APL Achievement Awards and Prizes: The Lab's Top Inventions, Discoveries, and Accomplishments in 2021

APL Staff Writers

ABSTRACT

Again this year, the Johns Hopkins University Applied Physics Laboratory (APL) celebrated the exceptional accomplishments of its staff members. APL introduced its awards program in 1986 to recognize staff members' best publications; over the ensuing decades, the program has expanded to recognize extraordinary achievements of all sorts—from exceptional work in both sponsored programs and independent research and development, to the most successful inventions and the greatest analytical achievements, to significant contributions that enhance operations and culture at the Laboratory. The 2022 APL Achievement Awards, honoring work from 2021, continued a practice that was introduced in 2020 during the COVID-19 pandemic: a safe and fun virtual format. This article details the awards and prizes presented to APL staff members in 2022 for their exemplary work in 2021.

INTRODUCTION

Continuing a tradition started almost four decades ago, APL celebrated some of the exceptional work performed by its staff members over the preceding year during the annual APL Achievement Awards. The virtual ceremony on April 26, 2022, honored outstanding publications and notable projects, individuals, and teams.

A record 824 staff members were nominated through 150 entries in 25 award categories. Ultimately, 178 staff members were recognized among 29 winning entries. The ceremony marked the debut of the Analytical Achievement Award, recognizing analytical work that resulted in a critical contribution to a government decision-maker or program.

"APL is celebrating its 80th anniversary, recognizing eight decades of game-changing impact and bold innovations," said Jerry Krill, one of the ceremony's hosts and APL's assistant director for science and technology. "These awards are a way to recognize the incredible work our staff has done over the past year for APL and the nation."

During the celebration, staff members received awards for outstanding work in areas such as publications, independent research and development (IRAD) projects, inventions, mission and enterprise accomplishments, and innovative ideas that had been awarded funding for exploration.

The ceremony also included two Director's Awards, which honor accomplishments that occur outside the usual award categories; the "Boldies," which recognize the boldest work at APL; and the Light the FUSE Award, which honors contributions that promote a positive, diverse, and inclusive culture at the Lab.

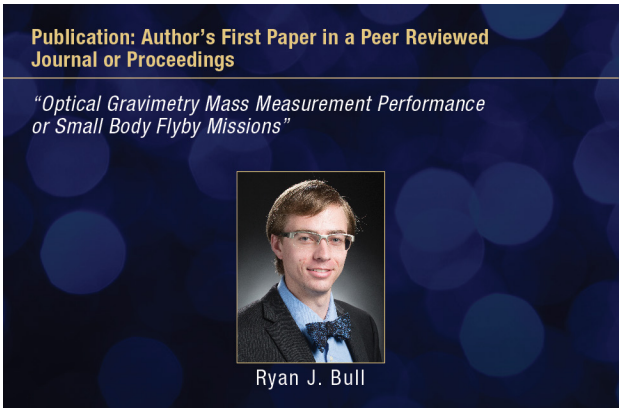
This article details the winning staff members and their achievements. Because the awards program is open to current APL staff members, only APL contributors are named. These projects and accomplishments exemplify not only what APL staff members achieved in 2021 but also what guides them every year: making critical contributions to the nation's most critical challenges.

PUBLICATION AWARDS

Administered by the editorial board of the *Johns Hopkins APL Technical Digest*, the publication awards program aims to inspire and recognize scholarship through publication in the professional literature. Awards were first presented in 1986, and the nomination and selection process has remained unchanged from that time: Departments and sectors may submit up to two nominations in each category. Judges consider the nominated works' significance and clarity, giving considerably greater weight to the significance of the work in advancing science, engineering, or the mission of the Laboratory.

Author's First Paper in a Peer-Reviewed Journal or Proceedings

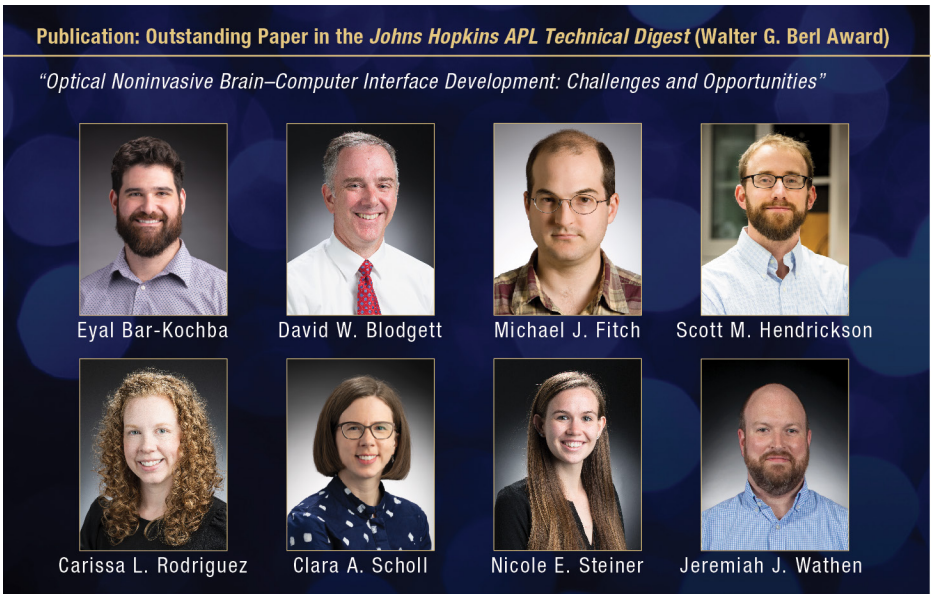
The award for an author's first paper published in a peer-reviewed journal or proceedings in 2021 went to Ryan J. Bull for "Optical Gravimetry Mass Measurement Performance for Small Body Flyby Missions," published in *Planetary and Space Science*.[1] This paper describes optical gravimetry, a method of determining the mass of a small asteroid from a spacecraft executing a high-speed flyby. The technique involves the spacecraft releasing and tracking a set of small test-masses that pass very close to the asteroid.



Outstanding Paper in the *Johns Hopkins APL Technical Digest* (Walter G. Berl Award)

Named for Walter Berl, editor-in-chief of the *Digest* when the publication awards program was created and who oversaw the program for many years, this award recognizes excellence in APL's own journal, the *Johns Hopkins APL Technical Digest*.

The 2021 award went to Eyal Bar-Kochba, David W. Blodgett, Michael J. Fitch, Scott M. Hendrickson, Carissa L. Rodriguez, Clara A. Scholl, Nicole E. Steiner, and Jeremiah J. Wathen for "Optical Noninvasive Brain–Computer Interface Development: Challenges and Opportunities."[2] This article chronicles two distinct approaches to achieving neuroimaging with unprecedented spatiotemporal resolution, forming the basis of next-generation noninvasive brain–computer interfaces. These interfaces have the potential to bring assistive and rehabilitative devices to more patients as well as to unleash entirely new modes of human–computer interaction.

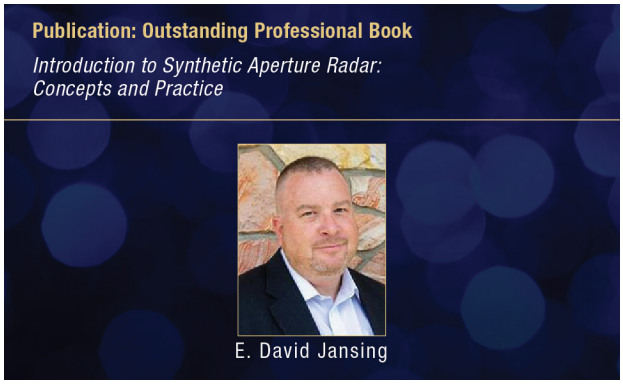


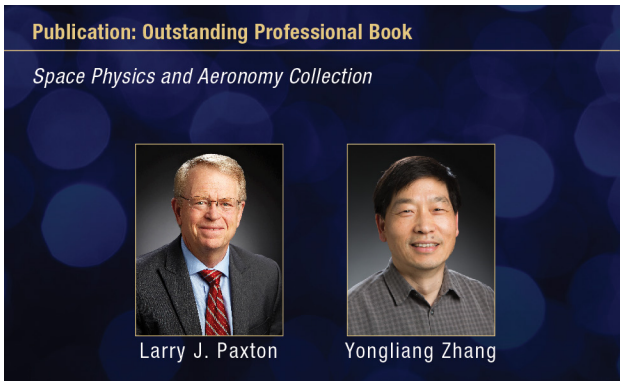
Outstanding Research Paper in an Externally Refereed Publication

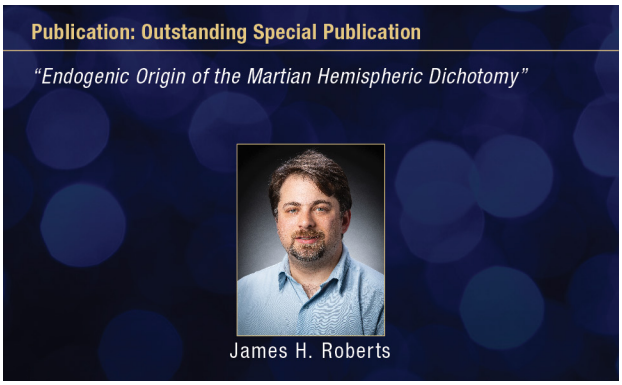
The award for outstanding research paper published in an externally refereed publication in 2021 went to Chuck E. Hebert, Andrew M. Lennon, James P. Mastandrea, Salahudin M. Nimer, Drew P. Seker, Steven M. Storck, Morgana M. Trexler, Douglas B. Trigg, and Gianna M. Valentino for "Controlled Shape-Morphing Metallic Components for Deployable Structures," published in the journal *Materials & Design*.[3] This paper discusses how a combination of alloy doping and laser processing parameter manipulation can tailor nickel titanium alloy phase transformation temperatures and create custom-designed plywood-style hinges, demonstrating the functional behavior as an actuator. Additively manufactured nickel titanium alloy hinges enabled a 75–90% reduction in cross-sectional area compared with the fully deployed structure.

Outstanding Development Paper in an Externally Refereed Publication

The award for outstanding development paper published in an externally refereed publication in 2021 went to Justin A. Atchison, Olivier S. Barnouin, Nancy L. Chabot, Andrew F. Cheng, R. Terik Daly, Carolyn M. Ernst, Andrew S. Rivkin, and Angela M. Stickle for "The Double Asteroid Redirection Test (DART): Planetary Defense Investigations and Requirements," published in the *Planetary Science Journal*.[4] DART is NASA's first planetary defense test mission. It demonstrated the kinetic impactor method, which is the deflection of an asteroid by ramming a mass—in this case a







spacecraft—into it at a high speed sufficient to change the asteroid's orbit and prevent its impact into the Earth.

Outstanding Professional Book

Three professional books published in 2021 were recognized. The first is *Introduction to Synthetic Aperture Radar: Concepts and Practice*, by E. David Jansing and published by McGraw Hill.[5] Previously available textbooks on this topic are written with a view to training practitioners in the nuts and bolts of specific synthetic aperture radar, or SAR, approaches. Dr. Jansing instead wrote a textbook that serves as a foundation to understand SAR and how it could be used in multiple applications.

The second book is *Space Physics and Aeronomy* (a five-volume set), by Larry J. Paxton and Yongliang Zhang and co-published by the American Geophysical Union and Wiley.[6] This multi-volume 2,400+-page reference series provides a comprehensive look at the global state of knowledge of how the Earth and the space around it are "connected" to the Sun.

The third award recognizes the book *Wireless Coexistence: Standards, Challenges, and Intelligent Solutions* by Andrew L. Adams, Daniel W. Chew, and Jason J. Uher and published by Wiley.[7] This book surveys several computer network standards, including IEEE standards, and expands on recent advances in machine learning and artificial intelligence to demonstrate how these technologies might be used to meet or exceed the challenges of wireless coexistence.

Outstanding Special Publication

The 2021 award for outstanding special publication was presented to James H. Roberts for the book chapter "Endogenic Origin of the Martian Hemispheric Dichotomy," in the book *Mars Geological Enigmas*, published by Elsevier.[8] There remain many outstanding questions on the geology of Mars, with divergent viewpoints based on varying interpretations and analyses. This chapter summarizes endogenic origin mechanisms for the dichotomy, its present orientation, and its relationship to Tharsis, a vast volcanic plateau centered near the equator in the western hemisphere of Mars.

Outstanding Conference Paper

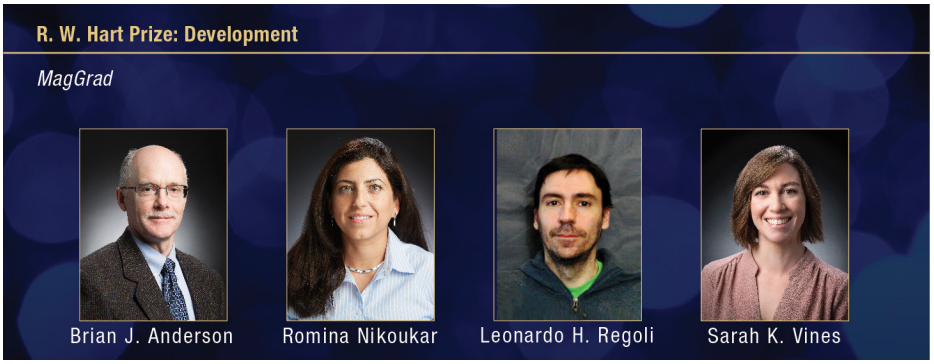
The award for outstanding 2021 conference paper went to David W. Blodgett, Michael J. Fitch, Scott M. Hendrickson, Griffin W. Milsap, Vincent R. Pagán, Lafe F. Spietz, and Jeremiah J. Wathen for "A 32-Channel Frequency-Domain fNIRS System Based on Silicon Photomultiplier Receivers," published in the SPIE Proceedings volume *Optical Techniques in Neurosurgery, Neurophotonics, and Optogenetics*.[9] This paper describes a novel frequency-domain near-infrared spectroscopy system permitting reliable sensing of brain activity deeper in the cortex with higher spatial resolution and providing more useful decoded information. Such a system can become a new tool for noninvasive functional brain imaging in the clinic in a low-cost, portable form factor.

Lifetime Achievement Publication Award

In addition to the 2021 publications honored, the most prestigious of the publication awards, the 2021 Lifetime Achievement Award, was conferred to Hal Weaver of APL's Space Exploration Sector. The Lifetime Achievement Publication Award honors an author's career of achievement through a substantial body of publications that are significant in terms of peer recognition, prizes, citation frequency, or influence on the innovation ecosystem. Weaver is just the 16th person to earn this award. He has spent over four decades studying rocky "small bodies"—primarily comets and Kuiper Belt objects—that carry clues to the origins of the solar system. His first research paper, which he coauthored as a graduate student, was published in *Nature*, one of the world's leading science journals, and even landed the cover. Since then, he has published hundreds of scientific papers.

R. W. HART PRIZES FOR EXCELLENCE IN INDEPENDENT RESEARCH AND DEVELOPMENT

The R. W. Hart Prizes for Excellence in Independent Research and Development—first presented in 1989 and named for former APL assistant director for research and exploratory development Robert W. Hart—recognize significant contributions that advance science and technology through independent research and development. Sectors and departments recommend candidates, and the Management Forum judges the nominations



on their quality and importance to APL. Prizes are awarded in two categories: best research project and best development project.

Best Research Project

The award for the best 2021 research project went to Ra'id S. Awadallah, Joseph A. Miragliotta, Korine A. Ohiri, Stergios J. Papadakis, David B. Shrekenhamer, and Timothy A. Sleasman for Metasurfaces for Adaptive Frequency Shifting.

Best Development Project

The award for the best 2021 development project went to Brian J. Anderson, Romina Nikoukar, Leonardo H. Regoli, and Sarah K. Vines for MagGrad.

AWARDS FOR INVENTION

Government Purpose Innovation Award

The first Government Purpose Innovation Award, recognizing an invention that meets a critical sponsor need, was presented in 2011. Selected by a team of technical leaders from across the Lab who are acquainted with APL's technology transfer practices, finalist inventions are judged on their novelty and potential impact to the sponsor community.

The award for innovation in 2021 went to Eric J. Adles, Chun-Huei Bair, Andrew J. Goers, William A. Irizarry-Cruz, Jay A. Komsa, Lindsey A. Marinello, Elad Siman-Tov, and Justin W. Zobel for Time and Frequency Distribution Using Stabilized Fiber-Optic Links.

Invention of the Year

The Invention of the Year Award was first presented in 2000 to encourage new technology and innovation at APL. To identify the top technology from the preceding year, an independent review panel judges invention disclosures. The judges, including technical and business consultants, technology transfer professionals, and intellectual property attorneys, assess inventions' creativity, novelty, improvement to existing technology, commercial potential, and probable benefit to society.

The winners of the Invention of the Year Award for 2021 were James K. Johnson, Jesse S. Ko, Nam Q. Le, Danielle R. Schlesinger, and Zhiyong Xia for Per- and Polyfluorinated Alkyl Substances (or PFAS) Removal by Magnetite Nanoparticle Catalyzed Fenton Reaction.[10]

AWARDS FOR OUTSTANDING ACCOMPLISHMENTS

Outstanding Mission Accomplishment Awards

The Outstanding Mission Accomplishment Awards, first presented in 2014, recognize major achievements in mission-oriented programs and projects. Awards are given in two categories: a current challenge and an emerging challenge. For both types, a review team of top managers and executives from APL's sectors and mission areas solicits nominations for technical accomplishments in sponsored programs during the previous year. A program has to have achieved a significant milestone within the previous fiscal year to be eligible. The panel judges entries on technical excellence and potential impact.

Mission Accomplishment for a Current Challenge

The award for Outstanding Mission Accomplishment for a Current Challenge in 2021 went to core team members Eric J. Adles, Donna M. Bush, J. Landon Garry, Reuben A. Johnston, Jonathan W. Labin, Helen A. Mitch, Gregory T. Moormann, Ron C. Schulze, Joshua H. Shrader, and R. Hank Tillman for Deep Space Advanced Radar Concept Technical Demonstration (or DARC-TD).[11]

Mission Accomplishment for an Emerging Challenge

Two awards for Outstanding Mission Accomplishment for a Current Challenge in 2021 were presented during the 2022 ceremony. The first went to principal contributors Angela L. Bates, Tri M. Freed,

A. Chris Najmi, Brian J. Nyffenegger, Stephen J. Quinn, John E. Schmidt, William E. Torruellas, and Geoffrey S. Uy for Establishing a Glide-Phase Hypersonic Defense Capability.

The second award recognized core team members Kevin C. Baldwin, Benjamin D. Baugher, Linda J. Frizzell-Makowski, Jennifer L. Mann, Robert M. Patterson, Craig M. Payne, G. Scott Peacock, William E. Sparrow Jr., and Radha A. Venkat for Long Range Anti-Submarine Warfare Surveillance on Autonomous Unmanned Surface Vessel.

Outstanding Enterprise Accomplishment Award

The Outstanding Enterprise Accomplishment Award, first presented in 2015, recognizes the enterprise accomplishment with the greatest impact on APL's operations and culture of innovation. Winners are selected by a joint panel of APL's operations executives and managing executives.

The 2021 award recognized project leaders Kevin J. Ames, Amy S. Bulcavage, Jason B. Coffroad, Christopher R. Gilligan, Joshua T. Helt, Nicholas A. Laswell, Jimmy D. Patel, Ronald C. Prietz Jr., Thomas V. Topper Jr., and Rebecca D. Young for Successful Expansion of the APL Footprint,[12] specifically the addition of 515,000 gross square feet of building space (primarily from the three new buildings).

The Alvin R. Eaton Award

The Alvin R. Eaton, or ARE, Award has been presented annually since 2001 but was not presented publicly during the awards ceremony until 2016. It honors staff members who have spent much of their careers

leading remarkable achievements that we cannot talk about openly. Awardees are selected by APL's director and assistant director for programs.

Kenneth R. Olson earned the 2021 Alvin R. Eaton Award for his exceptional analytical capabilities resulting in models and simulations that shaped the nature of strike missions, electronic warfare, and air combat.

AWARDS FOR INNOVATION

To position the Lab to respond to increasingly complex national challenges and to capitalize on rapid technological advances, APL's leaders have introduced several initiatives to encourage innovation across the Lab.[13] One of these initiatives, Project Catalyst, offers staff members three funding opportunities for bold, high-risk, transformational ideas that will ensure our nation's preeminence in the 21st century. Staff members submit ideas in response to challenges posted during several cycles throughout the year. Peers vote on the submissions, and finalists receive funding to develop their ideas.

Ignition Grant Prize for Innovation

The inaugural Project Catalyst award, the Ignition Grant Prize, was presented in 2013. It recognizes the project judged to be most creative and to have the greatest potential impact.

The 2021 award went to Wade C. Lewis, Griffin W. Milsap, Lynn M. Reggia, and Blake A. Schreurs for Multifaceted Intentional Natural Drone Control.

Combustion Grant Prize for Innovation

The Combustion Grant Prize, first presented in 2017, recognizes high-risk, high-impact technical ideas.

The 2021 award recognized Andrew J. Murphy and Kevin M. Schultz for Demonstrating Operationally Relevant Quantum Sensing.

Propulsion Grant Prize for Innovation

And, finally, presented for the first time in 2018, the Propulsion Grant Prize honors ideas that were selected for their third year of funding.

Three awards were presented in 2021. The first award went to team principals Joseph P. Angelo Jr., Anissa N. Elayadi, and Jason A. Spitaletta for Biosecurity and Health Screening.

The second award went to Amanda W. Ernlund, Michael A. Moore, Briana D. Vecchio-Pagan, and Kristina K. Zudock for Positive Observation of Sociogenic Illness through Entrusted Sentinels.

And the third award went to Michael C. Brupbacher, David M. Deglau, Michael Presley, and Joseph A. Scroggins for Solar Powered Rocket.

DIRECTOR'S AWARD FOR SPECIAL ACHIEVEMENTS

Sometimes a major accomplishment is outside the usual award categories. The Director's Award for Special Achievements recognizes such accomplishments. This award was first presented in 2017.

Two awards were presented for special achievements in 2021. The first award recognized team members Andrea M. Brown, Keith S. Caruso, Michael A. Kelly, Mark J. Mayr, Sandor S. Mester, Russell I. Popkin, Daniel Schwartz, Steven A. Tangen, Michael E. Thomas, and William J. Tropf for developing a technology that closed an urgent Department of Defense capability gap.

The second award went to core team members Steven T. Caperna, Stephen C. DiBenedetto, Christopher J. Garman, Andrew D. Jurik, Adam C. Martin, Jonathan M. Oben, Nicholas J. Pillitteri, Curtis S. Reybold, Douglas S. Wenstrand, and Jeana L. Yee for developing and deployig a set of capabilities incorporating signal detection, geolocation, and cyber.

THE BOLDIES

In early 2018, Lab management asked a team of technical leaders and contributors for recommendations on increasing APL's boldness. This group, Team Bold, proposed instituting two formal awards to celebrate boldness.

Bumblebee Award

The first award, the Bumblebee Award, recognizes improbable designs that had remarkable results, much like APL's historic Bumblebee program, whose name was inspired by a quote attributed to aviation pioneer Igor Sikorsky: "According to recognized aerotechnical tests the bumblebee cannot fly because of the shape and weight of his body in relation to the total wing areas. BUT, the bumblebee doesn't know this, so he goes ahead and flies anyway."

The Bumblebee Award recognizing 2021 achievements was presented to Edward W. Brouwers, Kyle A. Casterline, Christopher R. DeMay, Khang N. Ngo, Preethy Raman, Tunde B. Sanni, Robert L. Shearer III, Steven J. VanDerwalker, Nicholas J. Watkins, and Edward L. White for developing a digital, agile, open, and government-owned research and development test bed capability known as the Colosseum.[14]

The Noble Prize

The second award in this category, the Noble Prize, celebrates work that was not fully successful but yielded valuable lessons. Its name is a play on Nobel Prize and noble failure.

The Noble Prize for 2021 was awarded to Joseph T. Downs, Rahul Hingorani, Grace M. Hwang, Juan Ramirez Jr., Elizabeth P. Reilly, Anshu Saksena, Kevin M. Schultz, and Marisel Villafane-Delgado for Fourier-Analytic Theory of Emergence through which they created novel graph signal processing techniques and applied them to a wide range of APL challenges.

LIGHT THE FUSE AWARD

The Light the FUSE Award was first presented during the 2021 ceremony. The award name is a play on the acronym FUSE, referring to APL's FUSE employee resource group, which created this award, as well as the Lab's general innovation theme. FUSE, which stands for Fostering Unity and Staff Empowerment, is a consolidation of representatives from APL's affinity groups, sectors, and departments who are focused on enhancing the Lab's work environment and culture of innovation. This award recognizes significant contributions that promote a positive, diverse, and inclusive culture at the Laboratory, increasing APL's potential for innovation.

The second-ever Light the FUSE Award was presented to project leaders Natalie D. Anderson, Emily A. Camacho, Julia C. Eng, Ryan A. Pepito, Adjoa M. Poku, Robert A. Schrier, Arvin Siva, Emerson C. Smith, and Willie C. Stewart Jr. for implementing a cutting-edge collaborative approach to delivering relevant and timely threat information to staff members.

APL ANALYTICAL ACHIEVEMENT AWARD

The newest honor is the Analytical Achievement Award, which recognizes the most insightful analytic work that resulted in a critical contribution to a government decision-maker or program.

The inaugural Analytical Achievement Award was presented to core team members George J. Cancro, Erin N. Hahn, Sophia G. Jensen, Ian D. MacLeod, Christine S. Martin, Michael J. Moskowitz, Julie F. Obenauer-Motley, R. Freddy Obrecht, Lauren E. Shin, and Mareena R. Snowden for their analysis of an autonomous weapon system.

CONCLUSION

For a brief history of APL's awards program, see the article by Richardson and Livieratos in the issue commemorating APL's 75th anniversary.[15] This same issue includes a complete list of winners through 2017 (for 2016 achievements).[16] Summaries of the winners for achievements in subsequent years are also available in the *Digest*.[17–19]

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