

FLEET TACTICS
theory and practice



YEARS IN MONTEREY



2021

ANNUAL REPORT
NAVAL POSTGRADUATE SCHOOL

WHERE SCIENCE MEETS THE ART OF WARFARE



2021

ANNUAL REPORT &
MISSION MEASURES



MISSION

Provide defense-focused graduate education, including classified studies and interdisciplinary research, to advance the operational effectiveness, technological leadership and warfighting advantage of the Naval service.



FOR DECISIVE ADVANTAGE





A Message from the President

By Ann E. Rondeau, Vice Admiral, USN (Ret.)

2020 was a year of uncertainty. 2021 was a year of change and opportunity for the Naval Postgraduate School (NPS). Our strategic and organizational transformation journey continued with increased focus on the pacing threat and warfighter requirements.

As the fight against COVID-19 continued, we were able to gradually transition from teleworking and distance learning to resuming full in-person classes, while retaining gains from virtual operations. The past year has reaffirmed the flexibility and resourcefulness of our NPS faculty, staff and students. Our responsiveness to Fleet and Force needs has defined NPS since our inception in 1909 at the U.S. Naval Academy, through our move to Monterey in 1951, and into the dynamic environment in front of us.

2021 marked our 70th anniversary in Monterey, and on behalf of the NPS family, I want to again thank the entire Monterey community for their extraordinary support. Impressively, our time together has produced more than 60,000 degreed alumni, including thousands of international officers from hundreds of countries, and more than 40 astronauts (the most of any graduate institution). Last year, more than 17,000 U.S. and allied military and civilian students came through our degree granting programs, certificates, workshops, executive education and/or professional development.

The Monterey Peninsula has been a vital component to our success, in location and in partnership. Our proximity to Silicon Valley and to other distinguished universities and agencies enables us to jointly educate military officers and civilians in Monterey and through distance learning.

The past year saw the inauguration of our Sea Land Air Military Research (SLAMR) Laboratory on the Monterey waterfront as a 5G-enabled testbed; a partnership with Xerox which brought the world's first liquid metal 3D printer to campus to study at sea applications; and launched a new Climate Security Network to address defense-related impacts and challenges. We also completed our Navy IG inspection—a great team effort.

As much as we are proud of our accomplishments in 2021, we must also look ahead to the future. Last year, we welcomed the arrival of our 16th Provost and Academic Dean, Dr. Scott Gartner. Dr. Gartner brings a wealth of leadership and university experience. Upon arrival, he dove headlong into our “NPS Next” transformation efforts and challenges and made great strides in defining critical changes we need to make.

As we go forward, we will build on our successes, optimizing our value to the Naval and Joint forces by strengthening our core, increasing our impact, and enhancing our competitiveness. Ensuring our edge will require resolve and long-term commitment. To make this a reality, we established a new vision statement which sets our sights:

Vision: NPS will become the nation's leading institution for defense higher education and applied research, delivering transformative solutions and innovative leaders for decisive U.S. seapower and national defense.

NPS is fully capable of responding to any challenge set in front of us. It is that spirit and determination which drives our vision of the future. No matter how much we change, NPS must always be “*where science meets the art of warfare.*”

Ann E. Rondeau

A Message from the Provost

By Dr. Scott Gartner



It is with great pride, humility and a sense of privileged honor that I began my duties as NPS Provost and Academic Dean in 2021.

What drew me to NPS was my experience as a visiting professor in the Defense Analysis Department. What always stuck with me from that experience was the extraordinary students. They taught me! They come to NPS with 8-10 years of operational experience, some directly from combat tours, and my academic background in national/international security and policy assessment was informed everyday by the real-world perspectives they brought to the classes and their research.

Unique to NPS, our students not only discover new knowledge in their graduate research, but they apply it directly to solving operational problems. Last year NPS education programs reached more than 17,000 total students. NPS is the nexus of research, education and innovation for our Naval forces, and a strategic capability to the defense department and our nation.

Since its inception in 1909, the basic rationale for NPS has not changed—to provide our officers with advanced education oriented toward the critical thinking and comprehensive technical skills needed for their primary warfighting duties and to design and deploy emerging technology in the Fleet to fight and win future wars. This speaks to our enduring value proposition.

At NPS we teach our students how to think critically and connect strategically. My role as Provost is to ensure our nation's future military leaders receive the highest quality learning experiences we can provide to prepare them for the uncertainties they will face. Every degree student at NPS must complete a rigorous curriculum and an applied research thesis or capstone project to graduate delivering immediate return on education investment and enduring advantage as many continue to apply what they learned in their follow-on tours.

Unlike any other university in the country, NPS is 100 percent defense-focused. We work directly with Fleet and Joint sponsors to ensure the curricula is relevant and aligned to higher guidance. Student and faculty researchers respond to requests from the Fleet for research in technical areas critical to defense needs including: AI/ML, Autonomy, Data Science, Additive Manufacturing, Acquisition, Logistics, 5G and Cyber-related technologies. NPS is accredited by the same organization as Stanford, and 11 of our 13 departments ranked within the top 20 percent in the nation over the last five years. We do all this in an interservice, interagency and internationally diverse military environment.

Our unique value proposition is: only NPS synchronizes student *operational experience* and *graduate education* with *applied research* and *faculty expertise*, to deliver relevant warfighting solutions, and leaders educated to employ them.

I am proud to be the 16th NPS Provost and I have the deepest respect for our legacy of service and commitment to our education mission, the defense of the United States, and democracy.

Scott Gartner

Dr. Scott Gartner





The Naval Postgraduate School

Our History is Distinguishing and Distinguished

Ordered by President Theodore Roosevelt, the record-setting world cruise of the Great White Fleet, 1907-1909, was a powerful show of American strength and U.S. foreign policy. 16 of the latest U.S. Navy's battleships provided the strongest evidence yet that science and engineering prowess were of critical importance to U.S. seapower.

To further sharpen our Naval technological advance, Secretary of the Navy George von L. Meyer signed General Order No. 27 that same year, establishing a graduate-level school of marine engineering at Annapolis, which would later become the Naval Postgraduate School (NPS). In 1912, Meyer broadened NPS' role in officer graduate studies by directing that ordnance and gunnery electrical engineering, radio telegraphy, naval construction, civil engineering be added to the curriculum, laying the foundation for NPS to become an innovation hub where officers apply the tools of graduate academic rigor to developing solutions to operational problems.

During World War II, Fleet Admiral Ernest King, Chief of Naval Operations and Commander-In-Chief of both the Atlantic and Pacific fleets, established a commission to review the role of graduate education in the Navy. By the end of the war, it was apparent that the facilities of NPS at the Naval Academy at

Annapolis were insufficient for the Navy's future needs.

Fleet Admiral Chester Nimitz noted, *"To my horror — I learned that on 'D' Day — it was planned to close down the Naval War College and the Naval Postgraduate School in order to provide officers for an expanding Fleet — as was done on 'D' Day for World War I," said Nimitz reflecting on the war plans he received as his first act as Chief of Bureau of Navigation. "I immediately cancelled those plans and prepared for expanded classes at both..."*

Nimitz and King, along with SECNAV James Forrestal had a vision for the future of Naval graduate education and are considered the architects of today's NPS. In early 1944, more than a year before the first peace accord of World War II was signed, King's actions set the stage for landmark legislation in the 79th and 80th Congresses that transformed NPS.

Public Law 250 of December 1945 authorized the Postgraduate School to confer advanced degrees "in engineering and related fields" and NPS became a graduate Naval university with expanded research facilities, and led to the purchase of the world-famous 627-acre Hotel Del Monte in Monterey, previously home to a Navy flight school established in February 1943 (called the Del Monte Pre-Flight School, it graduated nearly 5,000 aviation cadets in 11

months before it was decommissioned in January 1944).

NPS moved to Monterey in 1951, and the coast-to-coast move involved 500 students, about 100 faculty and staff, and thousands of pounds of books and research equipment. Rear Adm. Ernest Edward Herrmann supervised the move that pumped new vitality into the Navy's efforts to advance naval science and technology.

In a 1959 commencement address at NPS to mark its 50th anniversary, then-Chief of Naval Operations Adm. Arleigh Burke, a 1930 NPS alumnus, attributed several important naval advances to the Navy's long-term commitment to postgraduate education. "Rapid technological advance...did not come by accident, nor did it come overnight. It has been the result of educating carefully selected officers in each succeeding generation of officers," he said.

"The naval leaders of 50 years ago showed great perspective and foresight in seeing the need for advanced technical and scientific knowledge among naval officers. They recognized that ships and naval weapons were becoming more complex, that their proper employment at sea would require officers who were familiar not only with the age-old profession of the sea, but who could understand and could use effectively the complex weapons of the years to come." ■

Did you know?



- 1950's**
- **1951:** RADM Ernest Herrmann officially moves NPS to Monterey from Annapolis.
- **1952:** Classes begin at NPS with keynote speeches from Secretary of the Navy Dan Kimball and Fleet Admiral Chester Nimitz.
- **1955:** ADM Arleigh Burke becomes Chief of Naval Operations, the first NPS alumnus to achieve this post.
- **1956:** The first woman officer student arrives at NPS.
- **1958:** Seymour Cray installs the CDC 1064 computer serial #1 at NPS.
- **1959:** The Office of Naval Research established a funded research program for NPS and sponsors its first projects.



- **1960's**
- **1960:** LT Wayne E. Meyer graduates and would go on to pioneer the AEGIS combat system.
- **1964:** The Aeronautics dept. opens the Turbopropulsion Laboratory near the Monterey Airport.
- **1965:** The Defense Resources Management Education Center is established and remains to this day offering short courses for officers of all services and around the world.



- **1970's**
- **1974:** Dr. Kildall builds Control Program/Microcomputer, the first standard operating system for microcomputers. His system allows a student to read and write from a disk. It will sell more than 250 million copies.
- **1978:** NPS student LCDR Martin Dundics research expedites the incorporation of micro-computer units in modern ship propulsion control systems.



- **1980's**
- **1982:** ADM James Watkins becomes the second NPS alumnus to hold the post of Chief of Naval Operations from '82-'86. His maritime strategy will help bring an end to the Cold War.
- **1987:** The Center for Autonomous Underwater Vehicle Research is established to advance pioneering research and Naval applications.



- **1990's**
- **1991:** NPS student LCDR Hearing's classified thesis becomes Challenge Athena, a secure communications network that also enables the first two-way imaging communications to aircraft carriers.
- **1996:** NPS alumna Patricia Tracey becomes the first woman promoted to the rank of vice admiral
- **1998:** Vice President Al Gore convenes the National Ocean Conference at King Hall during the international Year of the Ocean.



- **2000's**
- **2004:** NPS information technology experts already in Thailand rush to support Asian tsunami relief efforts by setting up wireless network communications.
- **2007:** ADM Michael Mullen nominated as the Chairman, Joint Chief of Staff, first NPS alumnus to achieve this position.



- **2010's**
- **2011:** Operation Neptune Spear neutralizes Osama Bin Laden. ADM William McRaven used what he learned at NPS in the planning and execution of that mission. His NPS thesis would later be published as a book: "Spec Ops: Case Studies in Special Operations Warfare."
- **2019:** After 10 years of development by NPS faculty and students, NPSAT-1 was launched aboard a SpaceX rocket to investigate space weather and the flight demonstration of space technologies.





“
There’s no doubt in my mind that
NPS helped shape me a lot. The
Navy needs to create and nurture
its intellectual capital, and that’s
exactly the purpose of the
Institute here at NPS.”

RADM WAYNE E. MEYER
Father of AEGIS combat system
Graduated 1960
NPS Hall of Fame, 2006





“NPS has a great legacy that we will build upon and make the institution stronger.”

VADM JAN E. TIGHE

NPS President 2012-13

Graduated 2001 Masters and PhD

*First female numbered Fleet Commander
(10th Fleet Cyber Command)*

NPS Hall of Fame, 2018

“*[Lt. Commander West] is an outstanding example and what makes NPS and U.S. Naval forces second to none.*”

Navy League CEO Mike Stevens





Student's Research Wins Prestigious National Award for Advancing Science, Technology

The Rear Admiral William S. Parsons Award for Scientific and Technical Progress is presented by the Navy League of the United States annually to a Navy or Marine Corps officer, enlisted or civilian who has made an outstanding contribution in any field of science that has furthered the development and progress of the Navy or Marine Corps.

In 2021, the winner of that recognition was an NPS student, graduating from the Meteorology and Oceanography program. U.S. Navy

Lt. Cmdr. Austin West's thesis examined the atmospheric effects of the maritime environment on the Navy's High Energy Laser Weapons System (HELWS), and how adaptive optics could compensate for those effects making the futuristic weapons system more effective.

"We are proud of Lt. Cmdr. West for the receipt of this award. We are also grateful for his contributions to the scientific community. He is an outstanding example and what makes NPS and U.S. Naval forces

second to none," said Navy League CEO Mike Stevens, who previously served as 13th Master Chief Petty Officer of the Navy.

"Having just graduated, I am prepared to return and relieve the watch," said West. "Hopefully I'm armed with more than just memorized equations and formulas, but creative and structured critical thinking skills that will allow me to not just tackle the problems that are emerging on the horizon, but those unforeseen ones that are coming tomorrow." ■



Did You Know?

Rear Adm. William S. Parsons himself graduated from NPS, and was instrumental in developing the variable time fuse in addition to his notable contributions to the Manhattan Project. Lt. Cmdr. Austin West is not the only NPS graduate to win the Parsons Award.

- **Adm. John H. Sides**, an NPS grad, is widely regarded as the father of the Navy's guided missile program.
- **Rear Adm. Wayne E. Meyer**, also an NPS grad, bears a remarkable legacy as the Father of the AEGIS program.



Rear Adm. William S. Parsons



Adm. John H. Sides



Rear Adm. Wayne E. Meyer



◀ **WATCH** Watch Lt. Cmdr. West describe his award-winning research in laser propagation.



“Experts have estimated that a 10-20 percent increase in ship fuel efficiency could be achieved if hull fouling levels were kept to a minimum, which would facilitate an extension of underway replenishment timelines, easing the burden on the fuel supply chain.”

U.S. Navy Lt. Sam Royster





Preparing Leaders to be Innovators

The Naval Postgraduate School places a high priority on supporting agility and innovative thought in its students, serving as a catalyst for the advancement of solutions to the complex challenges facing seapower in this era of global strategic competition.

Students walk onto the university campus with the seasoned leadership skills of a mid-career officer in the U.S. uniformed services. But does that mean they are prepared to create and lead innovation? A good idea is not innovation ... Rather, it is the maturation of that idea that leads to change ... a process, product or function that is now different.

This is where the university's Innovation Leadership course taught

by Dr. Peter Denning and retired Marine Corps Col. Todd Lyons, and NPS' annual showcase of good ideas, the Big Ideas Exchange (BIX), come into play.

U.S. Navy Lt. Sam Royster participated in both of these programs while pursuing his NPS degree in mechanical engineering. Then he applied the skills learned and knowledge gained all the way victory in the competitive NavalX Agility Summit Challenge competition.

Royster's studies in engineering focused on robotic controls and total ship systems engineering, leading his research toward developing a 21st century solution to marine bio-fouling management. He explored innovative methods of cleaning

algae and barnacles off ship hulls to make them more fuel efficient when underway, and reduce their maintenance burden during in-port periods.

"Experts have estimated that a 10-20 percent increase in ship fuel efficiency could be achieved if hull fouling levels were kept to a minimum, which would facilitate an extension of underway replenishment timelines, easing the burden on the fuel supply chain," said Royster.

Royster graduates in March 2022 but is one of many innovation leaders returning the Fleet. In fact, NPS established a new Masters of Science in Applied Design for Innovation in 2021, which builds on existing innovation certificates." ■



Did You Know?

Lt. Sam Royster is not the first NPS student to leverage the university's innovation programs to make a significant impact on the service. In 2019, then Capt. Courtney Thompson's Big Ideas Exchange presentation "Paying for Weight in Blood" motivated the Marine Corps to take a closer look at combat load outs.



◀ **WATCH** Lt. Sam Royster's pitch during the 2021 NavalX Agility Summit Challenge.



xerox

“As the Department of the Navy’s applied research university, NPS combines student operational experience with education and research to deliver innovative capabilities and develop innovative leaders with the knowhow to use them.”

- Vice Adm. Ann Rondeau, USN (ret.)
President, Naval Postgraduate School



NARESH SHANKER
Chief Technology Officer for Xerox



NPS Partnerships Advance Research Capabilities and Students' Learning Experiences

When Secretary of Defense Lloyd J. Austin detailed his top three strategic priorities in March 2021, he re-affirmed the critical role of partnership in the security of our nation. Partnership at every level – from joint efforts within the DOD, to the engagement of the legislature, to cooperative relationships with industry – will be required to win.

“Protecting the nation requires teamwork at every level — state, local, tribal and federal,” Austin wrote. “It requires cooperation from all with a stake in our national security: our interagency, Congress, private industry and the American people.”

The Naval Postgraduate School executes many partnerships, from joint professional military education to international student enrollment. But in 2021, the university contin-

ued on its trajectory of expanding partnership with private industry, and with resounding success.

In early 2021, the university began integrating state-of-the-art additive manufacturing technology into its research and education, in direct support of the Navy’s first-ever Additive Manufacturing (AM) strategy, released in January 2021.

As part of a Collaborative Research and Development Agreement (CRADA) with Xerox Corporation, NPS received the first ever Xerox ElemX™ Liquid Metal Printer, installed in the AM Lab in the university’s research lab complex. The new ElemX provided NPS faculty and students with the capability to explore new ways the technology can deliver on-demand 3D printing of metal parts and equipment from ship or shore, anytime or anywhere.

In October 2021, through a CRADA with telecommunications giant AT&T, NPS completed the installation of 5G capability at its Sea Land Air Military Research (SLAMR) facility. Once again, cutting-edge technology provides NPS students and faculty with the ability to explore innovative 5G network concepts that could one day connect ships, unmanned systems and sensors at sea.

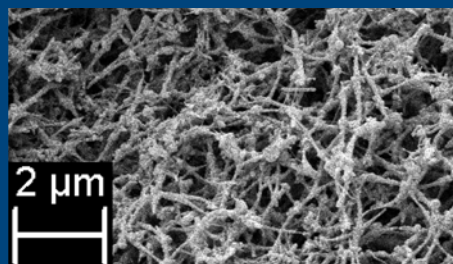
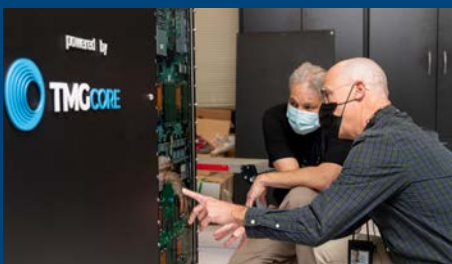
“Innovation occurs at the seams and intersections of practice and expertise and NPS provides an innovation hub where this applied 5G research can occur,” said retired Vice Adm. Ann E. Rondeau, NPS President. “By working alongside experts from our faculty and industry partners, we can apply the operational experience of our graduate students to accelerate and enhance research into 5G-related naval maritime capabilities.” ■



Did You Know?

In addition to its partnership, with AT&T and Xerox, NPS executed several cooperative research agreements with industry partners through 2021. Some of these include:

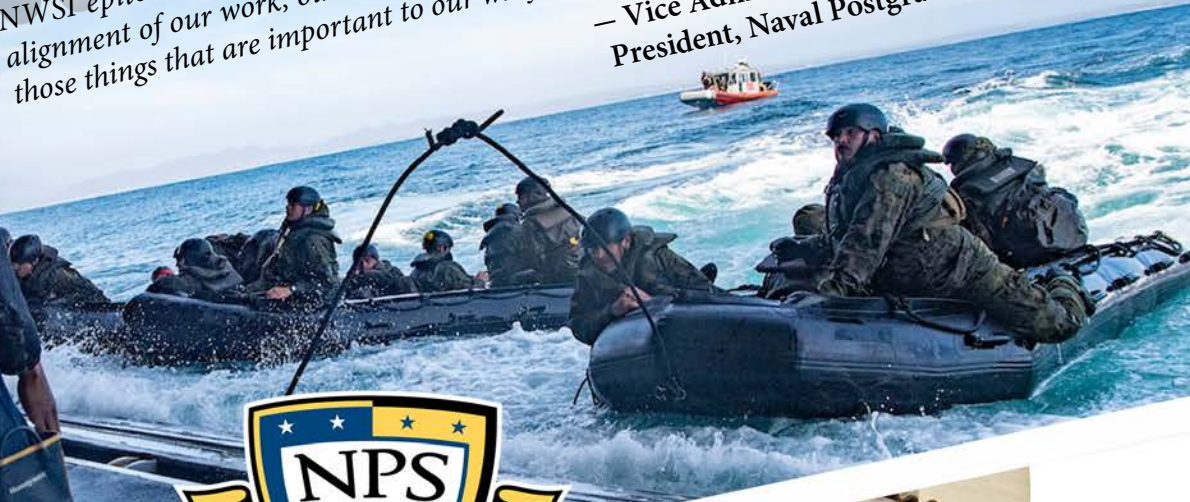
- A partnership with TMGCore to explore edge computing solutions using innovative liquid immersion computing.
- An agreement with BNNano, a manufacturing company known for producing revolutionary Boron Nitride Nanotubes, to test and evaluate Boron Nitride nanomaterials for potential defense applications.
- A partnership with Hybrid Air Vehicles exploring the potential for hybrid aircraft technologies in mobility resilience and flexibility.

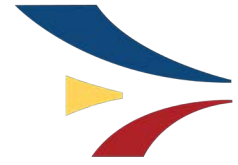




“NWSI epitomizes what we at NPS are seeking to deliberately achieve, and that is the alignment of our work, our research, our education, our students and faculty focused on those things that are important to our warfighters.”

— Vice Adm. Ann Rondeau, USN (ret.)
President, Naval Postgraduate School





Naval Warfare Studies Institute Connects NPS, Warfighting Solutions to the Fleet

The Naval Postgraduate School (NPS) launched a new organization to expedite the Navy’s ability to access the university’s immense talent and resources in taking on its most complex warfighting issues.

Commissioned as the Wayne P. Hughes, Jr. Naval Warfare Studies Institute (NWSI) in late 2020, NWSI spent 2021 maturing into an essential portal connecting the fleet and force with NPS research and expertise, as advantage at sea faces new operational challenges.

“NWSI epitomizes what we at NPS are seeking to deliberately achieve, and that is the alignment of our work, our research, our education, our students and faculty focused on those things that are important to our warfighters,” said NPS President retired Vice Adm. Ann Rondeau. “NWSI is

how we can bring together all that we are here at NPS to Great Power Competition in this Cognitive Age ... This is the way of the future.”

NPS has the capability to thoroughly explore every aspect of these emerging naval warfighting concepts, and NWSI provides a single point of entry to harness this capability. Such unity of effort has become an imperative in the Cognitive Era, in which intelligent systems, big data, machine learning and artificial intelligence increasingly augment human activity and decision-making.

NPS combines expertise in these topics in a way that no other university can. As new operational challenges, capability gaps, tactical problems and technical issues unfold, NWSI will respond by breaking them down into the best education and research-related sub-topics and components.

“We will then federate them across our 400+ incredibly talented and diverse faculty and our 1,400+ operationally-experienced mid-grade officers for solution development,” said Col. Randy Pugh, NWSI Deputy Director and NPS Senior Marine Corps Representative. “NWSI will also provide our stakeholders a conduit to all of NPS’ relationships with civilian universities, commercial and industry partners, the Naval Education Enterprise, the Naval Research and Development Establishment, and the Fleet and Marine Forces.




“The bottom line is that solving tomorrow’s complex problems will require an enterprise approach and NWSI is expressly designed to help broker and then support the required cross-organizational relationships and interdisciplinary solution development,” he continued. ■



Did You Know?

NPS’ Naval Warfare Studies Institute launched the Seapower Conversations series, featuring informal conversations with leading Navy, Marine Corps and defense experts on the trends, technologies and tactics that shape modern seapower.

Episodes include:

- A review of the Tri-Service Maritime Strategy: Advantage at Sea from the lead authors representing the Navy, Marine Corps and Coast Guard. 
- A five-part discussion with legendary Naval strategist, the late Capt. Wayne P. Hughes, USN (ret.) on the guiding principles of his Fleet Tactics. 
- A discussion on recent updates to the NWP-3, the U.S. Navy doctrinal foundation for Naval warfare at the operational level. 





WILLIAM MCRAVEN

Author of the Theory of Special Operations

Graduated 1993



Prepared for History — NPS and Operation Neptune Spear

May of 2021 marked the 10-year anniversary of one of the most consequential and well known military missions in modern U.S. history. Executed on an unremarkable compound in a relatively unknown city in northern Pakistan, the mission to neutralize Osama bin Laden, known as Operation Neptune Spear, made history worldwide and propelled one of the central figures in the execution of this pivotal mission into the global spotlight.

What is less known about that central figure, retired Adm. William H.

McRaven, is that he directly utilized what he learned at the Naval Postgraduate School in the planning and execution of that mission ... And quite a few others, in fact.

“Every day ... From the time I left the school, it didn’t take me long to realize that what I had been taught — the concepts, the ways of examining problems — has been exceedingly valuable to me,” McRaven stated during an interview one year following the raid at Abbottabad. “And as we look at the number of tactical operations I have had the good fortune to run, over the last three years

in particular, I applied the theory many times, and the theory proved out every single time — most notably in May.”

The “theory” refers to the “Theory of Special Operations,” a foundational text authored by McRaven that is very well known in the SOF community. “Special Ops: Case Studies in Special Operations Warfare Theory and Practice,” as it was aptly titled when finally published, was born from McRaven’s voluminous 612-page thesis, completed for his dual degree in 1993 from NPS. ■



Did You Know?

In a 2021 edition of the *Journal of Strategic Studies*, NPS’ Dr. James Wirtz provided a detailed analysis on McRaven’s impact on the 2011 raid, and how these might be adapted to the current strategic utilization of special operations. Check it out at: <https://tinyurl.com/2s684nxt>.



◀ **WATCH** William McRaven describe the impact of his Naval Postgraduate School education, and offer his perspectives on leadership to current NPS students in this 2021 Secretary of the Navy Guest Lecture.





“Thank you for making this effort. You and our joint force will be better and stronger because of it as this chapter of learning comes to an end.”



Vice Adm. Lisa Franchetti, USN
Commencement Speaker,
March 2021 Virtual Graduation



“Central to our success is the strength of our intellectual capital and creativity. We require leaders of competence and character who think freely and leverage the strength of diverse thinking from their teams ... You now possess knowledge, skills and abilities in an enhanced cognitive toolkit that will allow you to drive solutions.”



Vice Adm. Jeffrey Hughes, USN
DCNO for Warfighting Development (N7)
Commencement Speaker, June 2021 Graduation

Advancing Leadership Through Graduate Education, Research



The mission of the Naval Postgraduate School is to provide defense-focused graduate education, including classified studies and interdisciplinary research, to advance the operational effectiveness, technological leadership and warfighting advantage of the Naval service.

The impact of that critical mission is felt every three months, when the next class of NPS graduates is returned to the fleet and force more prepared to lead than when they arrived on the campus only months before.

NPS graduates are true warrior-scholars. They are well prepared, poised to make a great im-

pact wherever they go as leaders of our nation’s defense forces, partner agencies and coalition forces.

With the university’s unique mission and defense focus guiding its every action, the education provided by NPS to its graduates strengthens the leadership qualities, strategic abilities and warfighter capabilities that were infused in its military officer students the day they put on the uniform. A degree from NPS qualifies these men and women to claim an increase in knowledge and skills that advances the operational effectiveness, technological leadership and warfighting advantage of the Naval service. There is no other university in the

world that can make that claim in all of its graduates.

NPS is the realization of what NPS alumnus and current Secretary of the Navy Carlos del Toro coined “Strength in Unity.” It is a collaborative, interdisciplinary education and research environment that seamlessly integrates U.S. and allied armed services, and a wide range of global partnerships ... The result ... a standard of excellence that is unmatched anywhere.

In 2021, NPS returned thousands of graduates to the Navy, Marine Corps and the broader, global defense establishment. That is mission accomplished. ■



“This institution and our military’s technological advancement are completely linked ... For more than a century, the Naval Postgraduate School provided students with top-of-the-line, defense-focused education.”



Vice Adm. Roy Kitchener, USN
Commander, Naval Surface Forces
Commencement Speaker, September 2021 Graduation



“NPS is simply a national treasure with cutting-edge research and brilliant motivated students from a variety of backgrounds ... As you depart back to your commands, you leave with a great deal of new knowledge – including, most importantly, the ability to think through and solve problems and improvements needed to execute our national security strategy.”



Lt. Gen. Eric P. Wendt, USA (ret.)
Commencement Speaker, December 2021 Graduation

YEAR IN REVIEW

JAN

The university's **RAILGUN LABORATORY** — the largest of any academic institution — specializing in innovative, applied research in hypervelocity projectile (HVP) technology, advances its first cohort of graduates.



◀ **RETIRED ADM. CECIL HANEY**

presents a Secretary of the Navy Guest Lecture and introduces for induction the 24th nominee selected to join the NPS Hall of Fame, retired Vice Adm. Edward Moore.

FEB



◀ **XEROX AND NPS** announce a strategic collaboration focused on advancing additive manufacturing research, specifically liquid metal 3D printing, used to transform the way the military supplies its forward-deployed forces.

NPS launches its first graduate certificate program in **GREAT POWER COMPETITION** for 31 Navy and USMC students.

MAR

LAWRENCE LIVERMORE NATIONAL LABORATORY extends its long history with NPS by agreeing to share resources and provide education focused on solving future challenges to national defense.



◀ At the **NPS FIELD LAB AT CAMP ROBERTS**, 325 people from 208 unique government agencies, military commands, and private companies showcase, test and/or evaluate their latest technologies.

APR



◀ To resolve vital climate and security issues, NPS launches the interdisciplinary **CLIMATE AND SECURITY NETWORK**.

NPS, NASA team up on **"ASTROBATICS"** project advancing spacecraft robotics.

2021

NPS launches the Naval Warfare Studies Institute (NWSI) to connect the Fleet to NPS research, talent, resources and expertise to resolve complex warfighting issues and operational challenges.

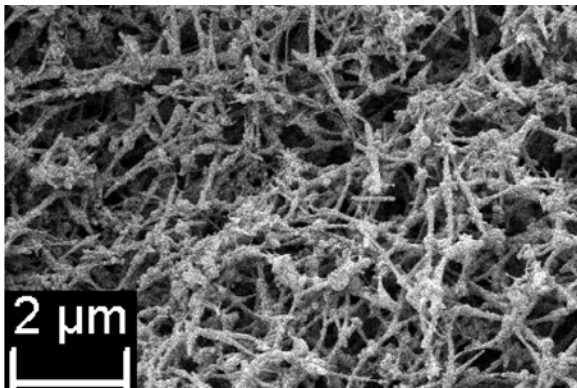
NAVAL WARFARE STUDIES INSTITUTE



MONTEREY PHOENIX, a NPS-developed behavior analysis tool for calculating potential system errors prior to writing code, becomes free and available to the public.



◀ **THE DEPARTMENT OF DEFENSE** selects NPS to advance research in environmental resilience and surprise to meet future climate challenges to operations at military installations.



◀ NPS enters into a **COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENT (CRADA)**, with BNNano, an advanced manufacturing company known for producing cutting-edge Boron Nitride Nanotubes, to explore potential defense applications for nanomaterials.

Enlisted Marine **STAFF SGT. WARREN DIFFEY** earns top Marine Corps student award.



NPS RECEIVES the maximum 10-year re-accreditation from the Western Association of Schools and Colleges Senior College and University Commission (WSCUC).

WASC | Senior College and University Commission



◀ The NPS community welcomes **DR. SCOTT GARTNER** as the university's 16th Provost and Academic Dean.

YEAR IN REVIEW

MAY

NASA teams with researchers at NPS and the International Space Station to conduct the first of five experiments of the **"ASTROBATICS" PROJECT**, designed to develop and test dynamic models, guidance and control techniques for the maneuvering of autonomous robotic spacecraft.



◀ The School hosts a virtual event, **"ASK AN ASTRONAUT,"** a Q&A session featuring three NPS astronauts, attended by military children and students from across the country.

JUN



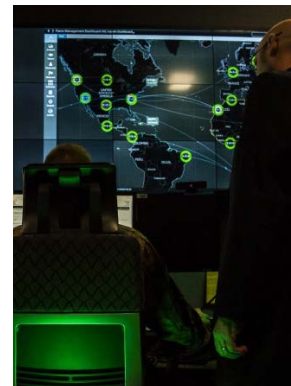
◀ NPS offers its first **"CYBERSPACE AND MILITARY OPERATIONS"** course focusing on the interconnection between cyberspace and the Great Power Competition.

NPS Oceanography **PROFESSOR MARA ORESCANIN WINS NATIONAL SCIENCE FOUNDATION CAREER PROGRAM GRANT**



JUL

The university begins a new certificate program called **"IMPLEMENTING TECHNOLOGICAL CHANGE"** to help support policy development and organizational change.



◀ The new **CENTER ON COMBATING HYBRID THREATS** opens to help detect, disrupt and deter hybrid threats by state and non-state actors.

AUG

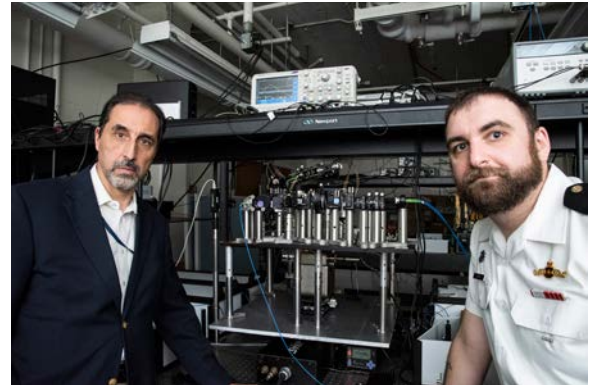
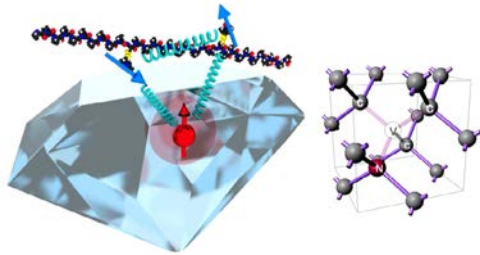


◀ A new curriculum on cyberwarfare is launched with NAVSEA sponsorship to educate the **CYBER WARFARE ENGINEER COMMUNITY** and future cyber warriors in the Navy and DOD.

A TRIO OF NAVAL AVIATORS attending NPS begin a trend—taking command of a squadron upon graduation.

2021

NPS PHYSICS PROFESSORS advance quantum sensing for the Navy which will detect and track platform motion in the absence of GPS capabilities in water or space.



RESEARCHERS DEVELOP a set of tools to support the acquisition of organically-developed AI systems that can determine the potential worth of technology emerging from start-up companies around the world.



◀ Keynote graduation speaker Deputy CNO for Warfighting Development **VICE ADM. JEFF HUGHES** congratulates 364 graduates, including 23 international students from 15 countries, stressing how the nation's warfighting advantage in this era will hinge on intellectual capital and technological innovation.



◀ Management professors develop the **DYNAMIC RETENTION MODEL**, which uses predictive analytics to assist in Navy recruitment, promotion and retention and in understanding the impact of pandemics on the workforce.

NPS Cybersecurity Expert Explores 'Weapons of Mass Disruption' in new **BITSKRIEG** book, by distinguished professor emeritus Dr. John Arquilla.



BITSKRIEG
THE NEW CHALLENGE
OF CYBERWARFARE

NPS hosts the **70TH ANNUAL ORDNANCE AND BALLISTICS WORKING GROUP** with the National Armaments Consortium to discuss classified research on explosives, warheads and terminal ballistics.

Navy **INSPECTOR GENERAL** assessment successfully completed, NPS self-evaluation credited as a **BEST PRACTICE**



◀ The campus welcomes the Navy Message to the Fleet from NPS alumnus (Space Systems Engineering) and 78th Secretary of the Navy, the Honorable **CARLOS DEL TORO.**

YEAR IN REVIEW

SEP

In partnership with AT&T, NPS converts a local wastewater treatment plant into the **SEA LAND AIR MILITARY RESEARCH LAB (SLAMR)**, for research in robotics, autonomous systems, cybersecurity and maritime related 5G telecommunications.



◀ Commencement speaker and NPS alumnus, Vice Adm. **ROY KITCHENER**, congratulates the 294 graduates, including 23 international students from 5 countries, conveying how the nation's warfighting ability is directly correlated to a NPS education.

OCT

 National Centers of Academic Excellence
IN CYBERSECURITY



◀ The National Security Agency's Center for Academic Excellence in Cyber Operations requests support from NPS to sponsor a **CYBER SUMMER INTERNSHIP PROGRAM** as part of the National Initiative for Cybersecurity Education.

TMGORE joins NPS in high-density computing experiments to test and evaluate Edgebox technology for advancing the mission objectives of military operators.

NOV

The first cohort of NPS graduates in the **WARFARE TACTICS INSTRUCTORS PROGRAM** return to the Fleet to serve in critical operational billets in anti-submarine and surface, amphibious, mine, or integrated air and missile defense warfare.



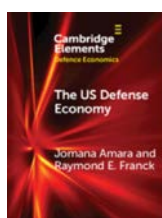
◀ NPS Applied Mathematics Professor Dr. Pantelimon Stanica receives the **INTERNATIONAL GEORGE BOOLE PRIZE** for his advanced research in cryptographic Boolean functions.

DEC



◀ NPS celebrates with its associate professor, Sam Buttrey, winner of the inaugural **"JEOPARDY" PROFESSORS TOURNAMENT**.

Cambridge University Press publishes **THE U.S. DEFENSE ECONOMY** co-authored by Dr. Jomana Amara, which examines defense industry consolidation, re-sourcing gaps and developments likely to shape the defense economy's future.



2021

Naval Postgraduate School teams with experts from the Joint Directed Energy Transition Office to host the **LASER LETHALITY TECHNICAL AREA WORKING GROUP** to collaborate and review DOD laser lethality programs and their technical efforts and results.

NPS honors victims, first responders, service members at the 20th anniversary **9/11 REMEMBRANCE CEREMONY**, in front of the university's Herrmann Hall.



Retired Navy Adm. **JAMES STAVRIDIS** speaks to the campus about technological warfare, the changing geopolitical environment, and how junior officers can develop into brilliant leaders.



◀ NPS alumnus Adm. **SAMUEL PAPARO** visits NPS to discuss critical operational challenges facing the fleet in the Pacific, and how NPS and Silicon Valley might partner on solutions.

“NPS is the flagship technical graduate school for the Navy and DOD.”

Commander, U.S. Pacific Fleet, Adm. Samuel Paparo



◀ A chief petty officer (CPO) pinning ceremony for **THREE NEW NPS CHIEFS** was held inside King Auditorium.

NPS Marine Corps Student competes in **NATIONAL JUDO COMPETITION**.



A NEW NODE IS CONNECTED between NPS and the Joint Information Operations Range, giving access to a globally-distributed, closed-loop, live-fire cyber range complex that enables classified training, testing and experimentation.

NPS leads graduate schools in **NASA ASTRONAUT SELECTIONS**; Luke Delany USMC (retired) and LCDR Jessica Wittner are latest alumni chosen.



◀ NPS Distinguished Alumnus retired U.S. Army Lt. Gen. **ERIC WENDT**, keynote speaker, encourages the class of 331 graduates to use their knowledge, remember their classmates, and enthusiastically recruit others to attend NPS.

Mission Measures

Naval Postgraduate School



Current Leadership

President: Dr. Ann E. Rondeau, Vice Admiral, USN (Ret.)
Provost: Dr. Scott Gartner
Chief of Staff: CAPT Philip Old, USN
Vice Provost: Dr. Michael Freeman
Dean of Students: CAPT Brandon Bryan, USN
Dean of Research: Dr. Kevin Smith
Assoc. Provost, Graduate Education: Dr. Dennis Lester
Assoc. Provost, Faculty Affairs: Dr. Jomana Amara

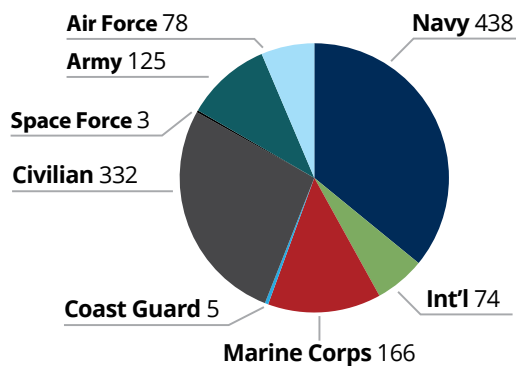
2021 Student Engagement

1,446 Resident Degree
 808 Distance Learning Degree
 513 Certificate/Non-Degree
 14,441 EE/PD*
17,208 total engagement

2021 Degrees Awarded

1,205 Master's Degrees
 16 Doctorates (PhDs)
1,221 total degrees

NPS Graduate Degrees Conferred by Service



* EE/PD = Executive Education/Professional Development

Faculty & Staff

213 Tenure Track Faculty
Non Tenure Track Faculty:
 165 Instructional Faculty
 174 Research Faculty
 17 Administrative Faculty
 318 Staff

Student Faculty Ratio

7:1*

* Tenure and non-tenure instructional faculty

Financials

- \$113 million Direct Authorization (w/o military salary)
- Approx \$97 million in sponsored/reimbursable education & research programs
- NPS utilizes a University Operating Model with reimbursable operations
- Delivers high-value leverage in a resource-constrained environment
- Enables responsive, diverse Grad-Ed and research results

Academic Facilities

62 Classrooms that offer media technology
 8 Classrooms with Video-Conferencing
 4 FLEX Classrooms of the Future
 4 Auditoria
 48 Labs

Accreditations

- WASC Senior College and University Commission (WSCUC)
- Accreditation Board for Engineering and Technology (ABET)
- Network of Schools of Public Policy, Affairs, and Administration (NASPAA)
- Association to Advance Collegiate Schools of Business (AACSB)

Source: Office of Institutional Research

STUDENTS & PROGRAMS



Above:
NPS students mentor local high schoolers in
"Breakfast for Your Brain."

Graduate Program Enrollment

2021

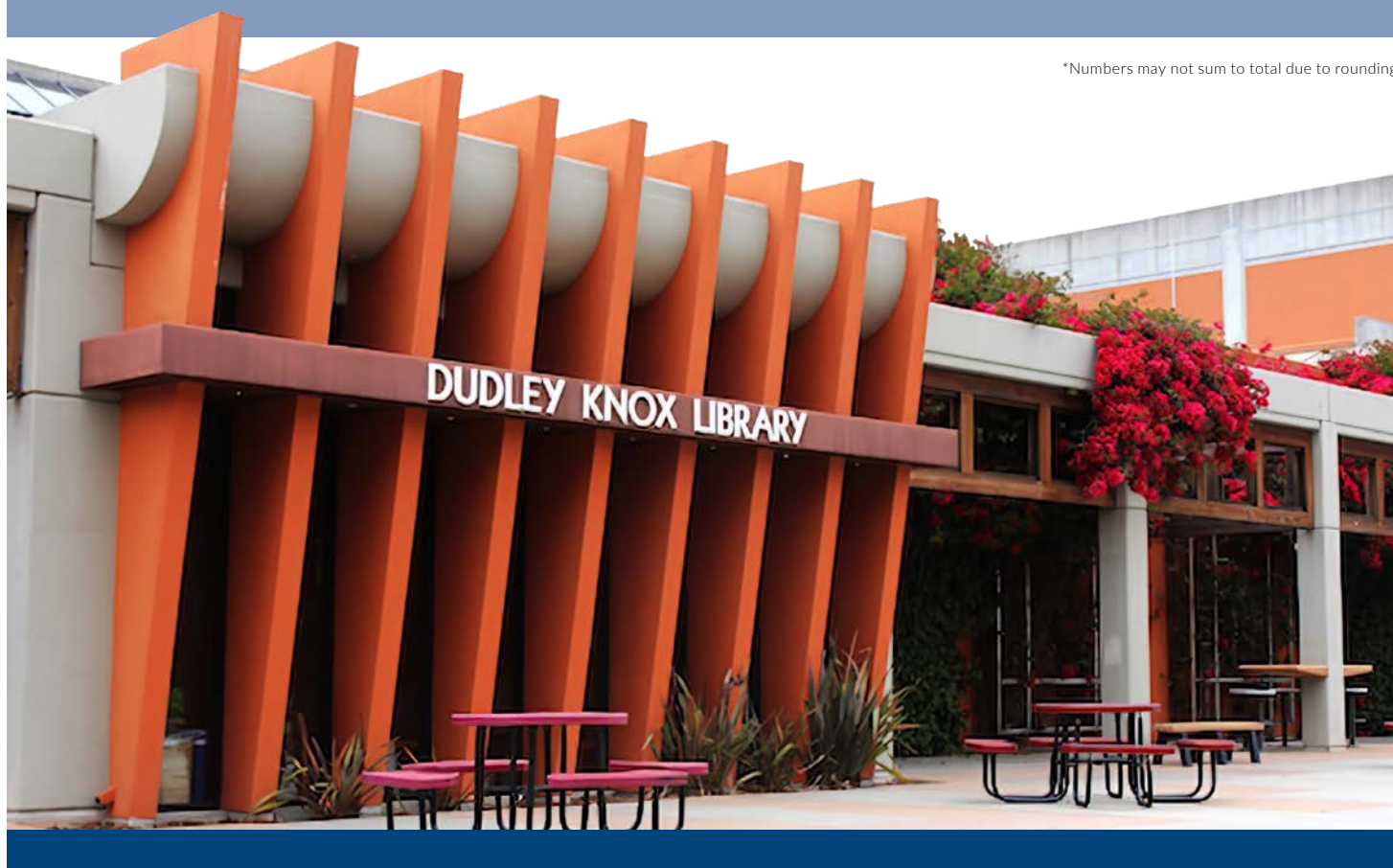
1,446 FULL TIME RESIDENT DEGREE

808 DISTANCE LEARNING (DL) DEGREE

513 GRADUATE CERTIFICATE AND NON-DEGREE



*Numbers may not sum to total due to rounding.



Graduate Student Enrollment

By Service

In 2021, 2,767* students attended the Naval Postgraduate School. NPS is a place where operationally experienced officers from the joint services, civilians from various defense and homeland security organizations, and international students from nearly 50 countries come together to learn from, and work with, a world-class faculty focused on global security issues vital to our national security strategy.

Type of Enrollment By Service	Full-Time Resident Degree	Distance Learning (DL) Degree	Graduate Certificate & Non-Degree
USN/R	629	274	157
USMC/R	239	45	48
USA/R	190	13	12
USAF/R	108	1	33
Other Services	13	0	1
Civilian	148	474	252
International	120	2	11



* Does not include EE/PD
 **Numbers may not sum to total due to rounding.

Graduate Student Enrollment

Total US Navy



629 FULL TIME RESIDENT DEGREE

274 DISTANCE LEARNING (DL) DEGREE

157 GRADUATE CERTIFICATE AND NON-DEGREE



Graduate Student Enrollment

By USN/R Community

In 2021, 1,060 USN/R students attended the Naval Postgraduate School. Student research addresses critical real world requirements relevant to combatant commander and warfighter needs through a unique integration of government agencies, commercial enterprises, other notable research universities and our allies.

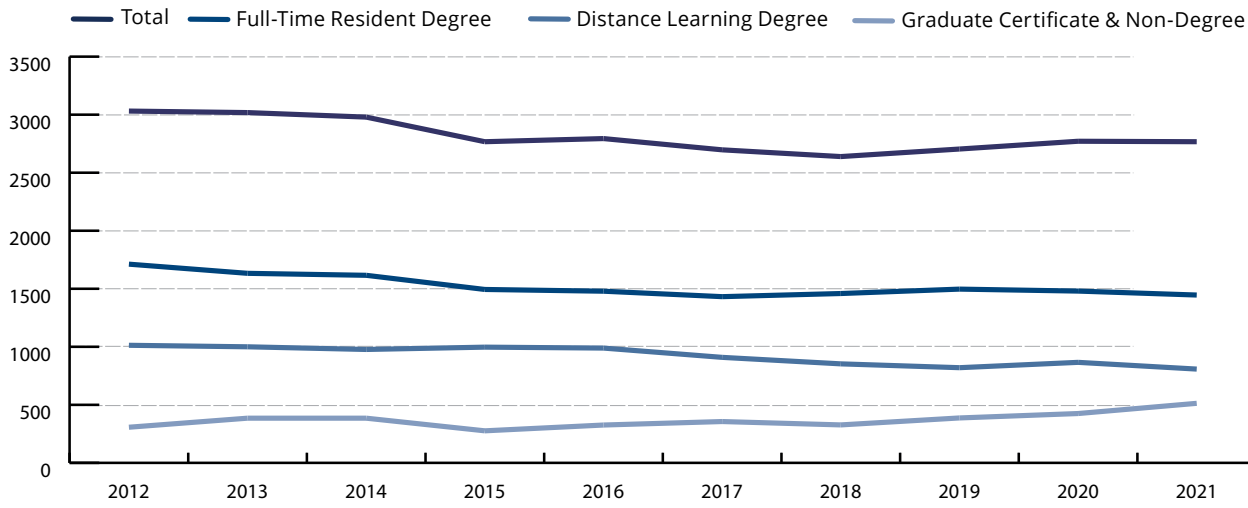
Type of Enrollment By USN/R Community	Full-Time Resident Degree	Distance Learning (DL) Degree	Graduate Certificate & Non-Degree
Aviation	47	62	22
Enlisted	8	1	16
Limited Duty	2	6	3
RL	313	47	71
Special Operations and Warfare	19	6	7
Staff Corps	95	57	14
Submarine Warfare	51	45	12
Surface Warfare	94	49	12
Warrant Officer	0	1	2



*Numbers may not sum to total due to rounding.

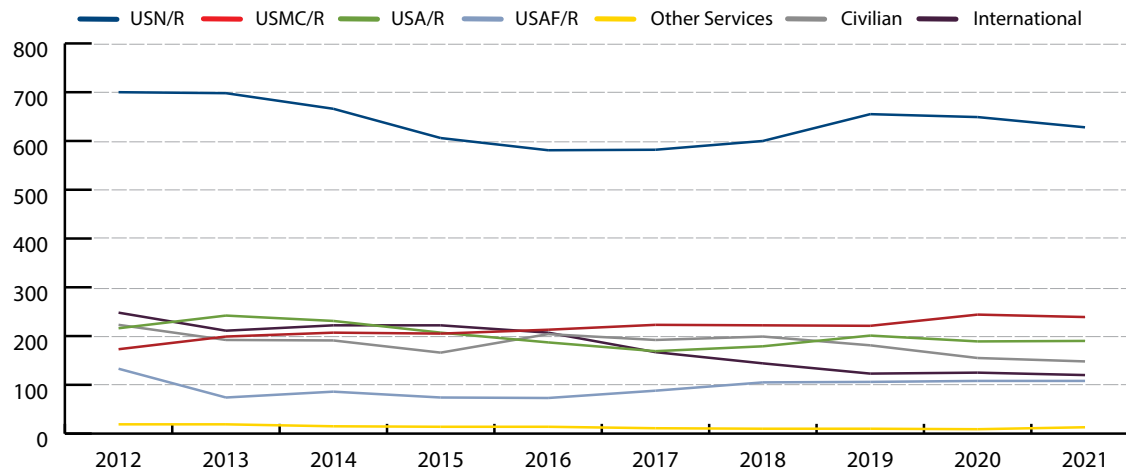
Graduate Student Enrollment Trends

By Type of Enrollment



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Full Time Resident Degree	1,712	1,633	1,616	1,494	1,479	1,432	1,459	1,497	1,480	1,446
Distance Learning (DL) Degree	1,013	1,000	977	997	989	909	853	820	866	808
Certificate and Non-Degree	307	385	385	276	326	356	327	387	425	513
Total	3,031	3,018	2,979	2,767	2,794	2,697	2,639	2,704	2,771	2,767

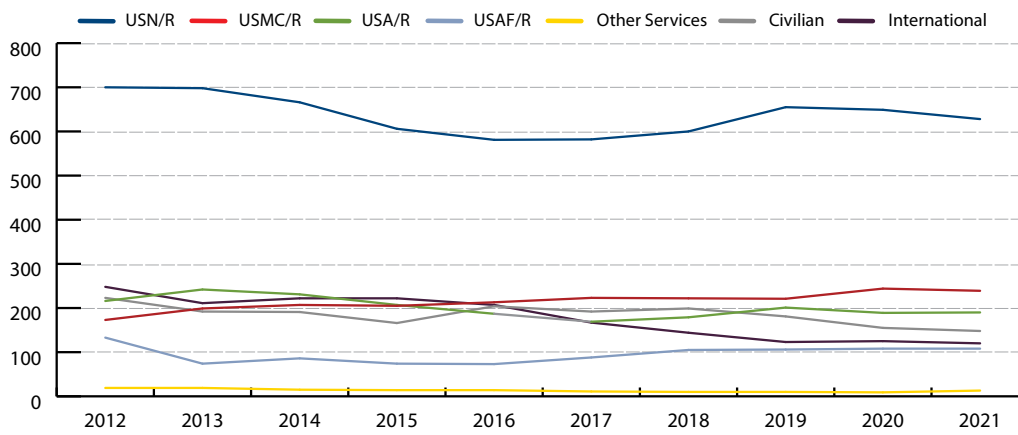
Resident Degree Students by Service



*Average on Board Student Population

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
USN/R	700	698	666	606	581	582	600	655	649	628
USMC/R	173	199	207	205	213	223	222	221	244	239
USA/R	216	242	231	207	187	169	179	201	189	190
USAF/R	133	74	86	74	73	88	105	106	108	108
Other Services	19	19	15	14	14	11	10	10	9	13
Civilian	223	192	191	166	204	192	199	181	155	148
International	248	211	222	222	207	167	144	123	125	120
Resident Degree Totals	1,712	1,633	1,616	1,494	1,479	1,432	1,459	1,497	1,480	1,446

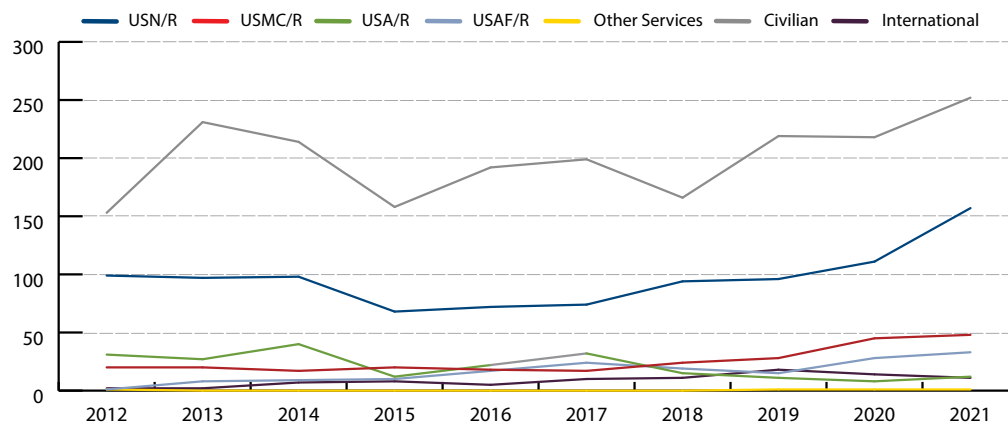
Distance Learning Degree Students by Service



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
USN/R	366	343	335	335	306	277	291	277	256	274
USMC/R	16	17	26	39	39	31	37	43	53	45
USA/R	5	7	8	12	11	8	8	13	14	13
USAF/R	22	14	6	1	1	1	0	2	2	1
Other Services	0	0	0	0	0	0	0	0	0	0
Civilian	605	620	601	608	630	592	517	484	540	474
International	0	0	1	2	2	0	1	2	1	2
DL Degree Totals	1,013	1,000	977	997	989	909	853	820	866	808

*Average on Board Student Population

Graduate Certificate and Non-Degree Students by Service

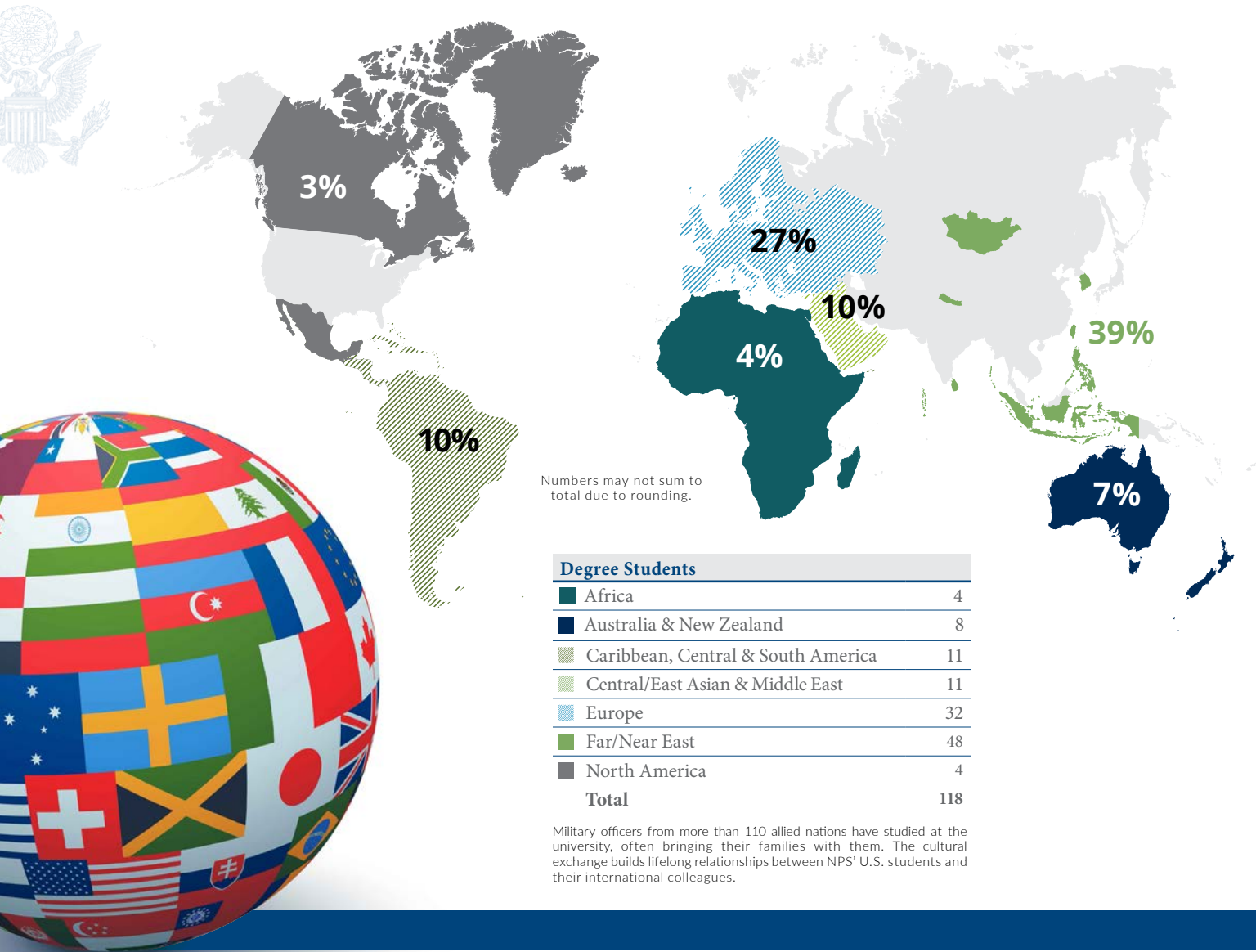


	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
USN/R	99	97	98	68	72	74	94	96	111	157
USMC/R	20	20	17	20	18	17	24	28	45	48
USA/R	31	27	40	12	22	32	15	11	8	12
USAF/R	1	8	9	10	17	24	19	15	28	33
Other Services	1	0	0	0	0	0	0	1	1	1
Civilian	153	231	214	158	192	199	166	219	218	252
International	2	2	7	8	5	10	11	18	14	11
Certificates and Non-Degree Totals	307	385	385	276	326	356	327	387	425	513

International Resident Degree Students By Region



Africa		Caribbean, Central and South America		Europe		Far/Near East	
Ghana	1	Brazil	7	Armenia	1	Indonesia	6
Malawi	1	Chile	1	Bulgaria	1	Japan	1
Sierra Leone	1	Costa Rica	1	Denmark	1	Korea	8
Uganda	1	Guyana	1	Estonia	1	Maldives	1
Total	4	Peru	1	Finland	1	Mongolia	3
		Total	11	Georgia	3	Nepal	1
				Germany	4	Philippines	7
Australia and New Zealand		Central/East Asia & Middle East		Greece	10	Singapore	18
Australia	8	Israel	1	Hungary	2	Taiwan	3
Total	8	Pakistan	6	Lithuania	1	Total	48
		Saudi Arabia	4	Netherlands	2		
		Total	11	Norway	2	North America	
				Portugal	1	Canada	2
				Sweden	4	Mexico	2
				Total	32	Total	4



Degrees Conferred

By Degree Type

1,205 MASTER'S DEGREES

16 DOCTOR OF PHILOSOPHY DEGREES (PH.D)



Degrees Conferred

by Academic Unit



CAG – CYBER ACADEMIC GROUP	18
MS Computer Science	10
MS Cyber Systems and Operations	6
MS Engineering Science (Electrical Engineering)	2
CS – COMPUTER SCIENCE	39
MS Computer Science	31
MS Modeling, Virtual Environments and Simulation	7
PhD Computer Science	1
DA – DEFENSE ANALYSIS	80
MS Defense Analysis	1
MS Defense Analysis (Astronautics)	2
MS Defense Analysis (Information Operations)	2
MS Defense Analysis (Irregular Warfare)	63
MS Defense Analysis (Operations Analysis)	2
MS Information Strategy and Political Warfare	10
ECE – ELECTRICAL AND COMPUTER ENGINEERING	67
EE Electrical Engineer	1
MEng Electrical Engineering	28
MS Electrical Engineering	34
MS Engineering Science (Electrical Engineering)	1
PhD Electrical Engineering	3
DDM – DEPARTMENT OF DEFENSE MANAGEMENT	302
EMBA Executive Master of Business Administration	87
MBA Master of Business Administration	114
MS Contract Management	44
MS Management	35
MS Program Management	18
PMBA Professional Master of Business Administration	4
IS – INFORMATION SCIENCES	54
MS Applied Cyber Operations	4
MS Information Technology Management	13
MS Information Warfare Systems Engineering	11
MS Network Operations and Technology	18
MS Systems Technology (Command, Control, and Communications)	3
PhD Information Sciences	5
MA – APPLIED MATHEMATICS	10
MS Applied Mathematics	9
PhD Applied Mathematics	1
MAE – MECHANICAL AND AEROSPACE ENGINEERING	58
MS Engineering Science (Aerospace Engineering)	14
MS Engineering Science (Electrical Engineering)	1
MS Engineering Science (Mechanical Engineering)	13
MS Mechanical Engineering	30

MR – METEOROLOGY	16
MS Meteorology	3
MS Meteorology and Physical Oceanography	12
PhD Meteorology	1
NSA – NATIONAL SECURITY AFFAIRS	209
MA Security Studies (Civil-Military Relations)	3
MA Security Studies (Combating Terrorism: Policy and Strategy)	9
MA Security Studies (East Asia and the Indo-Pacific)	29
MA Security Studies (Europe and Eurasia)	23
MA Security Studies (Homeland Security and Defense)	74
MA Security Studies (Middle East, South Asia, Sub-Saharan Africa)	41
MA Security Studies (Strategic Studies)	5
MA Security Studies (Western Hemisphere)	23
MS Strategy (Space Operations)	1
PhD Security Studies	1
OC – OCEANOGRAPHY	5
MS Physical Oceanography	3
PhD Physical Oceanography	2
OR – OPERATIONS RESEARCH	105
M Cost Estimating and Analysis	17
M Human Systems Integration	8
M Operational Analysis (Warfare)	1
M Systems Analysis	22
MS Applied Science (Operations Research)	3
MS Human Systems Integration	1
MS Operations Research	53
PH – PHYSICS	31
M Engineering Acoustics	11
MS Applied Physics	16
MS Combat Systems Technology	1
PhD Applied Physics	1
MS Engineering Acoustics	1
MS Physics	1
PhD Applied Physics	1
SE – SYSTEMS ENGINEERING	186
MS Engineering Systems	13
MS Systems Engineering	98
MS Systems Engineering Management	74
PhD Systems Engineering	1
SE/OR – SYSTEMS ENGINEERING/OPERATIONS RESEARCH	2
MS Systems Engineering	1
MS Systems Engineering Analysis	1

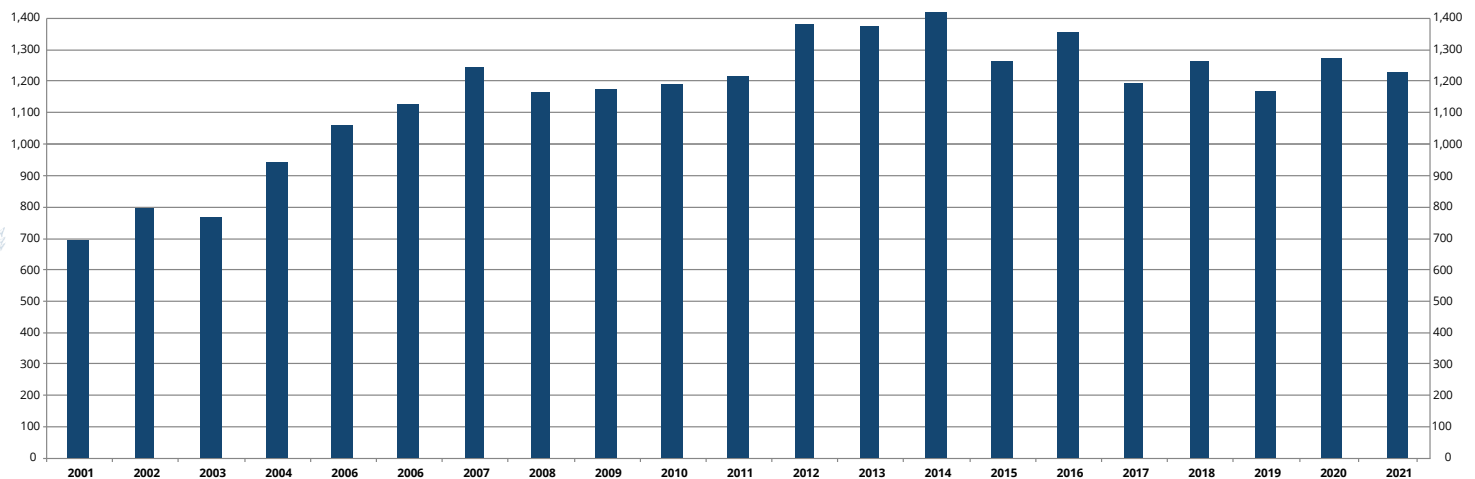


Degrees Conferred

by Academic Unit *continued*

SP – SPACE SYSTEMS ACADEMIC GROUP	29
MS Astronautical Engineering	10
MS Space Systems Operations	19
USWAG – UNDERSEA WARFARE ACADEMIC GROUP	10
MS Applied Mathematics	1
MS Astronautical Engineering	1
MS Engineering Acoustics	4
MS Operations Research	1
MS Physical Oceanography	3
NPS TOTAL	1,221

Degrees Conferred



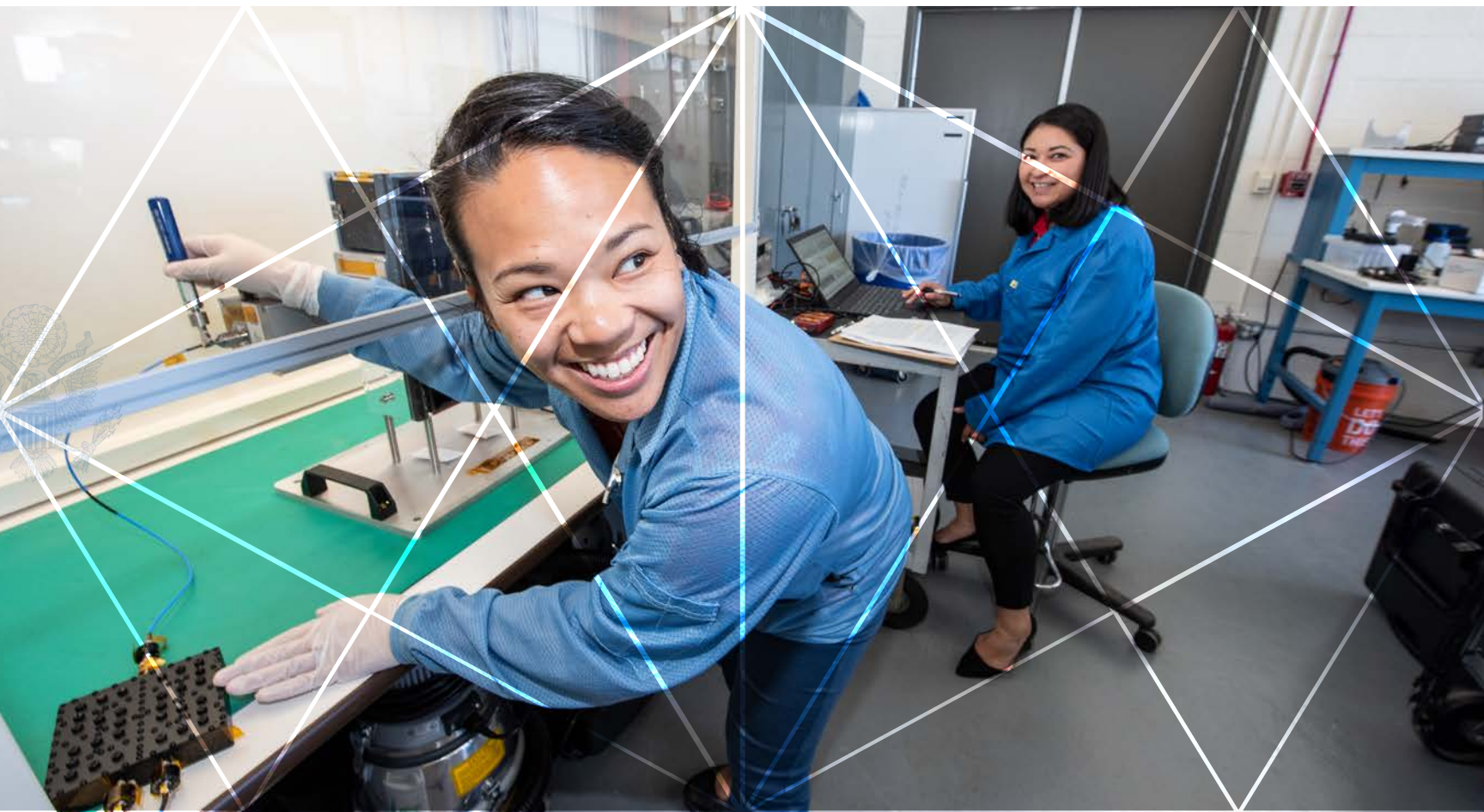
YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Degrees	696	798	771	940	1,059	1,122	1,241	1,170	1,179	1,188	1,210	1,379	1,373	1,411	1,269	1,358	1,193	1,260	1,161	1,275	1,221





Xerox chose NPS to install its first liquid metal 3D printer, the ElemX, to leverage the operational insights of military students with the expertise of faculty to study potential shipboard use cases.

RESEARCH & PROGRAMS



Above:
Mobile CubeSat Command and Control (MC3) ground station network research with industry and the Naval Research Lab.

Research & Sponsored Programs

Program Overview



The Naval Postgraduate School (NPS) has robust sponsored research and education programs. Per U.S. Code, Title 10 — 8541, NPS will “... provide advanced instruction and professional and technical education and research opportunities...” Sponsored programs (research, education, and professional development) are integral to the Naval Postgraduate School mission. The research programs support graduate education by providing militarily relevant thesis topics that address issues from the current needs of the Fleet and joint forces to the science and technology required to sustain long-term superiority of the Navy/DOD. Research varies from the fundamental to the applied and covers all levels of classification. Sponsored research includes:

- Fleet Support
- Basic and Applied Research
- Individual and Interdisciplinary Group Projects
- Cooperative Research and Development Agreements

Sponsored education programs include integrated graduate education and research in space systems, total-ship systems engineering, combat systems, systems engineering and homeland security and defense, supplemented by off-campus graduate and certificate programs. Professional development programs utilize NPS faculty expertise and student experience to support various communities within the Navy and DOD through short courses and web-based services.

Research Thrusts

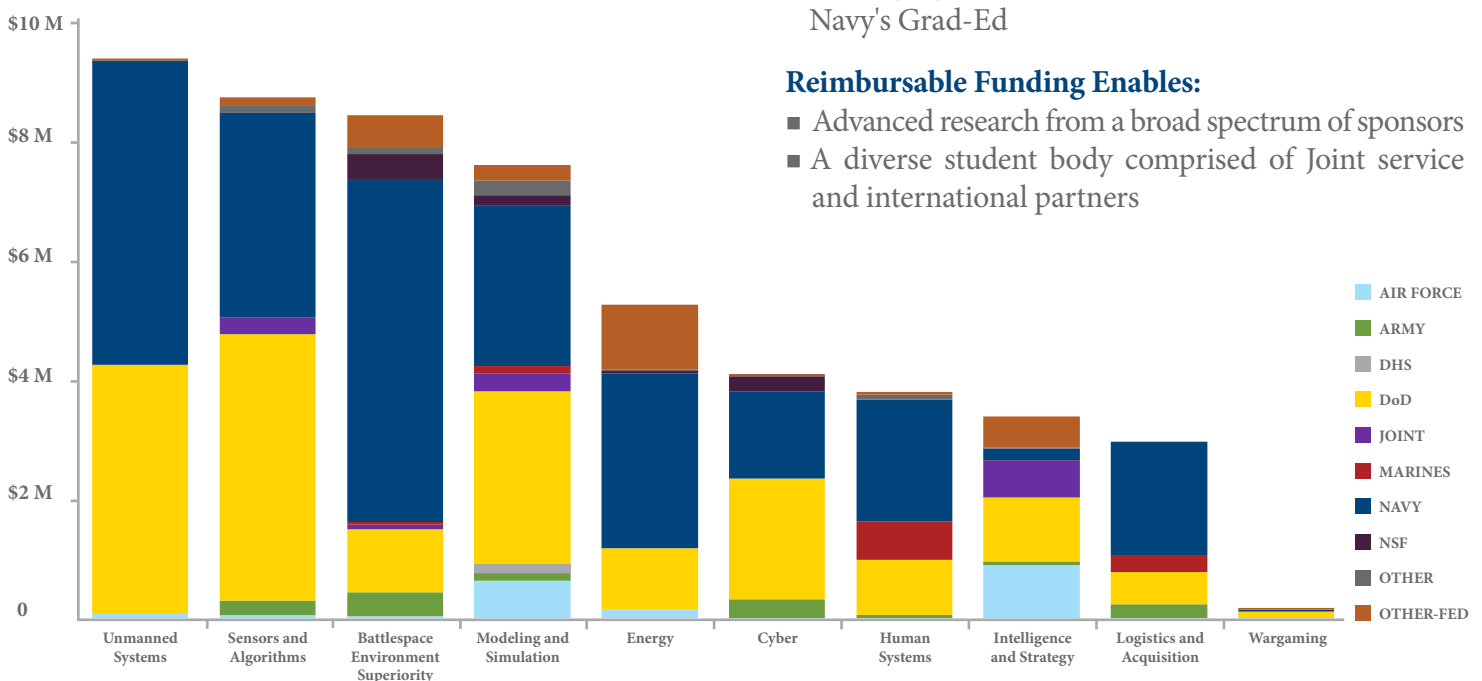
Research at NPS is intently focused on critical issues within the Departments of the Navy and Defense. Annually, the top 10 focal areas of NPS research are directly aligned to key operational problems detailed by Naval leadership in fleet and force strategies. For more about NPS research Centers see: <https://nps.edu/web/guest/departments>.

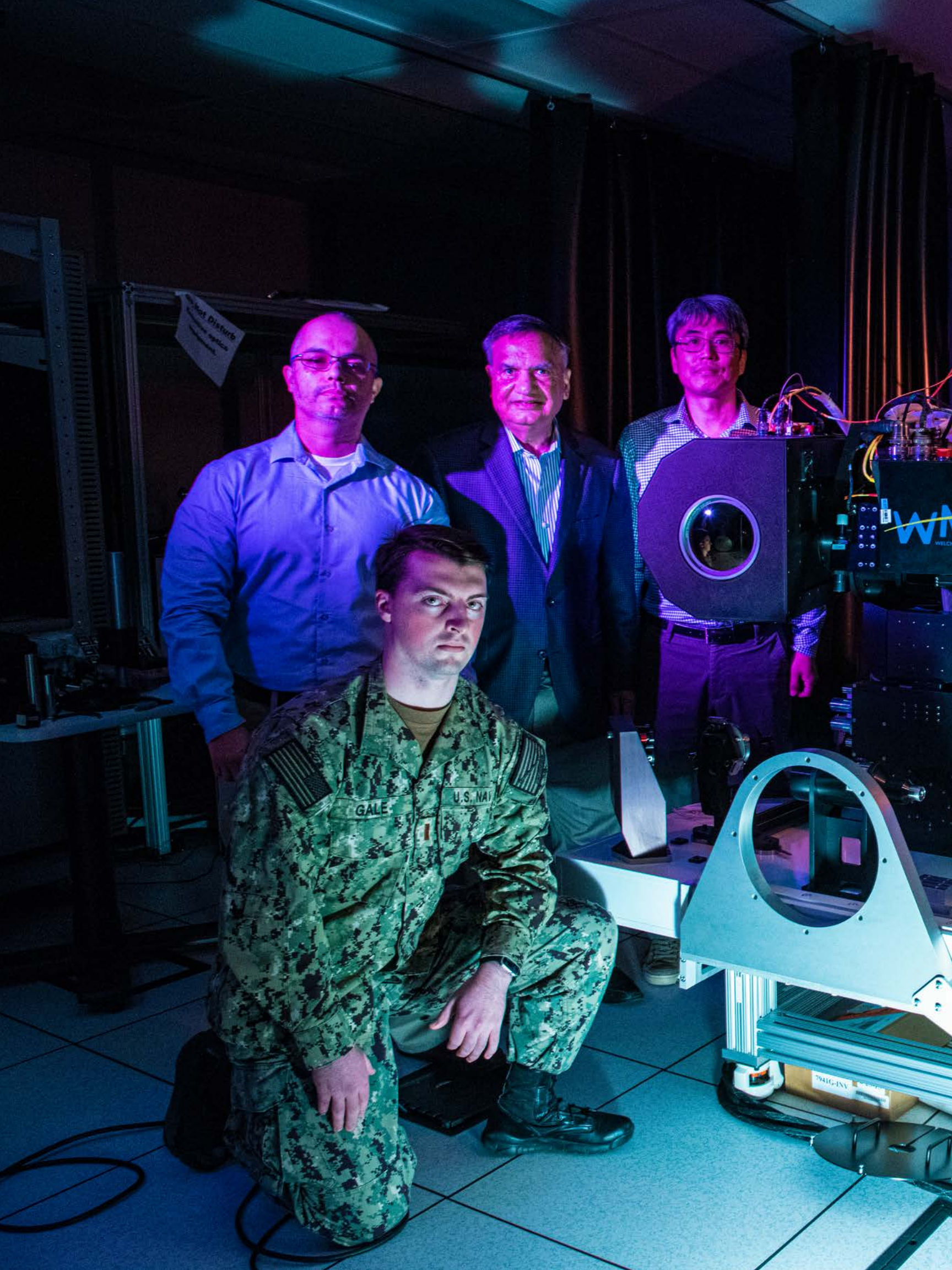
Research & Sponsored Programs Support:

- Operational relevance through resource sponsors
- Educational quality through theses and capstone projects
- Faculty Recruitment, Retention & Relevance with competitive proposals and peer-reviewed publications to maintain skillsets and expertise
- Leveraging reimbursables double the value of the Navy's Grad-Ed

Reimbursable Funding Enables:

- Advanced research from a broad spectrum of sponsors
- A diverse student body comprised of Joint service and international partners





Faculty and students use NPS' High-Energy Laser Beam Control Research Testbed to explore how the latest advances in adaptive optics and artificial intelligence can be utilized to improve the effectiveness of the laser weapons systems at sea.



EXECUTIVE EDUCATION



PROFESSIONAL DEVELOPMENT

Above:
Tailored Exec-Ed for U.S. and allied partners

Executive Education & Professional Development

Executive Summary

The Naval Postgraduate School (NPS) extends world-class executive education and professional development (EE/PD) programs to mid-and senior-grade professionals who are unable to take the time out of their careers to attend degree programs, or who need targeted information at their locations on their time schedules. In addition to degree and certificate courses offered for credit, Schools, Centers, Departments, Institutes and other organizations of NPS provide executive education, numerous short courses, seminars, fly-away teams and conferences to meet specific sponsors' needs. NPS' short courses do not award academic credit, but selected short courses may award continuing education units (CEUs). The primary organizations involved in EE/PD at NPS are:

- Center for Executive Education (CEE)
- Center for Homeland Defense and Security (CHDS)
- Center for Security Cooperation Support (CSCS)
- Center on Combating Hybrid Threats (CCHT)
- Defense Resources Management Institute (DRMI)
- Regional Security Education Program (RSEP)
- Academic Units (DA, DDM, EAG, OR)

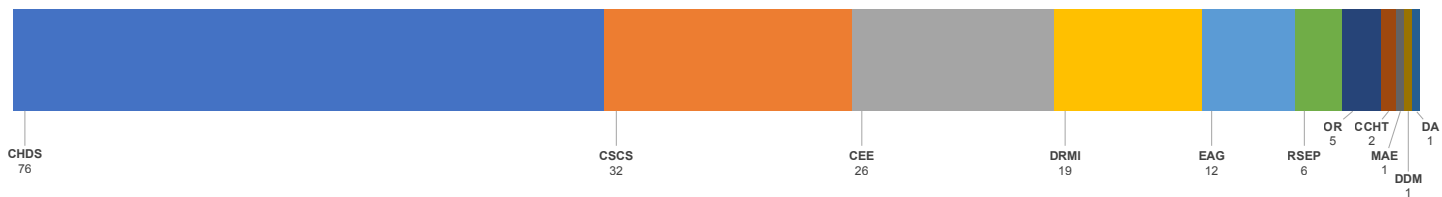
TOTAL STUDENTS BY AFFILIATION
(14,441 Total Students)



TOTAL COURSES BY SPONSOR
(181 Total Courses)



COURSES BY ORGANIZATION
(181 Total Courses)



FACULTY



Above:
NPS faculty are world-renowned experts in a broad range of critical defense disciplines.

Faculty

By Rank



Tenure Track

RANK	ACADEMIC DEPARTMENTS	RESEARCH OFFICE	ACADEMIC ADMIN	TOTAL
DISTINGUISHED PROFESSOR	19	--	--	19
PROFESSOR	90	1	3	94
ASSOCIATE PROFESSOR	66	--	--	66
ASSISTANT PROFESSOR	48	--	--	48
TOTAL	209	1	3	213

Non-Tenure Track

RANK	ACADEMIC DEPARTMENTS	RESEARCH OFFICE	ACADEMIC ADMIN	TOTAL
SENIOR LECTURER	59	--	2	61
LECTURER	42	--	11	53
PROFESSOR OF THE PRACTICE	22	1	1	24
RESEARCH PROFESSOR	9	--	--	9
RESEARCH ASSOCIATE PROFESSOR	27	--	--	27
RESEARCH ASSISTANT PROFESSOR	16	--	--	16
ADMINISTRATIVE FACULTY	8	--	9	17
ASSOCIATE FACULTY	136	2	7	145
VISITING FACULTY	4	--	--	4
TOTAL	323	3	30	356

NPS Faculty Distribution

	ACADEMIC DEPARTMENTS	RESEARCH OFFICE	ACADEMIC ADMIN	TOTAL
TENURE TRACK	209	1	3	213
NON-TENURE TRACK	323	3	30	356
TOTAL	532	4	33	569

NPS Faculty Distribution

	ACADEMIC DEPARTMENTS	RESEARCH OFFICE	ACADEMIC ADMIN	TOTAL
FACULTY	532	4	33	569
PERCENTAGE	93%	1%	6%	100%

US NEWS & WORLD REPORT BEST GRADUATE SCHOOLS

#1 Homeland Security and Emergency Management

#34 in Industrial/Manufacturing/Systems Engineering

#39 in Aerospace Engineering

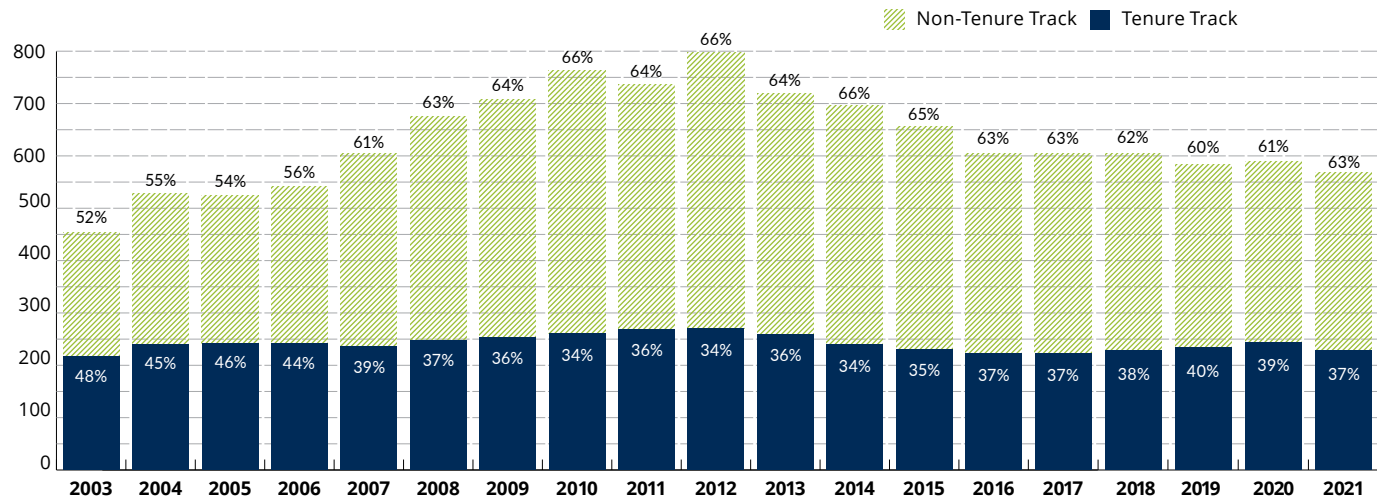
#75 in Electrical Engineering

#65 in Public Affairs

* EE/PD = Executive Education/Professional Development

Tenure Track/Non-Tenure Track Faculty

Trend since 2003-2004



	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
TENURE TRACK	240	242	241	236	248	254	260	269	270	259	239	230	223	228	231	227	230	213
NON-TENURE TRACK	288	283	301	369	428	454	504	468	527	460	457	426	382	384	379	347	358	356
TOTAL	528	525	542	605	676	708	764	737	797	719	696	656	605	612	610	574	588	569

Source: Faculty Administration

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
TENURE TRACK	45%	46%	44%	39%	37%	36%	34%	36%	34%	36%	34%	35%	37%	37%	38%	40%	39%	37%
NON-TENURE TRACK	55%	54%	56%	61%	63%	64%	66%	64%	66%	64%	66%	65%	63%	63%	62%	60%	61%	63%
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

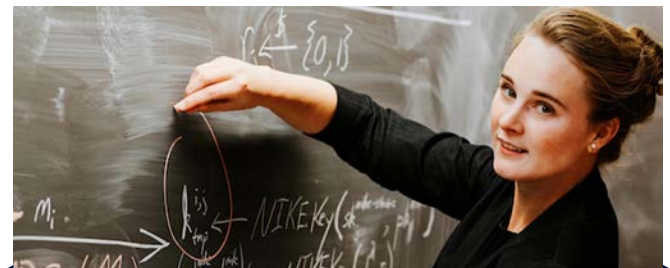
Faculty and Staff 2021

By Ethnicity

	Black/ African American	American Indian/ Alaskan Native	Asian	Native Hawaiian/ Pacific Islander	Hispanic	White	Two or More	Unknown	Total
NPS GS/WG	38	1	46	7	42	178	4	2	318
NPS FACULTY	5	2	45	3	22	483	2	7	569
TOTAL	43	3	91	10	64	661	6	9	887

By Gender

	Female	Male	Total
NPS GS/WG	163	155	318
NPS FACULTY	143	426	569
TOTAL	306	581	887



Britta Hale, Associate Professor, Cryptology



Gamani Karunasiri
Distinguished Professor of Physics



Jomana Amara
Associate Provost, Faculty Affairs

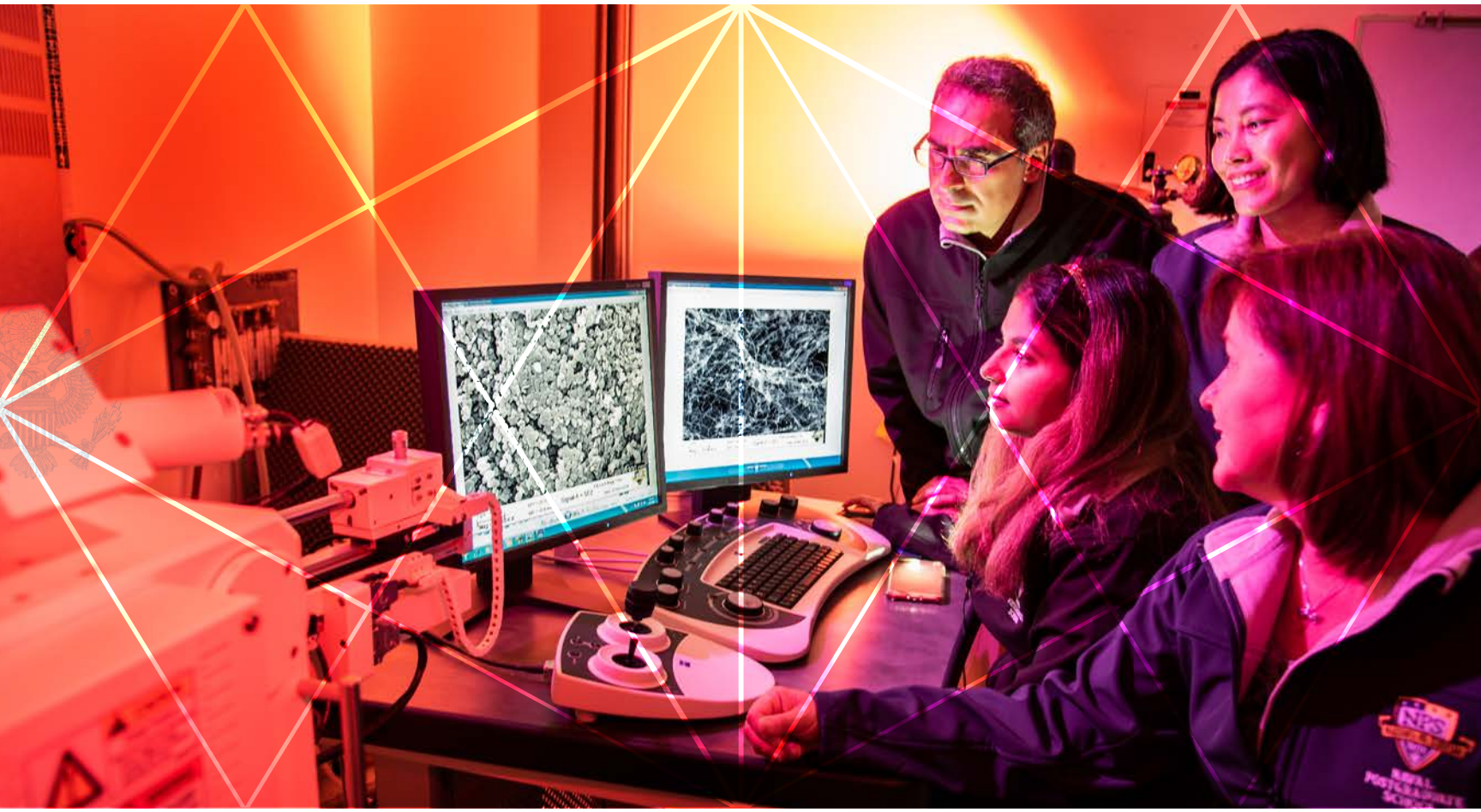


Ralucca Gera
Professor of Mathematics



Gurminder Singh
Professor of Computer Science
Selected as Chair, Computer Science Department, 2021

RESOURCES



Above:
Students apply nanomaterials research to enhance military readiness.

Resources

Information Technology and Communication Services



NPS Systems

Networks	Site	Provider
"PACBell" Commercial ISP	Research network	AT&T
Classified Networks	Various	Various
DODNet	Monterey DoD Interconnect: DMDC, PERSEREC, DLIFLC, NRL, FNMOC, NPS	NPS
EDU	nps.edu	CENIC
HPR	hpr.nps.edu	CENIC
MIL	nps.navy.mil	DREN
Public (for guests)	Public.nps.edu	CENIC

High Performance Computing (HPC)

Description	2014	2015	2016	2017	2018	2019	2020	2021
HPC supercomputer processors	3,154	4,290	4,698	5,166	4,516	6,140	5,156	5,000
HPC supercomputer users	210	356	327	180 [§]	474	688	741	372 ^{§§}
HPC disk space	475 TB	2 PB	3.2PB	3.2 PB	3.2 PB	3.2 PB	6.5 PB	6.5 PB
Linux computers on campus	375	300 [§]	286 [§]	242 [§]	224	173 [§]	124 [§]	97 [§]
Linux users on campus	500	600	722	748	704	756	740	672

§Decrease due to virtualization
 §§Decrease due to expired account cleanup



Wireless

Description	2012	2013	2014	2015	2016	2017*	2018	2019	2020	2021
Wireless (WiFi) Access Coverage	94%	95%	95%	95%	94%	98%	98%	98%	98%	99%
Number of bldgs covered by wireless	30	34	34	34	34	38	38	38	39	42
Average number of systems connected wirelessly	700	1300	465	1840	1840	2000	2500	2700	400*	1100*

*Reduced numbers due to directed telework during COVID-19

Web Services

Total Page views	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Extranet	19,937,866	19,937,866	18,490,648	3,157,716 ¹	4,472,814 ²	5,791,205 ²	6,862,199	7,232,980	7,405,217	6,736,461
Intranet	8,200,432	8,652,608	6,917,086	2,329,718 ¹	2,541,047	2,058,209	1,105,995 ²	456,003 ³	494,772 ³	674,844 ³

1 The metrics collection tool has changed from Urchin to Google Analytics; see the JIRA ticket for more details

2 Includes Liferay websites and legacy Rhythmyx websites

3 Includes Liferay private websites only



Established in 1997, CENIC operates the California Research and Education Network (CalREN), a high-capacity computer network with more than 8,000 miles of optical fiber serving California Community Colleges, the California State University, the University of California, public schools/libraries and private universities (Caltech, Naval Postgraduate School, Stanford University, and University of Southern California).



Resources

Dudley Knox Library

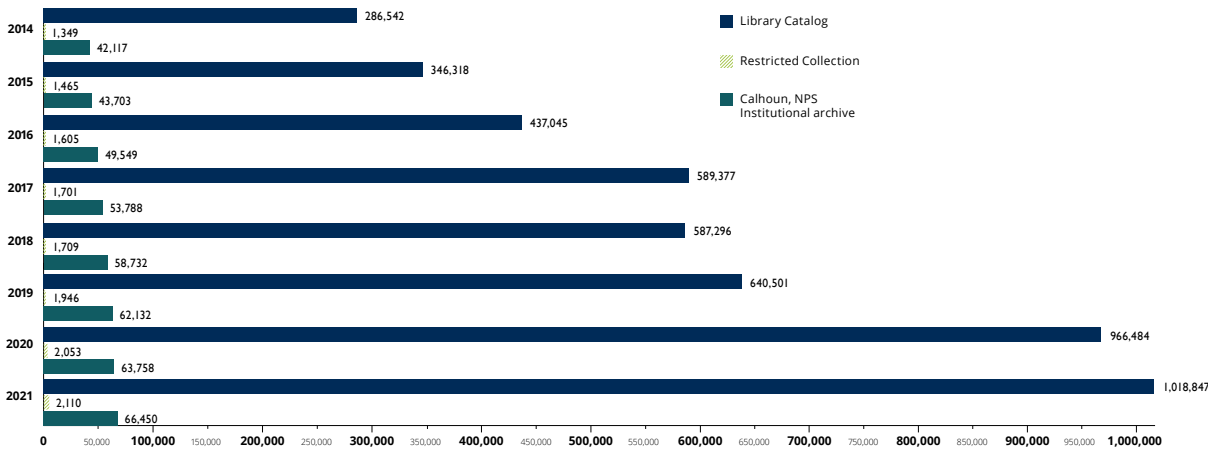
Quick Facts

DESCRIPTION	2015	2016	2017	2018	2019	2020	2021
Library staff FTE	28	27	26	25	21.5	22.5	21
Average weekly hours (Sunday-Saturday); extended hours during finals weeks	78	78	78	78	78	78	78
eResources available in library catalog (books, journals, reports & more)	391,486	377,192	589,377	587,296	640,051	966,484	1,018,847
eResources available in Restricted Collection (Restricted NPS Thesis, NPS Reports, etc.)	1,465	1,605	1,701	1,709	1,946	2,053	2,110
eResources in NPS Archive: Calhoun	43,703	49,549	53,788	58,732	63,132	63,758	66,450
On-site Library visits	313,199	280,376	281,393	272,037	260,761	108,457	13,989
Average daily library visits (on-site)	909	808	842	829	1,014	1,063	234
Average daily library visits (virtual)*	--	4,737	4,813	1,746	2,011	1,587	2,379
Hours students used collaborative study spaces	>8,200	8,164	24,051.75	28,267.25	28,851	12,376.50	5,950.50
Students receiving library instruction	2,746	2,435	2,501	2,432	2,191	1,968	2,031
Library instruction sessions offered (face-to-face and virtual)	146	126	138	149	134	118	108

*2018 changed to Google Analytics Sessions for counting virtual visits



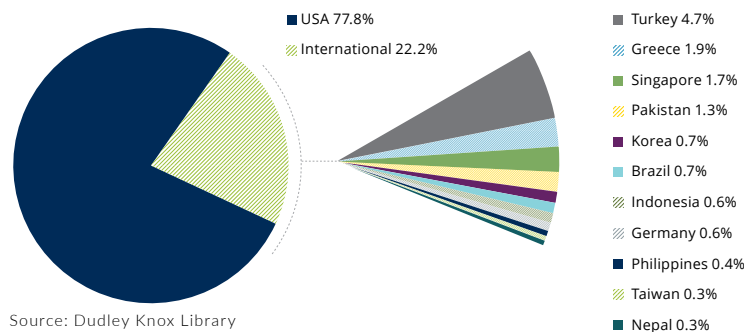
Number of Electronic Resources



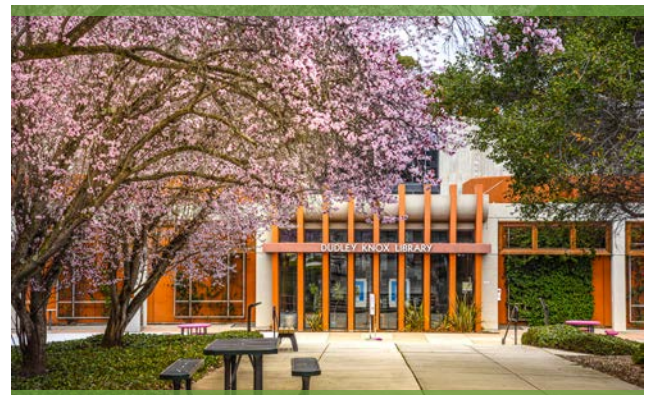
Alumni

YEAR	TOTAL
2012	2098
2013	2430
2014	2754
2015	3040
2016	3279
2017	3530
2018	3975
2019	4250
2020	4500
2021	4717

NPS Alumni Registered for AY2021 Library Access



Source: Dudley Knox Library





4 CLASSROOMS OF THE FUTURE

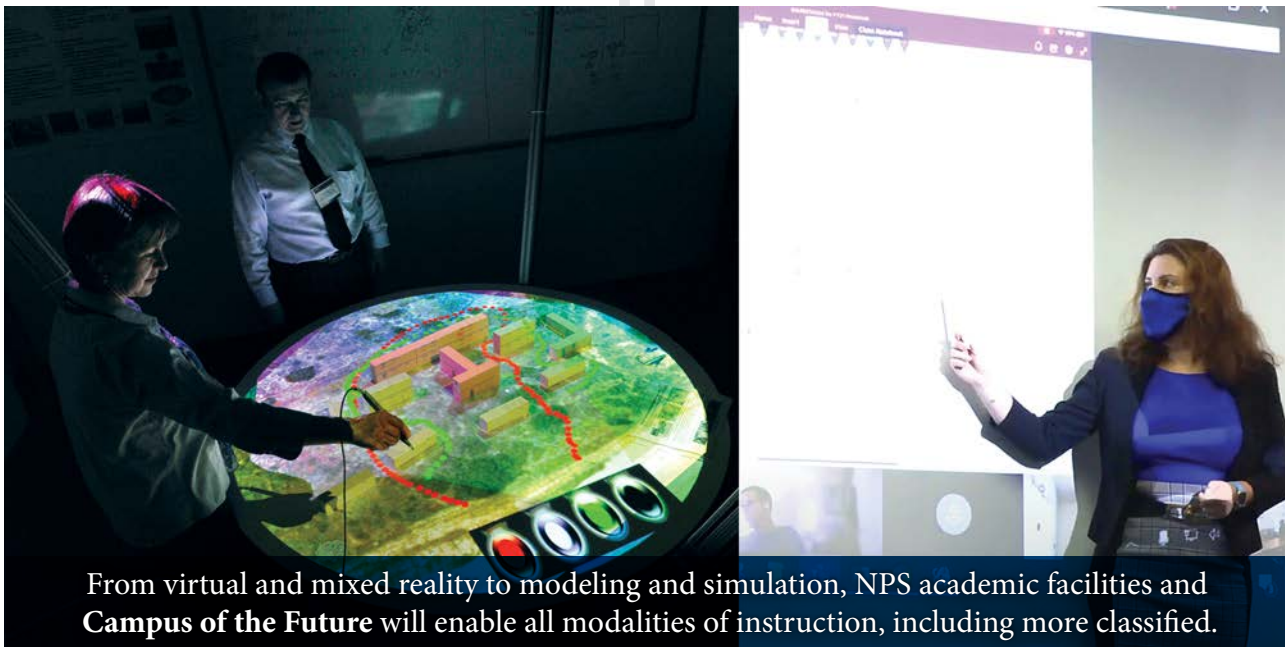
FLEx Classrooms with movable furniture and technology to support student-centered learning.

CAMPUS OF THE FUTURE

Integrating emerging technologies into the curricula and Virtual Classrooms will extend the NPS Smart Campus to the Fleet/Force. This includes a mobile virtual environment for information and data sharing, a modern mobile intranet using an artificial intelligence and 5G/6G to enhance educational delivery and collaboration.

16+ UNIQUE FACILITIES

- Common Operational Research Environment
- Cryptologic Research Laboratory
- Directed Energy Simulation Laboratory
- Interactive Digital Environment Analysis Laboratory
- Ocean Acoustic Observatory
- Radar/Electronic Warfare Laboratory
- Rocket and Combustion Laboratory
- Secure Computer Network Research Laboratory
- Secure Space Systems Research
- Spacecraft Research and Design Center
- Systems Technology Battle Laboratory
- Turbo Propulsion Laboratory
- Sea Land Air Military Research Initiative (5G lab)
- Energy and Energetics Lab (railgun and electric weapons)
- Anechoic Chamber (acoustics lab)
- Quantum Sensing Lab



From virtual and mixed reality to modeling and simulation, NPS academic facilities and **Campus of the Future** will enable all modalities of instruction, including more classified.



12 SYSTEMS ENGINEERING LABS

ROBODOJO (LAB)

Lab equipped with 3D printers, laser cutters, embedded computing, basic electronics, and robotic software programming for students, staff, faculty and friends to 'tinker' and learn about robot components and systems.

ARSENL (LAB)

Advanced robotic systems engineering laboratory for physically building, testing, and programming robots, such as unmanned aerial vehicles (UAVs) situated next to computation, modeling and simulation resources.

3 SECURE FACILITIES

SCIF, STBL, LIBRARY

NPS supports classified learning and communication in secure facilities.

68 MECHANICAL & AEROSPACE ENGINEERING LABS

SPACECRAFT ROBOTICS LABORATORY (LAB)

Lab set up to test instructional robotic manipulators with location sensors for multiple floating robots on the artificial weightlessness test bed of granite to verify and improve autonomous control theory of spacecraft.

CAVR (LAB)

Center for Autonomous Vehicle Research supports teaching and research in the area of autonomous systems, in particular underwater, surface and air vehicles.

9 SPACE SYSTEMS ACADEMIC GROUP LABS (LAB)

SMALL SATELLITE LABORATORY (LAB)

Labs equipped to design, build, and flight qualify space payloads. Partners of this lab include DOD space, the Jet Propulsion Laboratory and the Air Force Institute of Technology.

FINANCIALS



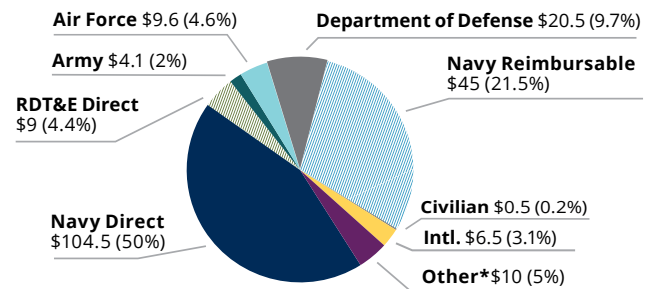
Above:
NPS staff run the business of NPS from financials to facilities, enabling mission success.



Financials

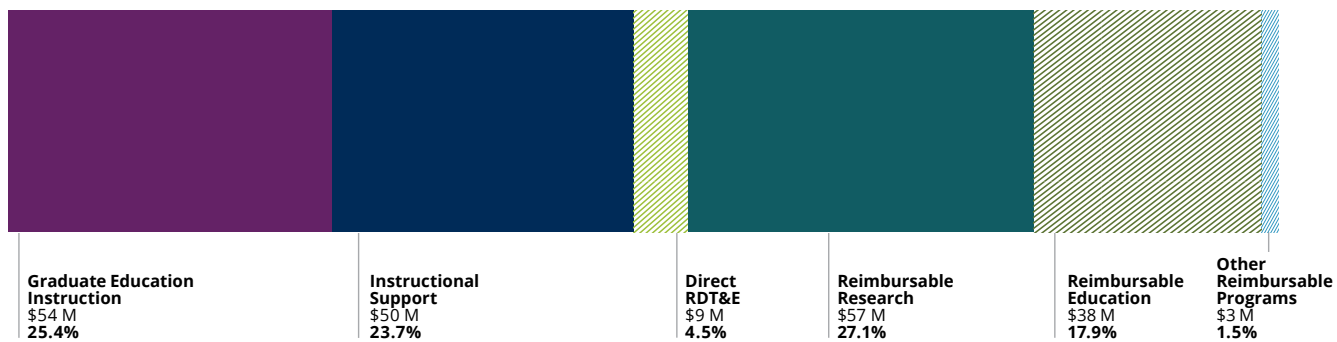
NPS FY2021 Funding By Source – Direct and Reimbursable

	PERCENTAGE	\$K
Navy Direct	49.6%	\$104,502
RDT&E Direct	4.4%	\$9,224
Direct Total		\$113,726
Army	2.0%	\$4,185
Air Force	4.6%	\$9,662
Department of Defense	9.7%	\$20,546
Navy Reimbursable	21.5%	\$45,389
Civilian	0.2%	\$463
International	3.1%	\$6,542
Other*	4.9%	\$10,366
Reimbursable Total		\$97,153
TOTAL REVENUE	100%	\$210,879



*Other = Dept. of Energy, Dept. of Justice, Dept. of State, Dept. of Veterans Affairs, Executive Office of the President, Homeland Security, NASA, National Science Foundation

NPS FY2021 Financials By Category – Direct and Reimbursable

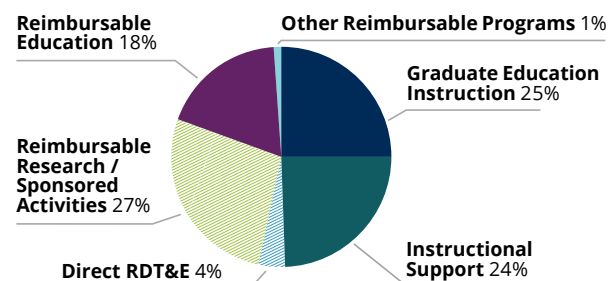


NPS Total Financial Resources

Total Operations – Budget by Source, FY2021

BUDGET ITEM	PERCENTAGE
Graduate Education Instruction	25%
Instructional Support	24%
Direct RDT&E	4%
Reimbursable Research / Sponsored Activities	27%
Reimbursable Education	18%
Other Reimbursable Programs	1%
TOTAL	100%

Source: Comptroller



IMPACTS



Above:
NPS develops leaders and solutions for the
Future Force.

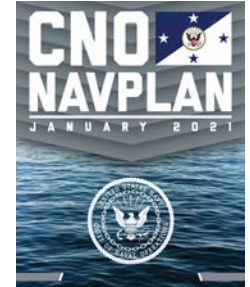
Impacts

Example Fleet and Force Outcomes



Applied Education and Research

Autonomy: The Naval Warfare Studies Institute (NWSI) launched the Warfare Innovation Continuum in September on a critical naval priority: Hybrid Force 2045. Nearly 130 participants, including, panelists, industry, observers and students, with participation from six allied nations looked at the interdisciplinary challenges from different perspectives and at all security levels. **IMPACT:** Throughout the year, the WIC will leverage classroom projects, theses and research to deliver results and advance naval concepts, assessing new technologies and developing tactics while enhancing student knowledge and DON technological leadership.



DevSecOps: LT Bridger Smith's thesis designed an AI-based DevSecOps tool to support maintenance planning and execution for SSBNs. Working with Project Blue and industry, he developed a 3D model and "Digital Twin" viewer that provides a common interface to address inefficiencies that lead to delays. **IMPACT:** Improved strategic deterrence. Provides shipyards, Trident Refit Facilities, and submarines with a shared, modern, open-sourced, DOD created, DISA approved maintenance planning and execution tool.

Radar: Surface Warfare Officer LT Jonathan Shepherd was recognized by Summer Quarter commencement speaker VADM Roy Kitchener, Commander, Naval Surface Forces, for his classified research on the SPY-6 radar. For his work, Shepherd received both the Military Operations Research Society (MORS) Tisdale Award and the Surface Navy Association Award for Excellence. **IMPACT:** Shepherd's classified research accurately quantified factors affecting the new radar's performance, which was provided to PEO IWS 2.0.

Hypersonics: The hypersonic glide body capability in the Conventional Prompt Strike Program is not due to reach IOC until 2025. Equipped with All Up Rounds (AUR) canisters, a student team's Systems Engineering capstone project solution utilized the San Antonio Class LPD to provide an affordable, viable interim maritime hypersonic glide body capability. **IMPACT:** The project team developed the candidate systems integrating the Army's vehicle mounted Long Range Hypersonic Weapon (LRHW).

Aviation: CDR Michael Hooten's applied research thesis performed a cost-effectiveness analysis for the U.S. F/A-18E/F Super Hornet squadrons as it relates to the DOD required combat Readiness Standards. **IMPACT:** Provided to OPNAV N8 and the NAE, the thesis identified options that can produce a marginal increase in overall Carrier Air Wing combat readiness while reducing fleetwide F/A-18E/F Super Hornet squadron operating costs by \$107 million per year.

Training: Capt. Michael Gannon, USMC, used commercial-off-the-shelf technology in his capstone project to design/replicate high-end training systems for field use. \$300 in 3D printing, a Raspberry Pi and open-source software replaced current \$20k designs. **IMPACT:** Increases effectiveness at greatly reduced costs. It's deployable, scalable and adaptable. The computer-aided instruction integrated with training simulators, provides real-time data collection and feedback on student performance.





ROBERT O. WORK

Former United States Deputy Secretary of Defense

Selected as the 25th inductee for the Hall of Fame

NPS Hall of Fame Honorees

The NPS Hall of Fame recognizes the accomplishments of NPS' 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 the University.



Vice Admiral Edward Moore, Jr. (Ret.)
(Inducted 26 Jan 2021)

Vice Admiral Jan E. Tighe (Ret.)
(Inducted 15 June 2018)

The Honorable Jack R. Borsting
(Posthumously inducted 27 Apr 2017)

The Honorable Everett Alvarez, Jr.
(Inducted 27 March 2015)

General Keith B. Alexander, USA (Ret.)
(Inducted 21 June 2013)

Colonel Walt Havenstein, USMCR (Ret.)
(Inducted 30 Nov 2012)

Admiral Eric T. Olson, USN (Ret.)
(Inducted 30 Nov 2012)

Dr. J. Phillip (Jack) London
(Inducted 2 Dec 2011)

Vice Admiral Pat Tracey, USN (Ret.)
(Inducted 3 Dec 2010)

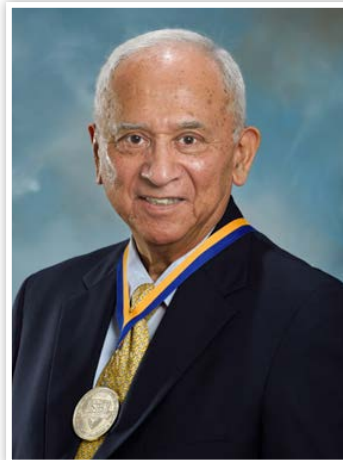
Admiral T. Joseph Lopez, USN (Ret.)
(Presented 3 Dec 2010)

Vice Admiral Thomas J. Hughes, USN (Ret.)
(Posthumously inducted 3 Dec 2010)

General Apichart Penkitti (Ret.)
(Inducted 30 July 2010)

Admiral Michael Mullen, USN (Ret.)
(Inducted 11 Aug 2009)

General Michael Hagee, USMC (Ret.)
(Inducted 23 May 2009)



For the full list of Hall of Fame honorees and please see: nps.edu/web/alumni/hall-of-fame





VISION

The Naval Postgraduate School will become the nation's leading institution for defense higher education and applied research, delivering transformative solutions and innovative leaders for decisive U.S. seapower and national defense.



IMMEDIATE IMPACT FUTURE ADVANTAGE ENDURING LEADERSHIP



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