVES) Institute, where forward-leaning faculty and dedicated students have opened countless doors to uses of VR that are now commonplace throughout the services.

NPS students and faculty have persistently pushed the boundaries of immersive technologies: 3D modeling, artificial intelligence, simulation, human-computer interaction and networking. These technologies have transformed the way the U.S. military does business across such disparate areas as virtual rifle ranges, cyber battlefields, logistics, recruitment and aircraft carrier landings.

"Simply put, virtual reality is the technology for moving through and interacting with a three-dimensional computer-generated environment," explained Dr. Mike Zyda, founder of the MOVES Institute, the group that has spearheaded NPS' contributions to the field of VR and how the DOD uses it.

"It's important to rehearse and know what's where, where you're going to do what you're going to do," Zyda added. "In the heat of battle, once the flash bang goes off, all of your cognitive functions disappear and what remains in your brain are the things that you've trained for."

NPS formally established the MOVES Institute in 2000 to bridge the military analysis work of its Operations Research department with the simulation and software development expertise of its Computer Science department. MOVES had existed as an interdisciplinary academic program since 1996, but its origins run much deeper.

In the early 1980s, NPS students began exploring the creation of 3D virtual environments and games on Silicon Graphics Iris 2400 workstations – cutting edge at the time. In 1986, two students developed a FOG-M anti-tank missile simulator as their graduate thesis. The simulator worked

brilliantly, accurately modeling the physical dynamics of the real thing.

This caught the attention of the U.S. Army, which had recently began exploring tank simulators through the Defense Advanced Research Projects Agency (DARPA). The DARPA effort yielded a system called SIMNET, which came at a hefty \$140 million a pop. In contrast, the commercially-available Iris 2400 workstations used by NPS cost \$60,000 each.

When the military adopted SIMNET in 1990, few people in the U.S. government understood how to effectively use it, and NPSNET provided a low-cost means to utilize its databases and networking formats. NPS students in the NPSNET group, which would later evolve into the MOVES program, developed hardware and built virtual simulations for a variety of platforms, including aircraft, underwater vehicles, command and control vehicles and forward observers.

“We were doing pioneering things in networking,” Zyda said.

Back then, not everyone, even on the NPS campus, was convinced that VR technology was the wave of the future. But with the backing of a three-star admiral and a guaranteed \$2 million per year to run the program, the NPS Academic Council approved the MOVES graduate degree program.

“All of a sudden, I had 40 students,” Zyda recalled. “We had a budget and took over the second floor of Spanagel Hall.”

In 1997, Zyda chaired a National Research Council study to explore the vast overlap between military simulation and commercial gaming. Their report, “Modeling and Simulation: Linking Entertainment and Defense,” fundamentally altered DOD’s use of, and attitude towards, entertainment technology in modeling and simulation systems.

This resulted in what would become a grand slam homerun for the MOVES Institute: America’s Army, a first-person shooter video game in which players engage in squad-level tactical combat, immersed in realistic, high-quality environments.

It was launched by the Army in 2002 as a free, downloadable recruiting tool and is still going strong with several million active users logging billions of hours of gameplay time.

“It’s the very first serious game that had a big impact. It became one of the top five played games online in the years that it was out and it was the most successful recruiting tool ever built by the U.S. Army,” Zyda said.

“The fact that NPS was involved in things like America’s Army was really significant because we recognized that you can immerse people to some degree. The whole idea behind America’s Army was envisioning what it would be like to be in the Army and then trying to use that kind of

environment to immerse you in a virtual reality,” said Dr. Imre Balogh, current director of the MOVES Institute.

Repurposing its engine has enabled a myriad of virtual reality training simulators, including advanced gunnery on the M1A2 Abrams, driving Mine-Resistant Ambush Protected vehicles, calling for artillery fire and conducting electronic warfare.

It’s not just the Army, though. All services are heavily investing in virtual reality-based training, such as the Navy’s Fleet Integrated Synthetic Training/Testing Facility (FIST2FAC) on Ford Island, Hawaii.

“This is the future of training for the Navy,” said Terry Allard, head of the Office of Naval Research’s Warfighter Performance Department. “With simulation, you can explore endless possibilities.”

VR also provides training opportunities that wouldn’t be possible otherwise, explained Dr. Amela Sadagic, research associate professor with the MOVES Institute. Sadagic cited the thesis work of her former student, Lt. Clay Greunke, as an example. Greunke, a Navy pilot who also served as a Landing Signal Officer (LSO), created a virtual reality training simulator for inexperienced LSOs to practice guiding in aircraft landing on carriers.

“The first time you go to the aircraft carrier, you have no idea what’s going on,” Greunke said. “Planes are going by, people are screaming, people are running across the flight deck ... You don’t know what to cross, when to cross, what you can and can’t do.”

So Greunke developed a lightweight, portable virtual reality LSO trainer kit that can be taken just about anywhere to better familiarize LSOs with flight deck operations and offer refresher training. For his work, he received an honorable mention in the 2016 Secretary of the Navy Innovation Awards. The winner was fellow NPS graduate student Lt. Brendan Geoghegan, also an advisee of Sadagic, for his thesis on using virtual reality head-mounted displays to augment ship navigation.

“The students come in with ideas and then start using those because they’re the ones who have the operational background,” Balogh said. “We enable them to understand virtual reality and they then say, ‘Oh boy, I can see how I can use this to address this particular problem in the military.’ That’s our place.

“One of the most important things we can do is bring that taught knowledge into the Navy and DOD,” Balogh continued. “We, as an entity, can get better connections to those pieces of the fleet. We won’t be able to solve all problems, but we can play the role of making sure that all the different efforts connect.” **IR**

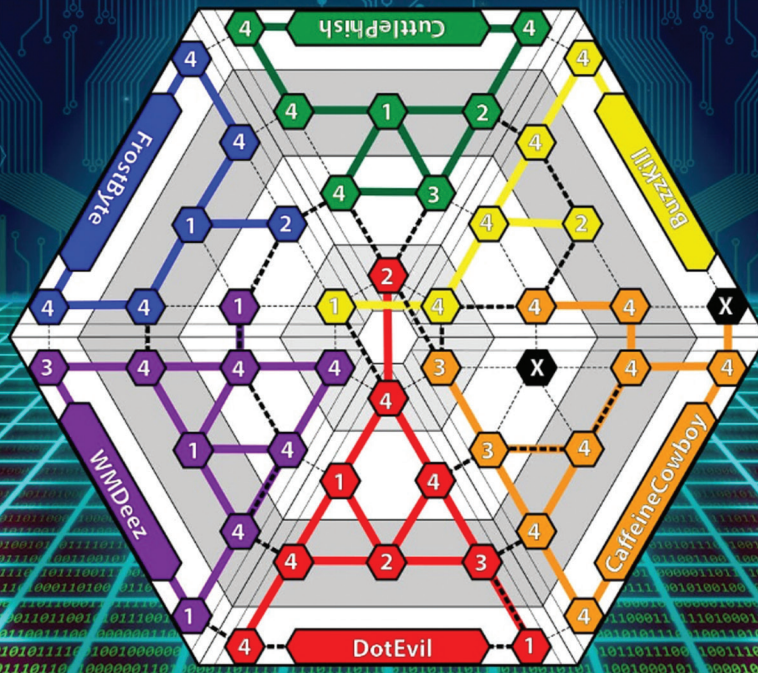
 Watch more at <https://youtu.be/ow-51qXDEp4>

“**In the heat of battle, once the flash bang goes off, all of your cognitive functions disappear and what remains in your brain are the things that you’ve trained for.**”

-Dr. Mike Zyda, founder of MOVES Institute

”

GAME ON: CYBERWAR:2025



NPS Students Teach CyberOps Fundamentals Through Gaming

By Matthew Schehl

Two Naval Postgraduate School students have created a way to bridge a training gap in U.S. military cyber operations ... through a game.

For their master's thesis, U.S. Army Master Sgt. David "Ty" Long and Capt. Chris Mulch designed and developed CyberWar 2025, a computer-based strategy wargame which challenges players to navigate through the core concepts of the cyber realm.

"The goal of CyberWar: 2025 is to stimulate and increase players' knowledge and experience of cyberspace operations," Mulch said. "The basic idea is to learn as you play."

In approximately 30-60 minutes of turn-based, 'sandbox' gameplay, players employ a range of the basic concepts laid out in Joint Publications 3-12(R) Cyberspace Operations. A deft combination of offensive cyber operations (OCO), defensive cyber operations (DCO) and computer network exploitation (CNE) can lead a player to victory, even if in a relatively weak position.

"Everybody starts out on a level playing field," Mulch explained. "Players utilize resources in a way they see fit, whether those resources are put into offense, defense or reconnaissance."

Long and Mulch developed CyberWar: 2025 at a critical time. A sense of urgency has burgeoned in the United States over the last decade as adversaries – state and non-state actors alike – have increasingly turned to the cyber domain to actively work against U.S. national security interests.

In a recent speech at John Hopkins University, Secretary of Defense Jim Mattis reiterated that the DOD absolutely must "invest in cyber defense, resilience, and the continued integration of cyber capabilities into the full spectrum of military operations."

"Our competitive edge has eroded in every domain of warfare—air, land, sea, space and cyberspace," he said. "And it is continually eroding."

"What's going on in cyber policy is a big question right now in DOD," Mulch said. "What does our competitive balance look like? Should we be strong? Should we be putting time and resources into defense, reconnaissance or research?"

And yet, there remains a critical gap in how DOD goes about preparing the military to engage in this domain. Several educational courses and training exercises have been developed to prepare leaders to plan and execute cyberspace-based effects to support operations, but there are no vir-

tual simulations used by the military to train and educate service members in the basic concepts of cyberspace operations.

When Long, a cyber warfare practitioner at Fort Meade, and Mulch, an Information Operations Officer, arrived at NPS in June 2016 to begin their graduate work in information strategy and political warfare, it didn't take them long to turn to solving this.

"People would say I'm the cyber guy, even though I really don't like that term," Long said. "When I came to NPS, my promise to myself was to [impact] the Army cyber mission; I had a lot of ideas about how we can educate people about cyber operations, and how we could do it correctly."

Attending a game theory course, they encountered an article exploring the strengths and weaknesses of American cyber capabilities vis-à-vis Russia and China. Over spirited arguments over how much emphasis the U.S. should be placing on offense, defense or reconnaissance, the kernel of CyberWar: 2025 was formed.

"We used game theory to explore that, but that was the basis of 'hey, I think we have a question here that we could look into,'" Mulch said.

Coming up with a game was not too far a stretch: the U.S. military has a long history of using games to prepare, understand and even plan for war. The earliest use of wargaming in the U.S. dates back to 1883, when Maj. William R. Livermore used topographical maps to practice the art of war.

However, such gaming is not just "beer and pretzels," Long stressed. Serious games, which academic literature refers to as "gamification," are played to stimulate creative thinking, decision making and problem solving to learn. Good gamification allows players to synthesize new knowledge and make critical judgements.

"With CyberWar: 2025, what we're really looking at, other than reinforcing terminology, is letting people learn through discovery what the relationship between cyber effects is," Mulch said.

For example, if a player has developed strong defensive capabilities but weak offensive capabilities, what would a potential conflict look like with an adversary with strong offensive capabilities?

"In a nutshell, that's what CyberWar: 2025 provides ... An interactive experience for you to reinforce concepts and potentially look at other ways to solve a problem," Mulch said.

NAVAL POSTGRADUATE SCHOOL

At the beginning of CyberWar: 2025, six players are randomized for anonymity, so you could be sitting next to somebody, but not necessarily be located next to them on the board. Play then proceeds simultaneously by round, with each player submitting their orders, which are resolved all at once before the next round.

"The players communicate with each other and maneuver around the map, which consists of 48 interconnected 'server nodes' that are represented by hexagons," Mulch explained.

As players capture new server nodes, they gain points which they then use to either conduct an action (OCO, DCO or CNE) or research three tiers of new, more advanced effects for these actions.

"The more points you have, the more you can put into effects, and then you can use these to launch attacks against your adversaries and so forth," Mulch said.

When all players have submitted their orders, the software engine running the game sorts their input, calculates each of their actions, analyzes the results and then broadcasts these back to the players within a split second.

From inception, Long and Mulch designed the game to be applicable for all branches of DOD and their subordinate cyber fields, as well as an educational tool for decision makers and leaders on cyber policy. Since their thesis was published in December 2017, CyberWar: 2025 has been successfully adopted in cyber courses at NPS, though Long and Mulch would like to see it become more widely available.

"The way forward is to have it incorporated into cyber education courses across the services," Mulch said.

"Whether they're about to go out to the National Training Center at Fort Irwin, California, the Joint Readiness Training Center at Fort Polk, Louisiana, or anywhere else, CyberWar: 2025 could be implemented as a reinforcement tool at the home station pre-train-up before they go into an actual exercise," Long said.

CyberWar: 2025 has been effectively used in the classroom at NPS, but the students hope to soon see the application available to a broader DOD audience. With further development, incorporating computer-controlled players, Long and Mulch see the opportunity for a DOD-wide training tool. **IR**

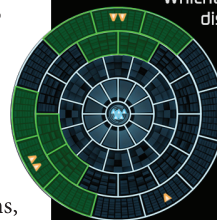


www.globalecco.org

Led by faculty at NPS, the Combating Terrorism Fellowship Program's GlobalECCO (Global Education Community Collaboration Online) hosts a variety of gaming applications that teach varied fundamental concepts of counter-terrorism. A few of them are highlighted below.

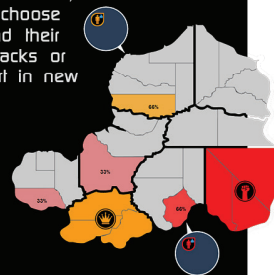
ASYMMETRIC WARFARE

This game depicts, in a very abstract way, the essence of insurgent warfare. The game is for two players, the State (representing the existing government or leadership of a country or organization) and the Insurgent (representing the opposition to that government or leadership). The State has powerful forces but less information; the Insurgent has complete information but little actual power. Whichever side overcomes its disadvantage wins (the State by gaining information on the Insurgents and killing them; the Insurgents by penetrating to the centre of State power).



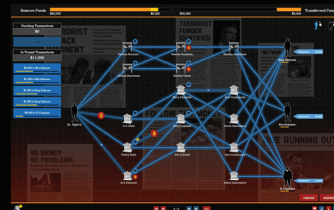
CONTAGION

Contagion introduces players to how terrorists spread their ideologies and how states counter that with their own ideology. Both sides try to gain as much popular support as possible, all while also denying their opponent support. With limited resources, players must choose whether to defend their gains against attacks or grow their support in new areas.



FOLLOW THE MONEY

Follow the Money is a game of terrorist financing and counter-terrorist financing. It reinforces some key methods used by terrorists to move money (banks, hawalas, courriers) and a key strategic choice the state must make of freezing or following financial transactions.





GAME ON: WARGAMING

A diverse team of NPS students executes a sponsored wargame on a multi-domain task force at the request of U.S. Army Pacific during Wargaming Week. The effort represents the culmination of students' studies in the operations research department's Wargaming Applications course.

Student Wargaming Addresses Sponsor Needs

By Matthew Schehl

In the near future, a crisis suddenly flares up on the southern Philippines island of Mindanao, and U.S. Marines are called to action to evacuate U.S. civilians trapped in a hostile city. The nearest Marine Expeditionary Unit, however, is several days away.

Several hundred Marines with the Marine Rotational Force-Darwin, on a training mission nearby with the Australian military, are re-tasked to embark on a Royal Australian Navy (RAN) Canberra class amphibious assault ship. With the support of a U.S. Navy destroyer and a small Littoral Combat Ship, they must extract the besieged civilians from a rapidly-devolving environment bristling with armed foreign fighters, mortar fire and explosives-laden small boats.

This is a fictional, though not implausible, scenario which raises a host of questions about the interoperability of American and Australian militaries that U.S. Marine Corps Forces, Pacific (MARFORPAC) is keen to answer.

“Can we do it? What can't we do from Australian ships? Can you land a V-22 Osprey on a Canberra class amphibious ship? How many, and what about maintenance, crews and ammunition? How are Marines

going to be supported on-ship and then off-ship? How will command and control work?” asked Marine Corps Capt. Chris Fletcher, a Naval Postgraduate School (NPS) graduate student tasked by MARFORPAC to explore the logistical challenges of such a joint U.S.-Australian littoral combat operation.

“Nobody really knows, so we're going to work that out,” he said.

Doing so in real life would potentially cost millions of dollars and endanger service members' lives, yet Fletcher and his five-man team of fellow Marines recently accomplished this by playing a wargame over two days.

Their wargame, entitled Combined Australian/U.S. Amphibious Operations, was the culmination of an 11-week capstone wargaming course for their graduate thesis. Along with four other teams working closely with Department of Defense (DOD) sponsors such as MARFORPAC, the students rigorously designed, developed and executed wargames which provide analytic input into some of the nation's most pressing security issues.

The five wargames – classified and unclassified – are then played out during NPS’ Wargaming Week, held in early June by the Operations Research (OR) department’s Wargaming Activity Hub.

“The great benefit of this wargaming course is it matches student teams with a real-world sponsor who has a real-world problem,” said Dr. Jeff Appleget, Wargaming Activity Hub director and senior lecturer in the OR department.

NPS students bring to the table diverse military backgrounds and academic training in advanced mathematics and statistics to address these problems through analytic wargaming.

Fletcher, a Marine aviation maintenance officer, teamed up with infantry and supply officers to create their game. It was played out at Wargaming Week by fellow Marines, U.S. Navy officers and visiting RAN officers, who utilized their operational experience to optimize results.

“The game was an overall success,” said Fletcher. “Our goal was to set the conditions for more detailed wargames to follow, and we did that. We networked with our Australian allies to develop our understanding of how they operate.”

“It isn’t easy to do in a two-day game, but we made some progress that we believe will be beneficial for future military interoperability,” he added.

One of the other teams developed a classified game for U.S. Army Pacific to explore the Multi-Domain Task Force, a new concept that U.S. Army Training and Doctrine Command (TRADOC) is developing to use new technologies to shape future battlefields across all domains: land, air, maritime, space, cyberspace and the electromagnetic spectrum.

“In such a short time, [NPS students] put together one of the best table top exercises I have been involved with in my 15 years of wargaming for TRADOC,” James Anderson, a representative with the Army Cyber Cen-

ter of Excellence’s Capability Development Integration Directorate, wrote Appleget after participating in the wargame. “It is important that our younger service members learn to do this, and provide fresh, new perspectives to the challenges we face in today’s uncertain world.”

For more than three decades, NPS has taught its students the craft of wargaming. In the mid-1980s, a partnership was formed with the Naval War College to share course materials and naval simulations, and NPS launched a resident Wargaming Applications course through its OR department that continues to this day.

“NPS is one of the very few institutions that has a robust wargaming education program to bring wargaming to the front and to get experienced wargaming practitioners that senior leadership can leverage,” Appleget said.

“
The great benefit of this wargaming course is it matches student teams with a real-world sponsor who has a real-world problem.

-Dr. Jeff Appleget, Wargaming Activity Hub director

Analytic wargaming, taught at NPS, is specifically designed to collect and analyze information from wargame play; this is then either fed directly into a decision or used to develop other analytic products.

“It’s ultimately a study of human decision-making,” Appleget noted.

“Wargaming is not a precise tool; it doesn’t provide lots of quantitative information,” he continued. “But then again, quantitative information with the wrong context is useless. In wargaming, we’re focused on human decision-making, not automated processes.”

The Wargaming Activity Hub at NPS has excelled at honing this analytic wargaming capability in U.S. military officers from all services. It’s part of NPS’ OR department, yet draws on expertise from many other entities across campus.

Stood up in 2014 to meet a surge of interest in wargaming across the military and synergize the myriad wargaming activities at NPS, the Wargaming Activity Hub serves as a nexus for the DOD, its allies and partners to access NPS’ unique student body and faculty. Over the last five years, NPS students have conducted more than 50 wargames for dozens of sponsors.

“Our mission is to leverage wargaming to conduct high-quality education, analysis and research; to prepare future leaders; and to help shape and form key decisions on the future of the DOD,” Appleget said.

Wargaming enables NPS graduate students to conduct operationally-relevant analysis, enhancing their understanding of complex strategic concepts and gaining practical experience which lays the groundwork for their future careers. The 11-week Wargaming Applications course, offered twice per year, teaches the fundamentals of analytic wargaming.

The first two weeks blend lecture and practical exercises, and by the third week students are introduced to their sponsor to begin the design process of a wargame. After the sixth week, students focus solely on designing and developing their wargame.

“When they graduate they’re going to have to apply these tools in a military context,” Appleget explained. “The wargaming sponsors pose a very fuzzy problem that is not clearly defined, and simply refining that problem is something you typically don’t practice when you’re learning a specific tool like linear programming.”

Creating the wargame provides invaluable experience in applying these acquired tools, while playing the game out during Wargaming Week serves as the student teams’ final exam.

In the end, officials say, the effort is about providing the American military, and its partners and allies, with a strategic asset as the demand for analytic wargaming grows in an increasingly complex world. **IR**

Watch more at <https://youtu.be/TAy1QRk2IAc>



U.S. Navy Ensign Edward Hanlon reviews a diagram of the Autonomous Mobile On-orbit Diagnostic System he developed with fellow students at the U.S. Naval Academy. Now continuing his education at NPS in the Systems Engineering department, Hanlon has been able to advance communications with AMODS, and is now projected to launch the system in late 2018.

Bowman Scholar's CubeSat Research Gets Help from NPS

By Matthew Schehl

Space robots will be launched into orbit this summer by a team of junior Navy officers in a test which has the opportunity to bring significant change to how the Department of Defense (DOD) operates assets in the extraterrestrial domain.

U.S. Navy Ensign Edward 'Ned' Hanlon, a Bowman Scholar currently studying in the Naval Postgraduate School's (NPS) Systems Engineering department, along with a team of fellow Midshipmen, developed a way to efficiently deploy robotic CubeSats into space to tend to ailing spacecraft. His Autonomous Mobile On-orbit Diagnostic System (AMODS) piggybacks grapefruit-sized robots in rocket payloads which can then investigate malfunctions, conduct repairs or perform maintenance on satellites.

"AMODS basically gives satellite operators another opportunity to interact with their spacecraft once it's in orbit," Hanlon said. "Currently, after a spacecraft is launched, it is nearly impossible to physically interact with it again. AMODS can change this."

Until now, satellites have been a costly, one-shot deal. Once launched

into space, the satellite is subject to myriad natural shocks ... Solar arrays or antennae may not deploy correctly, components fail, wear and tear degrades capabilities, etc. Operators are left guessing what went wrong, sorting through telemetry to figure out why a component didn't act the way it should.

If and when the spacecraft fails, there is nothing left to do shy of mounting a prohibitively expensive recovery mission.

"With AMODS, you have that additional diagnostic information so that you know exactly what went wrong and how it went wrong," Hanlon said. "You have a picture of the failure so you don't have to play a guessing game and you can either solve the problem or at least prevent yourself from making that same mistake in the future."

With the establishment of space as a domain of military conflict, AMODS can also provide a critical advantage. When a space asset goes down, it becomes imperative to immediately know the exact cause.

"We'll be able to correctly identify exactly what caused the fault so

it's not misattributed to hostile action or space weather," Hanlon said.

Plus, it's a breathtakingly cost-effective solution. An individual AMODS unit has a hardware cost of approximately \$22,000. In contrast, NASA space shuttle missions to maintain the Hubble Space Telescope were valued at \$900 million each.

"I like to think of AMODS as a \$22,000 insurance policy to prevent you from making the same mistake multiple times," Hanlon said.

Hanlon cited the experience of Silicon Valley-based company Space Systems/Loral (SSL) to illustrate AMODS' potential utility.

In 2004, an SSL Telstar 14 satellite suffered a crippling solar array failure. Despite spending \$13 million to figure out what went wrong, SSL was never able to determine its cause. Seven years later, its replacement Telstar 14R satellite met a similar fate, and the company spent an additional \$22 million to troubleshoot the issue. The next year, in 2012, the solar panels on another of its satellites failed.

"Had SSL been able to capture images of the failed 2004 spacecraft, their diagnostic analysis could have been much less expensive," Hanlon said. "Real-time images could have provided SSL with the data they needed to realize the flaw wasn't with the deployment mechanism, as originally assumed, but with the solar panel itself."

Hanlon is about to test this out.

In early June, a Rocket Lab Electron rocket will blast off from the Mahia Peninsula in New Zealand, carrying into space a payload of multiple CubeSats, miniature space research satellites developed in 1999 by California Polytechnic State University and Stanford University.

Among these will be several 'repair CubeSats' (RSats) built by Hanlon and his team. These RSats have robotic arms which are able to latch onto host satellites and crawl around, image and potentially repair various components.

If not directly embedded inside a host spacecraft, RSats could be delivered by the second component of AMODS, a self-propelled transport CubeSat (BRICSat).

"BRICSat is basically a little jet pack that you can strap to the back of an RSat," Hanlon explained. "If you have sort of a big bucket of RSats, the BRICSat just picks up an RSat, drops it off at the spacecraft, goes back to the bucket and grabs another RSat for the next spacecraft."

Operating these from NPS, Hanlon will run AMODS through a series of exercises to demonstrate their capabilities.

"We're going to take what's been done on the ground, put it in a box, send it to space and accomplish some complex tasks with the robotic arms," Hanlon said. "What we're looking to do now is continue to test the robotic arms and confirm that they're able to do the missions we're picking for it."

Working with NPS has allowed Hanlon to take AMODS to the next step. AMODS was conceived and prototyped by Hanlon and his team as the culmination of their undergraduate work as midshipmen at the Naval Academy. For this work, the midshipmen received the 2016 Secretary of the Navy Innovation Scholar Award.

Halfway through the development process, however, they hit a wall. As a government organization they weren't allowed to use amateur radio frequencies without an appropriate license.

NPS had the appropriate professional frequencies, and it was the beginning of a beautiful relationship. Hanlon graduated from the Naval Academy in May 2017, and as a Bowman Scholar, hit the ground in Monterey, Calif. to begin his NPS graduate work within a month.

"NPS was invaluable in supporting the effort and making sure that we'd be able to get the licenses," Hanlon recalled. "I was fortunate enough to come out here and help bridge the gap between the two institutions and get the ground station set up so that we can talk with the spacecraft."

U.S. Navy Ensign Edward Hanlon ('19)
Student, Systems Engineering

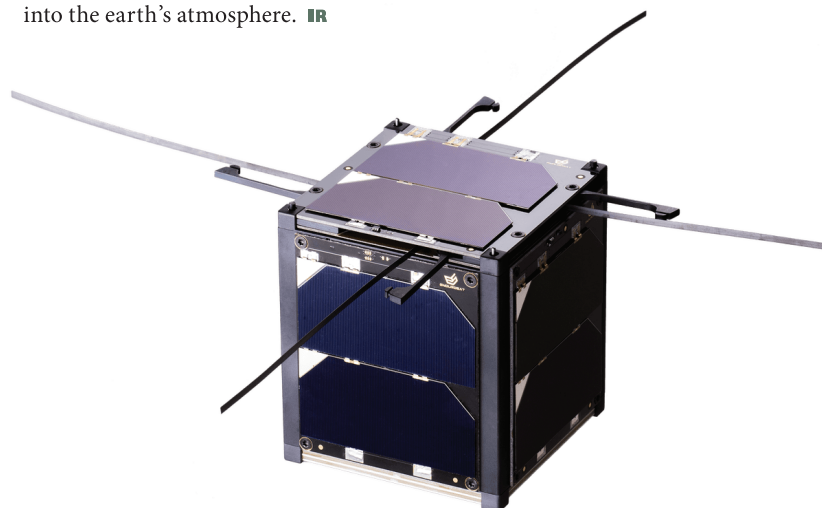
"We would not have been able to do it without NPS," he added.

Throughout its time in orbit, AMODS will provide NPS faculty and students the opportunity to explore data and experimentation of the dynamics of a robot in space.

"It's the first time, certainly on the space side of things, that we've had the opportunity for this tightly knit collaboration, and we're looking forward to continuing that as we move towards the future," Hanlon said.

AMODS will be in orbit for a year before burning up on re-entry into the earth's atmosphere. ■■

"I was fortunate enough to come out here and help bridge the gap between the two institutions and get the ground station set up so that we can talk with the spacecraft ... We would not have been able to do it without NPS."





Watch more at https://youtu.be/o_X5H7AworU

Unmanned vehicles navigate autonomously to a simulated person in distress during a search and rescue scenario developed by a cohort of eight students from the NPS Department of Systems Engineering (SE). The team, led by Dr. Oleg Yakimenko, used the nearby Military Operations in Urban Terrain (MOUT) facility in the former Ft. Ord to put their research to the test.

Students Put Their Research to the Test in Impossible City

By Javier Chagoya

NPS Systems Engineering students took advantage of the nearby Military Operations in Urban Terrain (MOUT) facility on the former Ft. Ord, also known as ‘Impossible City,’ to test and evaluate their research in ad hoc networking and autonomous control of unmanned systems.

“In this Concept of Operations, the team used an unmanned ground vehicle (UGV) and an unmanned aerial vehicle (UAV) to conduct a search and rescue mission to find and steer to a person in distress (PID) autonomously,” said Dr. Oleg Yakimenko.

The mission included a mannequin, substituting as an injured person, which was placed in an unspecified location. The team then utilized UAVs to scan the area from the air, helping ground vehicles

locate and track the simulated wounded soldier in tandem, all connected by a network the team deployed.

A portion of the team focused on a portable, deployable wireless network all from commercial off the shelf routers, conducting extensive testing in the lab on campus before field testing it at the MOUT. Other students focused on coding, writing the ‘software’ that would tell the autonomous systems what to do to locate the mannequin.

“The team spent over a month conducting subsystem testing, including power, signal strength, signal propagation, and signal latency. This project would not have come to fruition in such a short period of time without the determined effort of every member on the team.”

Lt. Rob Hall, Student, Systems Engineering

“Army Capt. Todd Howe and Lt. Travis Turner developed over 1,000 lines of operating code in a self-taught, open-source programming language,” said Lt. Rob Hall, one of eight members on the team. “The team utilized their strong systems engineering background to offset their relative inexperience in the fields of networking and robotics.”

“Army Capt. Todd Howe and Lt. Travis

“The team spent over a month conducting subsystem testing, including power, signal strength, signal propagation, and signal latency,” he continued. “This project would not have come to fruition in such a short period of time without the determined effort of every member on the team.”

The experimentation wasn’t flawless, but it teaches the students the fundamental concepts required for a set of technologies that will be on the not-so-distant battlefield.

“The team successfully demonstrated the search and rescue mission ... the UGV autonomously navigated via GPS waypoints to the [mannequin] in two scenarios,” said Yakimenko. “The team had to learn how to create a three-dimensional survey of the area, including roads and other access points, prior to deploying the search and rescue mission.”

“This exercise marked the culminating event in a series of three consecutive project courses that the SE cohort has worked on for three academic quarters,” added Yakimenko. “This brought together several disciplines that had to be learned quickly.”

The Systems Engineering cohort members are: team lead U.S. Army Capt. Todd Howe; Wei Shun Teo; U.S. Navy Lts. Mario Granata, Hall, Dan Michnewich, Wyatt Middleton, Joshua Ramsuer and Travis Turner; and, Army Capt. Ron Moreno. Lab support was provided by NPS Engineering Technician Rushen Dal and Academic Lab Engineer Albert Jordan. Other participants in this multidisciplinary effort included Exchange Engineer Stefan Wangert of the Information Sciences department, Research Scientist Sondre Engebraten from Defense Analysis, and Research Associate Jeremy Metcalf of the Physics Department. The final demonstration was observed by the Base Police and Monterey County Sheriff’s Office representatives. **IR**

Annual NRWG Connects Navy’s Issues to NPS Researchers

By MC2 Patrick Dionne

The Naval Postgraduate School held its latest annual Naval Research Working Group (NRWG), April 10-12, 2018, on the university’s campus in Monterey. The NRWG serves as a forum for Navy and Marine Corps organizations to communicate, review, validate and recommend topics for NPS researchers over the coming fiscal year.

“This is one more opportunity to tie our faculty and students back to our operating forces,” said Program Manager for NRWG 18, U.S. Marine Corps Lt. Col. Louis Camardo. “They are already doing world-class research in support of the DOD, and this helps not only bring problems from the fleet back to NPS, but also gives our sponsors the chance to see what is going to be important for the future.”

From poster sessions to panel sessions, the NRWG highlights research already underway at the university, and gets potential sponsors to envision what is possible.

“The poster sessions serve as a chance for our research sponsors to see the breadth and depth of research that is going on at NPS currently, and that starts a conversation regarding what is the art of the possible regarding research,” said Camardo.

“We have been doing this program since the beginning and we are here to help build a stronger bond between us and NPS to help do the research that answers our hardest problems,” said Deputy and Technical Director at OPNAV N1 (Manpower, Personnel, Training and Education) Modeling and Assessment Office Ilia Christman, who attended as a topic resource sponsor and representative for OPNAV N1.

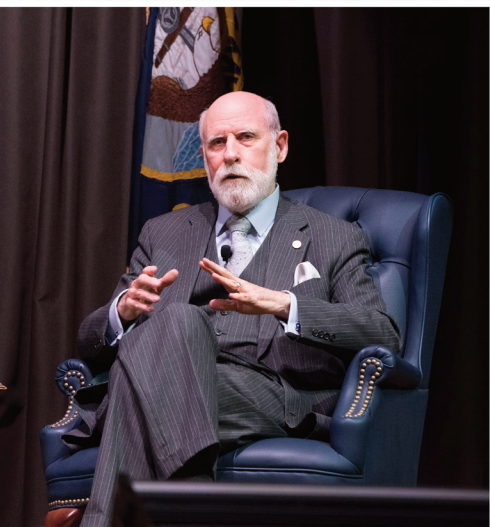
“We are looking at a broad spectrum to help us develop system support systems and metrics as well as systems for talent management with both the School of Business and Public Policy and the Operations Research Department, and as a former NPS alumnus myself, it is always nice to be back,” Christman said.

Funding for research in fiscal year 2019 is proposed to be about \$12 million. To date over 2,000 topics have been submitted through the Navy Research Program Topic Portal, and over 600 research projects have been completed or are in progress.

“It’s awesome to be able to see what is on the minds of all these important institutions and how it intercepts with our curriculum,” said Maj. Alissa Tarsiuk, a student studying Manpower and Systems Analysis. “A lot of questions that myself, and other students going into this, have is, ‘What can I do to help better the Marine Corps by choosing a meaningful thesis?’ Being able to see what’s on everyone’s mind and making important connections has been very helpful in making that happen.” **IR**



Deputy Commandant of Installation and Logistics U.S. Marine Corps Lt. Gen. Michael Dana, center left, listens to representatives from the Marine Corps Combat Development Command’s Capabilities Development Directorate discuss their needs and issues and during the 2018 Naval Research Working Group, April 11.



Speakers pictured (clockwise): former Chairman of the Joint Chiefs of Staff, retired Adm. Mike Mullen; Secretary of the Navy Richard V. Spencer; tech pioneer Dr. Vint Cerf.

NPS Lecture Series Offers Students Access to Our Nation's Top Minds

By NPS Public Affairs

The Naval Postgraduate School's long-standing Secretary of the Navy Guest Lecture (SGL) series began a resurgence in mid-2017 that has anything but slowed down in the current year. Since the beginning of 2018, a steady stream of some of the world's most recognized leaders in varied fields have addressed the university's student, faculty and staff community.

Kicking off 2018, former Chairman of the Joint Chiefs of Staff (CJCS), retired Adm. Mike Mullen provided NPS students, faculty and staff with a candid perspective on the challenges facing America today and our way forward, Jan. 23.

As CJCS, Mullen served as the nation's senior military officer and top military adviser to Presidents George W. Bush and Barack Obama. During that time, he oversaw the end of combat missions in Iraq, the killing of Osama Bin Laden, and the dismantling of Don't Ask, Don't Tell.

Prior to his service as CJCS, Mullen served as the Navy's 28th Chief of Naval Operations and was only the third officer in Naval history to be appointed to four different four-star assignments. He retired from the Navy in 2011 after a 43-year career.

"My career has seen defining times in our country's history," said Mullen. "During the September 11 attacks, I was in the Pentagon the moment the plane hit the building. I was actually down in the Chief of Naval Operations' area about 100 feet away and I knew one thing, the world as we knew it had changed."

Mullen summed up the nation's most significant challenges with something he referred to as the four Ds – disruption, distribution, discrimination and division. He spoke of accountability in the U.S. political system, inequalities in wealth distribution, and of issues that create decisive separations in the American populace.

Mullen graduated from NPS in 1985 with a master's degree in Operations Research, was named a distinguished alumnus in 2002, and bestowed with one of the university's highest honors in 2009 when he was inducted into the NPS Hall of Fame.

Shortly following Mullen's presentation, on February 1, Secretary of the Navy Richard V. Spencer spent time on the university's campus to offer his own perspective on the institution, and his vision for its future.

"We all have an interest in ensuring that NPS endures as the pre-eminent, postgraduate research and education institution, and the first choice for the Navy and Marine Corps and our partners," said Spencer. "But going even further, I want this institution to be the primary education and research enterprise for a partnership with the private sector, government sector and academia coming together at the research level."

Going forward, Spencer stressed the importance of NPS' academic focus, and the institution's need for service-wide support for the university's students, with their development essential to staying competitive, and reaching fleet and national security demands.

"This institution is a primary incubator for the capabilities that we need now," said Spencer. "It's all about time and urgency, from the rail-gun to unmanned systems, power solutions to business and public policy generation, information science to international studies, NPS is at the forefront of improving our capabilities."

"We are open to those organization, both public and private, who want to come to NPS to build, innovate, develop, test and improve ideas, products and solutions alongside us," said Spencer.

In March, tech pioneer and 'Father of the Internet' Dr. Vint Cerf presented his own views through a tête-à-tête with Dr. Peter Denning, NPS Computer Science Department Chair, and an extensive audience Q&A. Cerf took on a wide range of topics – from the Internet's creation to Russian cyber hacking to gender inequality – replete with personal anecdotes.

"The Internet has turned out to be a pretty amazing tool," Cerf said. "It's extremely open, it invites new inventions, but we should be very thoughtful about what we ask artificial systems to do."

Cerf is perhaps best known for his 1973 invention of TCP/IP protocols, the fundamental technology which makes the Internet possible. Together with Robert Kahn, Cerf developed TCP/IP for the U.S. military to allow networked communications between computers so they could share information.

Cerf addressed the inherent challenges created by the impressive openness of the Internet, its 'dark side.' Cyber-criminals challenge our national and international legal jurisdictions, and foreign adversaries manipulate social networks, interfere with elections, and provoke anxiety.

As a country, we're now faced with the desire to stay as open as possible to give our population freedom of access to information and freedom to share, while at the same time trying to fend off the side effects of publicly-accessible networking tools, Cerf said.

The only way to overcome this is to cultivate critical thinking, he noted. The ability to discern between what content should be accepted and what should be rejected is of paramount importance, and one which can be obtained through computational thinking: breaking down problems, asking questions to solve them, and putting things back together again.

Cerf also expressed fear of an impending Digital Dark Age. Preservation of human knowledge is at risk as rapid technological advancement swiftly obsolesces forms of digital records, whether through physical decay of media or through antiquated hardware and software to read them.

Additionally, Cerf addressed concerns over the proliferation of the 'internet of things' – the wired and wireless integration of everyday devices, from coffee makers to home security systems to insulin injections – and anxiety over rapid advancements in artificial intelligence and machine learning.

"I see these as tools to augment our capabilities, and people who worry that they will sort of take over should be worried, not about artificial intelligence but the autonomy we grant to that software: what decisions it is allowed to make and if we should permit it to make those decisions."

Following the conversation with Denning, Cerf fielded questions from NPS students. Dialogue touched on a variety of subjects ... the rapid expansion and censorship of Chinese Internet use, aversion to cryptocurrency and block chains, as well as the ability of a computer to distinguish between human and computer interactions.

SGL series lectures can also coincide with significant events occurring on the university campus. When the annual Naval Research Working Group (NRWG) came to campus (see pg. 21), Deputy Commandant of Installation and Logistics, U.S. Marine Corps Lt. Gen. Michael Dana keynoted the event under the auspices of an SGL.

Dana spoke about innovation and technology and the impact it has made on the way military operations are conducted throughout history, from the Gatling gun to canning food.

"Think about today, and where we will be 20 years from now with things like artificial intelligence and unmanned systems," Dana said.

"The biggest thing we can do is to start to frame the problem in different ways, because a lot of the times in problem-framing, there are things sitting right in front of you and you don't realize it," he continued. "That's why you need people who have different outlooks, different experiences, different perspectives to look at a problem and help turn it on its head."

With only half of the 2018 calendar year behind them, NPS students, faculty and staff still have a lengthy list of national leaders to tap into thanks to the university's SGL program.

Through NPS' Secretary of the Navy Guest Lecture (SGL) program, some of the nation's most compelling leaders in defense, industry, technology and more provide open and honest perspective to the university's student, faculty population, providing a tangible link between the content of their scholarship and the emerging defense needs of the nation. ■■



NPS Department of Applied Physics Associate Professor Emil Kartalov is researching next-generation dive suits here at NPS. But before he joined the university's faculty his efforts in microfluidics, for which he was awarded a patent in March, may have significant applications in the treatment of cancer.

NPS Physics Professor's Patent Could Have Significant Applications in Treatment of Cancer

By Matthew Schehl

A Naval Postgraduate School (NPS) applied physics associate professor has just been awarded a patent that could potentially revolutionize the treatment of cancer. Dr. Emil Kartalov received the patent, March 20, for work he did at the University of Southern California (USC) to use a biochemical method – microfluidics – to mark the DNA of mutated cancer cells.

“In other words, it’s like taking a tiny little pencil to write down the coordinates on the exact piece of DNA so that it can later be analyzed,” Kartalov explained. “We can tell how many of them there are and where they came from by these coordinates, and suddenly we have an enormous amount of information to work with.”

Time is a critical component in fighting cancer, and Kartalov says this is where the discovery can have a significant impact, dramatically reducing the gap between initial diagnosis and treatment.

Currently, targeted therapies are quite effective at decimating cancerous cell populations. The problem, however, is that nature always finds a way ... 99 percent might be eradicated, but that remaining one percent can lead to a resurgence which overwhelms the patient.

“The few mutants that are resistant have found a way around [the targeted therapy], they’ve short-circuited it somehow,” Kartalov said. “Suddenly those guys are going to repopulate and they potentially can kill the patient.”

Oncologists often chalk this up to ‘acquired resistance,’ but Kartalov says the resistance was already there. Mutations will always exist for any given population; the key is being able to identify them. Studying DNA sequences is the easy part ... Since the 1980s, a process known as Polymerase Chain Reaction (PCR) has been available to efficiently make copies, like a Xerox machine, of focused segments of DNA. The difficulty comes in when incorrect DNA gets amplified through the PCR process.

“Essentially, you are trying to see only a particular page of a book, but the Xerox machine can fail and instead start copying the rest of the book,” Kartalov explained. “Then you miss the critical page.”

Kartalov’s patent circumvents this. Instead of replicating an entire sample, it compartmentalizes it into little volumes, allowing reactions to be done for each. Using microfluidics, coordinates are assigned to each tiny chunk so that they can be isolated and studied in turn.

“Now, when you amplify the sample, you only compete with another hundred cells rather than a hundred thousand cells,” he explained. “You’re tilting the playing field in your favor so that you can identify the particular mutation much more easily.”

Kartalov filed the patent a number of years ago while at USC. In 2016, he came to NPS and became a civil servant, thus precluding any involvement in commercial development of the technology due to potential conflict of interest.

“But that’s OK,” he laughed. “It was a reasonable sacrifice to become part of the NPS team, and it’s a trade-off I’m not unhappy about.”

Others will take up the ideas of the patent and move the ball forward, and Kartalov has turned to integrating his biotech background into interdisciplinary endeavors with military applications.

He currently is developing insulation for next-generation divers’ suits with greater endurance and less susceptibility to hypothermia. On the horizon are exoskeletal suits enabling great strength and endurance to service members, not unlike Marvel Comics’ Iron Man. **IR**

 Watch more at <https://youtu.be/Lq6JRbG6p40/>

Acquisition Professionals Return to Monterey for 15th Annual Symposium

By MC2 Nathan Serpico

The Naval Postgraduate School (NPS) held its 15th annual Acquisition Research Symposium (ARS) at the nearby Embassy Suites hotel, May 9-10. The two-day symposium brought together leading defense acquisition experts from across the nation to exchange ideas, and to benefit from NPS student-led acquisition research.

The symposium provides a forum for the presentation of scholarly acquisition research, creating dialogue between scholars, students and acquisition policy makers and practitioners. NPS students from all services and allied nations, senior acquisition professionals, industry representatives, and researchers from universities across the country were all present to enrich the discussion.

“The Acquisition Research Program has had, and continues to have, a significant positive impact on defense acquisition,” said William Lucyshyn, a research professor at the University of Maryland and one of the few individuals who has attended every NPS-hosted Acquisition Research Symposium to date. “This is continually affirmed by the growing participation, particularly by senior DOD acquisition leaders and program officials.”

The Honorable Anne Rung, Director, Government Sector for Amazon Business and former U.S. Chief Acquisition Officer for the Office of Management and Budget, took the stage as the first keynote speaker of the event, offering insights into her transition from government to industry.

“Amazon’s number one leadership principle is customer obsession,” said Rung. “That means leaders in our company constantly strive to start with the customer and then work backwards.”

She discussed applying this same mindset of customer obsession to the government, and how to systematically capture customer voice and build it into every procurement innovation.

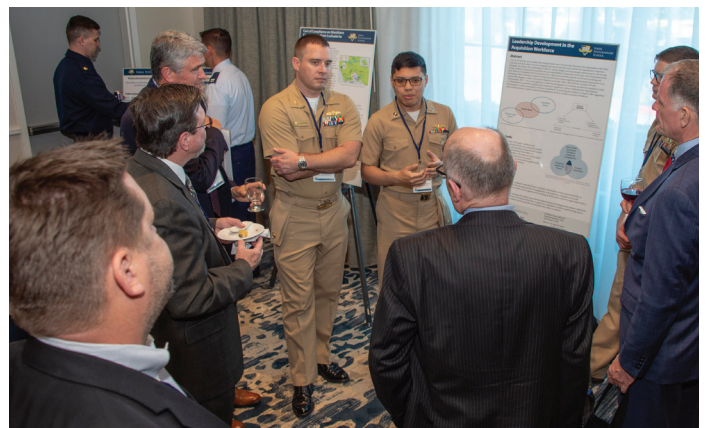
“I think it’s clear that, in government, we are ready for a change and it’s not about getting rid of the humans,” stated Rung. “It’s about using technology to provide insights to those people who can, in turn, focus on the really strategic decisions. It’s about having a competitive marketplace with information at your fingertips. Whether you call it machine learning, big data or predictive analytics, it’s about pooling this all together to help you make smarter buying decisions.”

In the evening, attendees gathered for a student research poster session, where acquisition students presented their research theses to attending acquisition professionals and leaders.

“The [poster session] helps further their research and gets ideas that students have taken and developed and puts them out there for greater conversation among some of the senior military and government employees in the acquisition environment,” said NPS Graduate School of Business and Public Policy student Army Capt. Patrick M. Gress. “A lot of the people I have talked to have a lot of experience in the subject matter that I’ve been researching for the last year and it’s interesting to see their viewpoints.”

Vice Adm. David H. Lewis, Director, Defense Contract Management Agency (DCMA), served as the keynote speaker for the second day, discussing how the DCMA functions within the government, and the relationship between the DCMA and its civilian counterparts.

“Logistics, contracting, engineering and program management lessons are all things I get from the civilian community. I believe we should require all of our acquisition community to know what those are as an introduction to the community,” he said. **IR**



Graduate School of Business and Public Policy students Lt. Cmdr. Andrew Foursha, left, and Lt. Raymond-Victor Pajarillo, right, detail their research on leadership development in the acquisition community to attendees of the 15th annual NPS Acquisition Research Symposium, May 9.

NPS Inducts Newest Member into Esteemed Hall of Fame

By Matthew Schehl



Vice Adm. Jan E. Tighe became the 23rd individual inducted into the Naval Postgraduate School's Hall of Fame, June 15, during Spring Quarter commencement. Tighe served as president of the university from November 2012 through October 2013, and currently serves as the Deputy Chief of Naval Operations for Information Warfare.

The Naval Postgraduate School (NPS) welcomed its newest inductee into the university's prestigious Hall of Fame.

Vice Adm. Jan E. Tighe was presented with the NPS Hall of Fame medal – honoring her momentous service to the nation, the Navy and NPS – at the Spring Quarter Graduation ceremony held in King Auditorium, June 15, for which she was the guest commencement speaker.

Tighe, the first woman to command a numbered fleet in U.S. Navy

history, humbly accepted the award and, asking NPS faculty and staff to rise, directed the audience applause to them.

“It’s always special to return to NPS, it feels like coming home and that is because of the NPS family that I have here,” Tighe said. “Without a doubt, I am where I am today because of the partnership, support and things we accomplished here in 2013 ... I want to say thank you very much to all of you, and I am accepting the NPS Hall of Fame induction on behalf of all of us, together.”

“Admiral Tighe’s induction in the NPS Hall of Fame is a tribute to her long history of service to her country and her many achievements,” said university president, retired Vice Adm. Ronald A. Route. “It also recognizes her as a distinguished ambassador from the school and is a testament to the high level of accomplishment and excellence that NPS is known for.”

Tighe’s intimate understanding of the university was instrumental in her accomplishments on campus as its president. In June 2001, she earned her Ph.D. in Electrical Engineering from NPS, as well as a master’s degree in Applied Mathematics.

When she returned to the fleet after graduation, she brought her new knowledge forward, she says, applying it within several organizations including the National Security Agency and U.S. Cyber Command, among others.

In April 2014, she became the first woman to serve as a numbered fleet commander when she took charge of the Navy’s Fleet Cyber Command, U.S. 10th Fleet (FCC/C10F). In this position, she was responsible for executing a full spectrum of the Navy’s offensive and defensive cyber, information network, electromagnetic, space and signals intelligence operations.

From there, she became the Deputy Chief of Naval Operations for Information Warfare in July 2016. In this position, Tighe has worked to integrate information warfare capabilities across the Navy and advocated multi-domain operations, which allows the Navy to leverage information systems already in place.

“A gifted and dynamic leader, Vice Admiral Tighe has been a driving force in the development and use of information as a warfighting capability at the tactical, operational and strategic level throughout her career,” her NPS Hall of Fame citation reads.

“She actively led the integration of information into all warfare areas, providing the Navy assured networks, heightened cybersecurity, integrated cyberspace fires capability and improved battlespace awareness in order to enable maritime dominance.”

Tighe is the 23rd person to be inducted into the NPS Hall of Fame in the institution’s 109-year history.

The NPS Hall of Fame recognizes the accomplishments of the school’s most distinguished alumni and friends who, through the attainment of positions at the highest levels of public service, have made the greatest contributions to society, their nations, and to NPS. **IR**

Former NPS President Tighe Returns to Honor Spring Quarter Grads

By MC2 Patrick Dionne

The Naval Postgraduate School (NPS) bid farewell to 317 graduates earning 323 advanced degrees, including 27 international students, during the 2018 Spring Quarter Graduation ceremony in King Auditorium, June 15.

University president retired Vice Adm. Ronald A. Route opened the ceremony with a congratulatory message to the quarter’s graduating class, recognizing the significance of their commitments and accomplishments, as well as those of the graduates’ families.

“We have immersed you all in an extremely competitive academic environment that has enabled you to focus on the challenges that affect your service, our defense capabilities, and national security,” Route said. “From today forward, our nation will count on you as strategic influencers, problem solvers and leaders. It is our hope and expectation that you leave here prepared to serve, and prepared to do something great.”

Route went on to thank the faculty, staff and loved ones that contributed to the students’ successes, while also recognizing the NPS Foundation for providing the university with an important “margin of excellence.”

He then turned the podium over to commencement speaker, Deputy Chief of Naval Operations for Information Warfare, Director of Naval Intelligence and former NPS President Vice Adm. Jan E. Tighe. Tighe graduated from NPS in June of 2001, earning a Doctorate of Philosophy in Electrical Engineering as well as a Master of Science in Applied Mathematics.

 Watch more at <https://youtu.be/XrUJZNQaAFQ>

As she began her commencement address with a welcome to the graduates and their families, it didn’t take long for Tighe to turn her attention a topic she is well versed in. She referenced a recent threat assessment by Director of National Intelligence Dan Coates, released earlier this year, listing cyber as the leading global threat.

“To face this new and much more complex world, we must recognize this changing character of war, and look for rapid technological changes that can give us an edge in the information age,” said Tighe. “Data science, artificial intelligence, human-machine teaming, machine learning, modeling and simulation, and gaming, make up the new face of modern warfare and can ensure our advantage in any fight.”

“With the operational environment we face, now more than ever, the Navy and all branches of the military, our government and our allied nations need a cadre of professionals educated at the highest level,” Tighe continued. “That’s why you are here, completing your degrees at this prestigious institution. The Naval Postgraduate School has always been the key center of education that provides the military with leaders, technologists and critical thinkers that give us the edge.”

“Your NPS education is an investment we made in you, and I challenge you to pay it back every day in your role as a leader in the service,” Tighe said in concluding her remarks. “I want to congratulate each of you for what you have accomplished. Be proud of your achievement because we are proud of you.” **IR**



Heroes Among Us

DEPARTMENT OF THE NAVY
PUBLIC AFFAIRS OFFICE
NAVAL POSTGRADUATE SCHOOL
1 UNIVERSITY CIRCLE ROOM HE-130
MONTEREY, CA 93943-5038
OFFICIAL BUSINESS

With a student population largely consisting of military officers from the U.S. Armed Forces and the forces of our allies, fresh from the front lines of the world's most contested conflicts, one would expect quite a few stories of heroism in this collective of men and women.

Every now and then, one stands out.

U.S. Air Force Maj. Philip Garito is a student in the university's Department of Defense Analysis studying special operations and information warfare. During an intimate ceremony in late May 2018, with his family and fellow Airmen in attendance, Garito was presented with the prestigious Distinguished Flying Cross, receiving the award for his actions on July 25, 2016, while serving as the Fire Control Officer for the 4th Expeditionary Special Operations Squadron in Afghanistan.

Garito, humble and soft spoken, diverted credit from himself, as heroes often do. He attributed his team's success to the trainers and evaluators that ensure gunship air crews operate to their fullest abilities. And he points to his crew of professionals on the AC-130 that day, and their critical roles in ensuring their mission succeeded.

With his receipt of the Distinguished Flying Cross, Garito joins notable company, including then-Brig. Gen. Charles Lindbergh, aviator Amelia Earhart, astronaut Buzz Aldrin and former President George H. W. Bush.

And he even joins in an achievement in common with a member of his own family, in fact the only member of his family to serve with the nation's Air Force. Garito's maternal grandfather, James Marvin Hayes, received a Distinguished Flying Cross of his own for heroism during WWII in the Army Air Corps.

"My grandfather was part of the invasion forces that liberated Sicily," Garito said.

After receiving the honor, Garito has since returned to the relative anonymity of an NPS classroom with his peers. Then again, with nothing but military leaders all around you, it's possible for even the heroes among us to walk with their equals.