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Welcome,

It is my pleasure to provide the ONR Global International Science Prospectus for fiscal year 2021. It summarizes the important work accomplished by our command in the areas of international networking, collaborations and fundamental research grants. The international science tools utilized by our science directors are detailed along with the participating countries, university and institution partnerships, research technology areas, and co-funding sponsors.

An addendum is included that contains a complete portfolio listing of all new and active investments. It also highlights some of the outcomes and results of the research ONR Global has funded. The award recognitions, publications and technology readiness progression serve as a testament to the value we provide.

Our vision is to be the partner of choice for international science and technology leaders. That means building trust and partnerships with the world’s best researchers. My hope is that this prospectus reflects the many ways we engage around the globe in order to achieve that vision.

Please contact me or my staff if you have any questions, feedback, recommendations or opportunities.

Sincerely,

Capt. Matthew Farr  
Commanding Officer  
London, UK  
+44-1895-61-6212

Dr. Rhett Jefferies  
Technical Director  
London, UK  
+44-1895-61-6323

Capt. Andrew Berner  
Executive Officer  
Arlington, VA  
703-696-5639
ONR GLOBAL MISSION

Mission: To obtain, coordinate and make available worldwide scientific information

Vision: Be the PARTNER OF CHOICE for science and technology leaders

INTERNATIONAL SCIENCE TECHNICAL STAFF

ONR Global’s International Science Department consists of a department head, two regional chief scientists and up to 22 science directors. Science directors act as fundamental science and technology (S&T) scouts, connecting technical experts in the Naval Research Enterprise (NRE) with leading international S&T researchers. Professional attributes include doctorate degrees in relevant fields, experience with the NRE, foreign language skills and international S&T experience. Our ONR Global on-site locations include the following:

- Arlington (includes International Science Department head)
- London (includes regional chief scientist)
- Melbourne
- Prague
- Santiago
- São Paulo
- Singapore (includes regional chief scientist)
- Tokyo (includes regional director)

ONR Global’s composition and placement is in alignment with the National Defense Strategy’s understanding of worldwide S&T trends. Science directors monitor the following locations in addition to their home locations (includes COCOM Partnerships):

Europe+: Armenia, Austria, Baltics, Belgium, Croatia, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, UK, Ukraine

Indo-Pacific: Australia, Cambodia, China, Hong Kong, Indonesia, India, Japan, Laos, Macau, Malaysia, Mongolia, Myanmar, New Zealand, Philippines, Republic of Korea, Sri Lanka, Singapore, Taiwan, Thailand, Vietnam

Americas: Argentina, Brazil, Canada, Chile, Colombia, Mexico, Peru
The photos above include the current science directors. We would also like to recognize the following science directors who have recently transitioned from ONR Global:

Dr. Yoko Furukawa (Melbourne), Dr. Sung-Eun Kim (Tokyo), Dr. Ben Knott (Tokyo), Dr. Malen Link (Singapore), Dr. Jeffrey Simmen (Singapore), Dr. Diogenes Placencia (São Paulo), Dr. Paul Sundaram (São Paulo), Dr. Ayodeji Coker (London), Dr. Andrey Kanaev (London), Dr. Predrag Milojkovic (London), and Dr. Stephen O’Regan (Prague).
International science priorities and naval relevance comes from the following guidance:

1. NRE R&D Framework (ONR, DC): A Framework for the Navy and Marine Corps After Next
   - Five Integrated Research Portfolios
   - Five Actionable Technology Priorities

2. Under Secretary of Defense for Research and Engineering (USD R&E), (OSD, DC); Technical Domain Priorities
   - 11 Areas Having Naval Applicability
   - Information, Cyber and Spectrum Security
   - Ocean Battlespace and Expeditionary Access
   - Mission Capable, Persistent and Survivable Naval Platforms
   - Aviation, Force Projection and Integrated Defense
   - Warfighter Performance

NRE Integrated Portfolios
- Information, Cyber and Spectrum Security
- Ocean Battlespace and Expeditionary Access
- Mission Capable, Persistent and Survivable Naval Platforms
- Aviation, Force Projection and Integrated Defense
- Warfighter Performance

NRE Technical Priorities
- Augmented Warfighter
- Operational Endurance
- Integrated and Distributed Forces
- Sensing and Sense Making
- Scalable Lethality

DOD Modernization Priorities
- Hypersonics
- Fully Networked Command
- Space
- Autonomy
- Directed Energy
- Cyber
- Quantum Science
- Microelectronics
- Biotechnology
- Machine Learning/Artificial Intelligence
- 5G
Fiscal Year 2021 Overview

International Science Tools Available to ONR Global’s Technical Staff

DIGITAL SEARCH
LIAISON VISIT
VISITING SCIENCE PROGRAM (VSP)
COLLABORATIVE SCIENCE PROGRAM (CSP)
RESEARCH GRANTS

“SMALL, EARLY INVESTMENTS CAN LEAD TO SIGNIFICANT RESULTS”
–CAPT Matt Farr
Commanding Officer, ONR Global
Capt. Andy Berner, executive officer, ONR Global
Felipe Reisch, strategic communications specialist, ONR Global

Did you know that, according to the 2017 Global R&D Funding Forecast, 80% of the world’s research is accomplished outside of the United States?

Were you aware that, according to the Times Higher Education World University Ranking 2021, 25 of the top 50 universities, and 63 of the top 100, are outside of the United States?

These facts mean that the United States would be significantly behind if it adopted an isolationist mindset when it comes to science and technology. Indeed, there is a ton of great science happening all around the globe all the time. Brilliant minds across every continent continue to make discoveries and significant technological advances. Since critical ingredients for discovery and advancement are the collaboration and synergy resulting from trust-based relationships, the United States should reach out to collaborate with the many researchers beyond its borders. That is precisely what the ONR Global has done for the last 80 years and continues to do.

As the chief of naval research’s international arm, ONR Global maintains offices in eight strategic locations: London, Prague, São Paolo, Santiago, Tokyo, Singapore, Melbourne and Arlington. Through this international presence, ONR Global builds relationships with international researchers and finds pathways for collaborative solutions that positively influence the Department of the Navy and its Sailors and Marines.

These collaborative solutions require a constant effort and a presence that can adapt to navigate ever-changing political, social and economic environments.

Presence and flexibility are paramount and ensure that long-lasting, trust-based relationships endure despite hard times such as those presented by COVID-19. COVID-19 changed the science and technology community’s way of doing business and ONR Global needed to get creative in order to accomplish its mission. It leveraged video teleconferencing and web-based technologies to visit laboratories; review proposals; receive updated analysis; attend critical technological conferences and informational briefings; view experiments and futuristic demonstrations; and, most importantly, continue to build the personal connections that spark and develop technological innovations.

Despite the pandemic, ONR Global continued to accomplish its international mission. ONR Global successfully launched the second edition of its Global-X Challenge to address capability gaps in the polar region. It funded a world-leading group of researchers from Japan, U.S., Finland and the U.K. to find ways to navigate in GPS-denied environments. ONR Global also enabled Brazil’s health system to save more lives through a collaboration with the University of São Paulo to create low-cost ventilators for COVID-19 patients.

With continued interest in the impact of climate change and its effects on the rapidly changing Arctic Ocean, ONR Global worked through its International Engagement Office to lead an iceberg tagging effort. This effort provided much-needed situational awareness to the international maritime community through the use of unmanned aerial vehicles, which deployed GPS tags onto icebergs near Disko Bay, Greenland. Tracking these tags closely will improve understanding of ocean circulation and meteorological impacts on icebergs — key factors that improve and ensure maritime situational awareness in this increasingly important part of the globe.
ONR Global also continued to explore the benefits of synthetic biology through ongoing research at the Imperial London College on self-healing “living materials.” This groundbreaking effort, cofounded by ONR Global and published in Nature Communications, could lead to the creation of real-world materials that detect and heal their own damage, such as fixing a crack in a windshield, a tear in the fuselage of an aircraft or a pothole in the road. Without a doubt, ONR Global stayed busy over the past year!

LOOKING AHEAD FOR ONR GLOBAL ...

ONR Global is committed to building relationships that enable worldwide science and technology leaders to partner with the United States and the broader naval community. Through its worldwide presence, ONR Global will continue to find ways to build relationships and trusted partnerships. It will “leave no stone unturned” so researchers can achieve the most innovative and mutually beneficial international advancements that anyone might imagine.

More specifically, ONR Global sees a future in which artificial intelligence (AI) is an increasingly instrumental component in science at a global scale. This is the main reason it is building ties with local AI scientific communities to understand AI’s main challenges and opportunities. Most recently, ONR Global spearheaded the launch of a Women in AI Association in Chile, led by Ms. Sonia Wolff, associate science director.

Through efforts like AI (and many others), ONR Global will continue to shape the future. However, its overall mission will remain constant. It will continue to be the international component of ONR. It will continue to do whatever it can to ensure the United States is the partner of choice when it comes to science and technology and that international researchers can leverage creative minds and technology in the United States. Simply put, ONR Global will continue to be an international team builder, and it will continue to advance the development of innovative, problem-solving technologies through long-standing, as well as brand-new, international collaborations.
ONR Global’s technical staff attends international events and visits international institutions to develop, access and discover cutting-edge science and technology. These international science networking liaison visits are the primary tool in monitoring overall Global Technical Awareness. Additionally, they can foster future Visiting Scientists Program, Collaborative Science Program and Research Grant opportunities. For FY2021, ONR Global had over 123 Liaison Visits, with approximately 55% being virtual engagements across 29 countries.

123 LIAISON VISITS
29 COUNTRIES IN FY2021

RESEARCH TECH-DOMAINS

- 6G Technologies
- Acoustics and Undersea Technologies
- Advanced Photonics
- Advanced Materials
- Advanced Signal and Noise Processing
- Advanced Sensors
- AI and Brain Science
- ASW and Mine Warfare
- Augmented and Virtual Reality
- Autonomy and Unmanned Systems
- Biology
- Biomedical
- Biotechnology, Synthetic Biology
- Chemistry
- Cryptography and Block Chains
- Cyber Applications
- Data Science
- Digital and Optical Comms
- Directed Energy
- Energetic Materials
- Environmental Science
- Human-Machine Teaming
- Hydrodynamics
- Hypersonics
- Interdisciplinary S&T
- Machine Learning / Artificial Intelligence (ML/AI)
- Material Science
- Maritime Domain Awareness
- Microelectronics
- Nanotechnology
- Naval Science
- Naval and Marine Platforms
- Neuromorphic Sensing
- Oceanography
- Optoelectronics and Sensors
- Physics Science
- Polar Science
- PTSD diagnostics using AI; sensing
- Power & Energy
- Quantum Information, Computing, Materials, and Physics
- Quantum Dots
- RF and Power Devices
- Robotics
- Spectrum Applications
- Swarms and Emerging Behaviors
- Thermal Science
- Undersea Medicine

COUNTRIES

- Australia
- Austria
- Bangladesh
- Belgium
- Brazil
- Canada
- Chile
- Colombia
- Czech Republic
- Finland
- France
- Germany
- Hungary
- Iceland
- Italy
- Japan
- Mexico
- Netherlands
- Norway
- Peru
- Republic of Korea
- Serbia
- Singapore
- Spain
- Sweden
- Switzerland
- UAE
- Ukraine
- United Kingdom
Liaison Visits
UNIVERSITIES, INSTITUTIONS AND ORGANIZATIONS

- 1st Virtual European Conference on Fracture; EU
- 22nd International Conference on Composite Materials; ICCM
- 6G Flagship, University of Oulu
- 6th World Conference on Advanced Materials; BIT Congress
- 6th Biological Workshop in Komorní Hradec: Highly virulent agents and their vectors
- Acoustic Research Laboratory Tropical Marine Science Institute
- AVANTE 2020 award ceremony
- BioSense
- Brazilian Biomedical Engineering Society
- Brno University of Technology
- Bundeswehr Cyber Innovation Hub
- Bundeswehr Naval Medical Institute
- Bundeswehr Warfare Center 91 for Weapons and Munitions
- Catholic University Leuven
- Center for Research and Interdisciplinarity
- CentraleSupélec (CS); French graduate engineering school of Paris-Saclay University in Metz
- Centre de Nanosciences et de Nanotechnologies (C2N); French National Centre for Scientific Research (CNRS) in Paris-Scalay
- Centre for Research and Experimentation (CMRE), La Spezia
- Compound Semi-conductor Week (CSW) Women-in-Stem
- CROSSING Laboratory
- CZE University of Defense/Olomouc University
- Czech Academy of Sciences
- de l’information(Grenoble); The French Alternative Energies and Atomic Energy Commission (CEA)
- Deakin University
- Defence Innovation Network
- Defence Innovation Partnership
- Defence Science and Technology (DSTL) – Defense Materials Forum
- Defence Science and Technology (DSTL), Porton Down
- Defence Science and Technology Group (DSTG), Australia
- Department of Cybernetics
- DIPRIDA (Chilean ONR equivalent)

- ELI Beamlines
- ENCIT 2020, 18th Brazilian Congress on Thermal Science and Engineering
- ETH, Zurich
- European Conference on Power Electronics and Applications (EPE)
- European Geosciences Union Conference
- European Marine Energy Centre – Orkney Islands
- Financial Cryptography 2021
- Flinders University
- French Office national d'études et de recherches aérospatiales (ONERA), Châtillon
- Future Systems and Technology Directorate (FSTD) Ministry of Defense, Singapore
- Hamburgische Schiffbau-Versuchsanstalt
- Heinrich Heine University Düsseldorf
- Hungarian Academy of Sciences
- IKEM - Institute of Clinical and Experimental Medicine
- Institute of Molecular Genetics and Genetic Engineering
- Institute of Physics
- International Materials Research Conference
- International Nanotechnology Conference & Exhibition; The Converting Technical Institute
- Interspeech 2021
- International Symposium on AI and Brain Science
- International Symposium on Polar Regions
- IOSB Fraunhofer, Ettlingen
- Karlsruhe Institute of Technology Institute of Biological and Chemical systems and Biological Information Processing
- Khalifa University
- KTH
- LATAM ONRG Program Review
- Latin America Quantum Computing Center in Salvador, Bahia
- Launch of Chilean Women in AI event
- Leti: Laboratoire d'électronique des technologies
- Masaryk University
- Mejzik Propellers
- Ministry of Defence (MOD) ST&I, Colombia
- Ministry of Defense (MOD), Singapore
<table>
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<th>Universities, Institutions and Organizations (continued)</th>
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<tr>
<td>• Monash University</td>
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<td>• Nanyang Technological Institute</td>
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<td>• Nanyang Technological University</td>
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<td>• National University of Singapore (NUS)</td>
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<td>• NATO Workshop on Energetic Materials</td>
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<td>• Naval War College (Chilean)</td>
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<td>• New Technologies Research Center</td>
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<td>• Odessa Filatov Institute</td>
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<td>• Olomouc University – CATRIN Research Center</td>
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<td>• Orkustofurnum (National Energy Authority)</td>
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<td>• Pázmány Péter Catholic University</td>
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<td>• Photonics Center</td>
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<td>• Pontific University Catolica de Chile</td>
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<td>• Pontific University Catolica de Peru</td>
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<td>• Reykjavik University</td>
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<td>• Singapore Institute of Technology</td>
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<td>• Solliance</td>
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<td>• Spanish IMDEA</td>
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<td>• Strathclyde University</td>
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<td>• Stratosyst</td>
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<td>• Symposium: CSW 2020</td>
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<td>• Technical University of Darmstadt</td>
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<td>• Technical University of Dortmund</td>
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<td>• Technical University of Liberec</td>
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<td>• Technische Universität Hamburg, Institute of Technical Microbiology</td>
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<td>• Technology Centre for Offshore and Marine (TCOMS);</td>
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<td>• The Madrid Institute for Advanced Studies (IMDEA)</td>
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<td>• The University of the Basque Country, Materials Physics Center</td>
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<td>• Thyssenkrupp Marine Systems/ATLAS Elektronics</td>
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<td>• TNO, Netherlands</td>
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<td>• Ubiquitous Robots 2021</td>
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<td>• Universidad de Chile</td>
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<tr>
<td>• Universidad Federal Fluminense</td>
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<tr>
<td>• University College London – Physics Department</td>
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<td>• University of Adelaide</td>
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<td>• University of Belgrade</td>
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<td>• University of Edinburgh</td>
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<td>• University of Geneva</td>
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<td>• University of Ghent, Vlaams Instituut voor Biotechnologie</td>
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<td>• University of Glasgow</td>
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<td>• University of Iceland</td>
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<td>• University of Leicester</td>
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<td>• University of New South Wales</td>
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<tr>
<td>• University of Nottingham – Propulsion Futures Beacon: Electric Propulsion University of Nottingham – Propulsion Futures Beacon: Disruptive Technologies</td>
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<td>• University of Novi Sad</td>
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<td>• University of Pardubice</td>
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<td>• University of Queensland Center for Hypersonics</td>
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<td>• University of South Australia</td>
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<td>• University of Southampton</td>
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<td>• University of Strathclyde</td>
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<td>• University of Sussex</td>
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<td>• University of Tasmania</td>
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<td>• University of Zaragoa</td>
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<tr>
<td>• Useful Arctic Knowledge 2021 (UAK), Norwegian icebreaker Svalbard</td>
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<td>• Western Sydney University</td>
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<td>• Wigetworks, Pte Ltd</td>
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<td>• Workshop on Compound Semiconductor Devices</td>
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Unfortunately, pandemic travel restrictions and safety precautions limited travel in FY2021. We are looking forward to more travel in FY2022!

**What is VSP?**

The Visiting Scientists Program (VSP) supports short-term travel opportunities for international scientists to the United States, or to international conferences, to interact with researchers and socialize new S&T ideas or findings with the NRE that advance basic research though collaboration.

**RECAP of FY2020**

**AUSTRALIA**
- HTS Tape Characterization Over Long Lengths

**BRAZIL**
- Research Grant Kick-Off Meeting / Quantum Mechanical Sensors

**ISRAEL**
- Quantum Magnematory Atoms Correlation

**SWITZERLAND**
- Event-Based Polarized Sensors

**UNITED KINGDOM**
- Speaker at Naval Applications for Machine Learning 2020
ONR Global supports foreign or international workshops and conferences having naval interest. This international science networking tool can also foster future Liaison Visits, VSPs and Research Grants, along with providing overall Global Technical Awareness. For FY2021, ONR Global had 14 Collaborative Science Program engagements, with approximately 55% being virtual engagements, becoming a new agility norm across 12 countries. See the following for portfolio information:

### RESEARCH TECH DOMAINS

- AI, Robotics
- Assure Access to the Maritime Battlespace
- Autonomy
- Bioinspiration
- Information, Cyber and Spectrum Superiority
- Operational Energy
- Sea Platforms
- Synthetic Biology
- Undersea Battlespace and Maritime Domain Access

### COUNTRIES

- Brazil
- Brunei Darussalam
- Chile
- Czech Republic
- France
- Greece
- Ireland
- Italy
- South Korea
- Spain
- Uganda
- Vietnam

This photo was taken in front of an installed 2MW Orbital O2 underwater turbine near Eday Island during the Chief of Naval Research Rear Adm. Lorin Selby’s July 2021 visit to the European Marine Energy Center (EMEC) in Orkney Islands, Scotland. Left to right: Richy Ainsworth (U.S. project engineer, EMEC), Dr. Chip Eddy (ONR Global science director), Beth Huber (ONR Global International Engagement Office), James Potticary (midshipman U.S. Naval Academy), Rear Adm. Selby, Lt. Matt Metzdorff (CNR flag aide).
Collaborative Science Program

- Digital for Mental Health
- Faculty of Science, Universiti Brunei Darussalam
- Foundation for Research and Technology Hellas
- Fundacion Athenalab
- Hanoi University of Science and Technology
- Ho Chi Minh City University of Technology
- Institute of Materials Science, VAST
- Pontifical Universidade Catolica de Rio de Janeiro
- SBA Synbio Africa Limited
- Seoul National University
- Trinity College Dublin
- Universidad de Zaragoza
- Universitas’ Degli Studi Di camerino
- Vysoke Uceni Technicke V Brne / DCGM FIT

**Brazil** 8th Asia Pacific Workshop on Structural Health Monitoring (Monash University)

**Brunei Darussalam** Workshop on Biodiversity and Bioinspiration

**Chile** Avante 2021 Challenge (Fundacion Athenalab)

**Czech Republic** Interspeech 2021 (Vysoke Uceni Technicke v Brne / DCGM FIT)

**France** Predictive AI in PTS, a complex Problem (Myndblue LTD)

**Greece** 10th Underwater Acoustics Conference & Exhibition (UACE2021)

**Ireland** EUSIPSO - The 29th European Signal Processing Conference (Trinity College)

**Italy** Metamaterials 2021 - 14th International Congress on Artificial Materials for Novel Wave Phenomena) - University of Roma Tre

**South Korea** The 11th International Symposium on Cavitation (CAV2021)

**Spain** Science and Systems (RSS) Conference; Workshop on Behavioral Inference of Remotely Sensed Multi-agent Systems in conjunction with virtual Robotics (University of Zaragoza)

**Uganada** SBA 1 Inaugural International synthetic biology and biosecurity conference in Africa

**Vietnam**
- International Conference on Communications and Electronics 2020 Vietnam
- 17th International Conference on Intelligent Unmanned Systems (ICIUS 2021)
- The 10th International Workshop on Advanced Materials Science and Nanotechnology
50 NEW RESEARCH GRANTS
IN 19 COUNTRIES
55 INSTITUTIONS/ UNIVERSITIES
COVERING 19 MAIN TECH AREAS
Research Grant Funding Criteria: Grant is fundamental research versus product development, outreach or education, along with having technical quality and qualified principal investigators (PIs). Requires having naval relevance potential, a documented research approach and cost realism. ONR Global only funds PIs outside of the U.S. Submissions are through GRANTS.GOV, based on the ONR headquarter’s Long Range Broad Agency Announcement. Government organizations are not funded. Publishing in the open literature (research unclassified) is encouraged while the intellectual property remains with the PI. Deliverable is a final report and/or conference proceeding.

RESEARCH TECH DOMAINS

- Acoustics
- Additive Manufacturing
- Advanced Microelectronics
- Advanced Sensors
- Autonomy and Unmanned Systems, Robotics
- Bio-Medical
- Biotechnology and Synthetic Biology
- Command, Control, Communications (C3)
- Computer Science
- Decision Science
- Environmental Science
- Human Performance
- Machine Learning/Artificial Intelligence and Human-Machine Teaming
- Maritime Diplomacy
- Maritime Domain
- Marine Science and Oceanography
- Material Science, including Composites and Metamaterials
- Naval Science
- Quantum Science
- Undersea Technologies

COUNTRIES

- Argentina
- Australia
- Brazil
- Denmark
- Germany
- Indonesia
- Israel
- Italy
- Japan
- Netherlands
- New Zealand
- Oman
- Peru
- Poland
- Sweden
- Switzerland
- United Arab Emirates
- United Kingdom
- United States

CO-FUNDING SOURCES

- Army
- Air Force
Research Grants PARTNERS

- Australian Acoustical Society
- Ben Gurion University of the Negev
- Consejo Nacional de Investigaciones
- Consiglio Nazionale delle Ricerche
- Consorzio Nazionale Interuniversitario Per Le Tele
- Deakin University
- Federal University of Pelotas (UFPel)
- Fondazione Instituto Italiano di Tecnologia
- Fraunhofer FKIE
- Geoptic
- Hamburg University of Technology
- Instituto Multidisciplinario de Biologia Vegetal
- Instytut Wysokich Cisnien Polskiej Akademii Nauk
- JFE Mineral Company, LTD
- Khalifa University of Science and Technology
- Macquarie University
- Maritime Research Institute Netherlands (MARIN)
- Monash University
- National Polytechnic of Malang
- Netherlands Organization for Applied Scientific Research TNO
- Pontificia Universidad Catolica del Peru
- RISE Research Institutes of Sweden AB
- Rite-Solutions, Inc.
- Robert Gordon University
- Stanhope AI LTD
- Stichting National Lucht- En Ruimtevaartlaboratorium
- Sultan Qaboos University
- Swansea University

- Swinburne University of Technology
- Technical University of Denmark
- Technion R&D Foundation, Haifa Technische Universiteit Delft
- Tel Aviv University
- The Systems Biology Institute
- The University of Wollongong
- Univ. of Auckland
- Universidade Federal de Rio de Janeiro (UFRJ)
- Universidade Federal Rio Grande do Sul (UFRGS)
- Université de Genève
- University of Auckland
- University of Cambridge
- University of Exeter
- University of Glasgow
- University of New South Wales - Sydney
- University of Nottingham
- University of Oxford
- University of Technology, Sydney
- University Of Western Australia
The International Global-X Challenge, launched in April 2021 by the ONR Global, selects promising international projects that demonstrate revolutionary capabilities for the U.S. Navy, Marine Corps, commercial marketplace and the public. It is designed to discover, disrupt and ultimately provide a catalyst for development and delivery of new capabilities.

WHAT IS THE GLOBAL-X CHALLENGE?

The winning project is a team composed of researchers from Japan, U.K., U.S. and Finland, led by Dr. Chris Steer from Geoptic Infrastructure Investigations Limited (U.K.), and will seek to show in nine months a proof of concept of an alternative navigation system in the Arctic using muons with precision equal to that of GPS. They will be using a natural source of radiation called cosmic ray muons as an alternative to the satellite-derived GPS signals. The unique aspect of this work is these subatomic particles pass through rock, buildings and earth — areas where GPS communications cannot be received. The lead ONR Global science director for this project, Dr. Charles Eddy, said, “The ability to navigate in Polar Regions will be of increasing importance in the coming decades as climate change is opening up Arctic waterways to commercial and military activities. This project, which uses cosmic relativistic particles that continuously impinge on the Earth’s entire surface, offers an innovative approach to the challenge of navigation at high latitudes with little or no GPS service.”

On the same line, Steer commented, “Like echolocation, the timing difference between ‘pings’ — the signals from a crossing muon in our detectors — can allow the user to measure the distance from one detector to another with multiple detectors allowing location by triangulation. The technique has already been tested in the laboratory before, where the process of converting particles’ crossing times to infer the position of a detector was successfully demonstrated.”
Challenges, Opportunities and Future Applicability

After initially testing the system in a large water-immersion tank in the U.K., the project will move to Finland to deploy into an Arctic lake that is covered by one meter of ice. At these high latitudes, conventional GPS measurements are problematic due their orbital constraints. From a science perspective, a significant challenge is the development of a number of tightly specified sensors, such as a highly synchronized set of distributed clocks (to better than 10 billionths of a second), in order to minimize the inferred position uncertainty, and their integration with the muon detectors. To make matters even more challenging, said Steer, “we also need to deploy our system in Arctic weather conditions (typically -20 degrees Celsius), in an isolated environment and partially underwater. The cold environment has implications across many aspects of the project, from personnel to ensuring the electronics are robust to the cold.”

The science opportunities abound and they extend well beyond the underwater environment, as operating in GPS-denied environments is such a common problem. “The sea is broadly transparent to cosmic ray muons, so we expect there to be a number of scientific subsea navigation opportunities. Similarly, as cosmic ray muons are highly penetrating and able to pass through many tens to hundreds of meters of rock, it is possible to see that this technology also has strong opportunities in tunnels and other underground settings,” Steer continued. The future is extremely bright for this line of research given that position finding is fundamental within many areas of science, engineering and industry. While generally a very positive aspect, “the wide-applicability can also be a distracting issue, as often a focus application is required to make progress,” said Steer. “Consequently, the next stage after this project would be to understand the positioning needs of end users, down selecting to the best fit with our positioning measurement system, and maturing the technology for their needs.”

The potential scope is wide and the project’s technology is transformative for positioning inside tunnels, and on land or underwater at high latitudes.

About Global-X

The purpose of the Global-X Challenge is to discover, disrupt and ultimately provide a catalyst through basic and applied research for later development and delivery of revolutionary capabilities to the U.S. Navy and Marine Corps, the commercial marketplace and the public.

ONR Global sponsors scientific efforts outside of the U.S., working with scientists and partners worldwide to discover and advance naval capabilities.

Prof. Lee Thompson, left, Dr. Chris Steer, center, and Dr. Charles Eddy, ONR Global science director, right, are shown in the Geoptic Infrastructure Investigations Limited laboratory with an underwater remotely operated vehicle that will be used in their research. (Photo courtesy of ONR Global)
HIGHLIGHTS OF OUTCOMES, RESULTS AND RESEARCH GRANTS

OUTCOMES AND RESULTS

- Award Recognitions
- Knowledge Transfers
- Patents
- Presentations
- Publications
- TRL Progressions
- Press Releases

PREVIEW OF FY2021 RESEARCH GRANTS

- Active Inference: from Neuroscience to Real World Systems
- Active Metamaterial-Based Chaff for Radar Deception
- Bio-inspiration for Efficient Mobile Sensor Networks
- Circular Bioconversion of Epoxy-based Polymers Inspired by Nature
- Controlled Spatial Fabrication of Metalloprotein Nanostructures for Bio-Interfacing
- Designing Quantum Systems with Radiative Centers in Two-Dimensional materials
- High-Temperature Coatings for Composites
- Metabarcoding the Global Fouling Community
- New Ideas for Advanced Relativistic Magnetrons
- Object Detection and Recognition Using Knowledge Growing System
The Tech Bridge will serve as an open forum for industry and academia engagement with the Department of the Navy, the Royal Navy, and U.K. Ministry of Defense. It will provide guidance, support and development opportunities for the defence workforce and connected stakeholders. This unique Tech Bridge will leverage the historic partnership between the two nations and operate as a two-way flow, enabling connections between the U.S. and U.K. The Tech Bridge will strengthen our nations’ bond and improve the interoperability and interchangeability of our naval and defense services.

**THE LONDON TECH BRIDGE VISION**

**CONNECT**
- Industry, academia, government/defense departments

**COLLABORATE**
- Build and sustain partnerships that enable joint success

**INNOVATE**
- Discover “dual-use” solutions to stakeholder problem sets

**SUPPORT**
- Support ecosystem through STEM outreach, knowledge seminars and networking facilitation

**ENGAGE**
- Leverage location in Global “Tech Hub” to expand and diversify local and total network

**DEVELOP**
- Grow the U.S. naval workforce’s knowledge and abilities to work with U.K. stakeholders

**TECHNOLOGY FOCUS AREAS**

- Artificial Intelligence
- Autonomy/Unmanned
- Biotechnology
- Space
- Lasers/Directed Energy
HIGHLIGHTS AND ACCOMPLISHMENTS

London Tech Bridge APEX Undersea Challenge Selects Three Winning Projects

LONDON, UK. — The international APEX Undersea Challenge, launched in April by the London Tech Bridge, has selected three winning projects to demonstrate their capabilities in a six-month period of performance, aimed to deliver rapid proficiency advances with both military and commercial value. Selected by an international panel of experts, the winning teams are from Robert Gordon University in Aberdeen, U.K.; the Netherlands Organization for Applied Scientific Research TNO in The Hague; and an industry-academia collaboration between Rite-Solutions, Inc., and the University of Rhode Island in the U.S. Joining the London Tech Bridge as members of the APEX Undersea Challenge evaluation panel were the ONR Global, Office of the Chief Technology Officer Royal Navy, NATO Maritime Unmanned Systems Innovation and Coordination Cell, Imperial College London Institute for Security Science and Technology, and U.K. MoD Defense and Security Accelerator. The evaluation panel selected three teams under two challenge topics: “High Bandwidth Long Range Underwater Cooperative Network” and “Sense and Avoid of Underwater Obstacles for UXV (UUV and USV)”.

U.S. Navy Opens Tech Bridge Network in London – October 2020

The U.S. Navy’s acquisition chief announced on Oct. 20, 2020, the establishment of the London Tech Bridge — the Navy’s first such innovation center outside the United States. The London Tech Bridge will connect U.K. technology solutions to the Department of the Navy (DoN) and will also partner U.S. companies with U.K. industry. NavalX, with the London-based U.S. Office of Naval Research Global, in place since 1946, explored new connections with industry startups to large businesses, academia and U.K. defense partners. Together, the team aims to connect technology solutions to the DoN and harness innovation.

U.S. Navy and Royal Navy Partner in Newly Launched London Tech Bridge - December 2020

The U.K.'s Royal Navy and the U. S. Navy announced a new partnership to accelerate the adoption of novel ideas and technologies, marking a unique chapter in the historic relationship between the two nations. A newly established London Tech Bridge — with both nations as full partners — will serve as a command post for innovation for the two navies as they work toward interchangeability in everything from technology development to deployment and operations.
A Multisite Study of the Utility of Sleep Trackers for Military Populations

- **Knowledge transfer**: Presented at the Human Performance Tri-Service Asia Portfolio Review June 2021.

Advanced Methods for Blind Extraction of Independent Sources from Multi-Sensor Observations

- **Presentation**: Interspeech 2021 “Advanced semi-blind speaker extraction and tracking implemented in experimental device with revolving dense microphone array.”
- **Knowledge Transfer**: Algorithm and MATLAB code transfer to Carderock.

AlGaN/GaN HEMT Devices on 200mm Engineered Substrates for 5G Applications

- **Knowledge transfer**: NRL – High Power Electronics Branch

Anticipative Point-Mass Method for High-Performance Estimation and Navigation (APHEN)

- **Knowledge Transfer**: Algorithms to Air Force
Artificial Intelligence to Simulate Earth’s Stratosphere

- **Award:** Prof. Tim Palmer inducted as International Member of the United States National Academy of Sciences.
- **Knowledge transfer:** to NRL Marine Metrology Division (NRL-Monterey)

Bio-inspiration from a 400 Million-Year-Old Arms-Race: Stomatopods vs Cephalopods

- **Presentation:** Human Performance Tri-Service Asia Portfolio Review June 2021
- **Knowledge Transfer:** Camera systems were used in the filming of “Life in Colour” with Sir David Attenborough” produced by Netflix and the BBC, released (in the UK) on April 22, 2021

Biosonar Characterization of Microhabitats for Rhinolophid & Hipposiderid Bats in Brunei

- **Publication:** Manuscript in review at Ecology and Evolution: Aylen, O., P.J. Bishop, R.A. Wahab & T.U. Grafe. Effectiveness of acoustic lures for increasing interior-forest bat captures in tropical forests.

BRAIN-Inspired Networks of Ultrafast LASER Neurons

- **Recognition:** Prof. Antonio Hurtado, University of Strathclyde, received Turing AI Fellowship (Turing Institute) for the development of photonics based neuromorphic computing circuits, a highly prestigious award, to continue collaborative research with in the field.

Compact High Power Microwave Oscillators

- **Knowledge Transfer:** to NRL Theory and Computation Section of the Electromagnetics Technology Branch
- **Knowledge Transfer:** to HPM director at NSWC-Dahlgren.
- **Knowledge transfer:** Results provided at ONR Directed Energy/Counter Directed Energy Weapons Portfolio Review
Context-aware Intent Prediction


Correlation Spectra in Nonlinear Modulation Instabilities and Rogue Waves

- **Publication**: Solitons supported by intensity-dependent dispersion
  https://www.osapublishing.org/ol/fulltext.cfm?uri=ol-45-6-1471&id=428856

Cross-Slope Acoustic Scattering and Transmission Experiment in the Northeastern South China Sea


Cross-Slope Acoustic Scattering and Transmission Experiment in the Northeastern South China Sea (continued)

Deterministic Solid-State Quantum Memory

- **Award** - 2020 Thomas Young Medal for Prof Mete Atature, University of Cambridge, is the highest award in the world for quantum information science received “for his pioneering contributions to quantum optical phenomena in semiconductors and diamond, creating exciting applications in quantum technologies”

Development of Materials and Processes for Tandem Perovskite/Silicon Solar Cells

- **Award** - European Becquerel Prize for Outstanding Merits in Photovoltaics – Henry Snaith
- (Presentation) “Understanding and achieving high open-circuit voltage in stable wide band gap perovskite solar cells” Dr Ashley Marshall (for Prof Henry Snaith) at the Tandem PV 2021 Workshop 13-16 April 2021 online.

Development of Wearable Amine/Ammonia Sensors for Health Monitoring

- **Presentation/Knowledge Transfer**: Human Performance Tri-Service Asia Portfolio Review June 2021

Examining Colour Usage in Next Generation Displays when Using Laser Eye Protection

- **Presentation/Knowledge Transfer**: Human Performance Tri-Service Asia Portfolio Review June 2021

Extending the Applicability of the Ecological Dynamics Framework to Measuring and Understanding Team Performance in a Military Setting

- **Presentation**: High Performance Research Network (HPRNet) conference 2021
- **Knowledge Transfer**: Human Performance Tri-Service Asia Portfolio Review June 2021

Fatigue Life of Post-Buckled Composite Structures


Feasibility and accuracy of multi-component models of ocean ambient noise

**Feeling Like a Fish**
- *Presentation:* ONR Bio-Inspired Autonomous Systems Review
- *Knowledge Transfer:* Human Performance Tri-Service Asia Portfolio Review June 2021
- *Technology Transfer:* Awarded a follow-on grant with ONR, “Sensing Flow Like a Fish”
- *Publication:* Lain A. Anderson, Markus Haller, Christopher Walker, Derek Orbaugh, Simon Freeman, Samuel Rosset, “A proprioceptive DE sensor skin for a fish-like continuum robot,” Proc. SPIE 11587, Electroactive Polymer Actuators and Devices (EAPAD) XXIII, 1158723 (22 March 2021); doi: 10.1117/12.2585325

**FT-SMXB (Numerical Prediction of Delamination Growth Under Fatigue Loading Conditions)**
- *Presentation:* A. Russo, A. Sellitto, P. Curatolo, A. Riccio. “A Computational Cost-effective numerical methodology for the simulation of the fatigue behaviour in composite materials” ICCS23,
- *Presentation:* Gas narcosis in hyperbaric environments: detection, prevention and physiology of hypoxia, hypercapnia and nitrogen narcosis in rebreather diving

**Geometry of Information Flow and Uncertainty Quantification for Robust Neural Network Architectures in Deep Learning**

**Geodesic Luneberg Lenses for High Power Applications**
- *Knowledge Transfer* to NRL Code 5745 of the High Power Microwave Section of the Tactical Electronic Warfare Division
- *Knowledge transfer:* Results provided at ONR Directed Energy/Couter Directed Energy Weapons Portfolio Review
- *Knowledge Transfer:* to HPM director at NSWC-Dahlgren.
Health and Activity Monitoring by Wearables in Extreme Conditions

- **Knowledge Transfer**: AI algorithms to ONR and Mayo Clinic

Heat Tolerance in Humans: Understanding the Responder/Non-Responder Phenomenon and its Implications for Balancing Force Protection

- **Publication and Knowledge Transfer**: Human Performance Tri-Service Asia Portfolio Review June 2021

Improving the Characterization and Understanding of Global Contribution to Environmental Impacts of Plastic Debris in Aquatic Environments

- **Publication**: Bao-Son Trinh, A Separation of Plastic Debris in Saigon River Sediment Using a MicroPlastic Sediment Separator, SCIENCE AND TECHNOLOGY DEVELOPMENT JOURNAL - SCIENCE OF THE EARTH & ENVIRONMENT
- **Presentation**: Dr. Trinh Bao Son “High density polyethylene microplastic ingestion and egestion of hard clam, Meretrix Lyrata, under controlled conditions, Asia-Pacific network for global change research; International webinar on “Plastic/Microplastic Pollution and Management” Sirindghorn International Institute of Technology; Institut Teknologi Bangdung; and VanLang University.

Long-Term Monitoring of Deep-Ocean Near Inertial Wave Activity and Surface Sea-Ice Cover in the Arctic Ocean Using PDS-CPIES

- **Presentation**: Arctic Portfolio Seminar Series: Oceanography (virtual: May 10-14, 2021) Use of inverted echo sounders for long-term monitoring of deep-ocean changes (13 May at 1200 GMT)
Millimeter Wave Adaptive Power Beaming of UAVs

- **Award:** Best Paper Award at Korean Institute of Electromagnetic Engineering and Science Conference, Feb. 2021

Molecular Mechanisms of Barnacle Adhesion: A Combined Structural Biology and Computational Study

- **Publication:** Akshita Kumar, Harini Mohanram, Jianguo Li, Hortense Le Ferrand, Chandra S. Verma, and Ali Miserez
- **Publication:** Disorder–Order Interplay of a Barnacle Cement Protein Triggered by Interactions with Calcium and Carbonate Ions: A Molecular Dynamics Study Chemistry of Materials 2020 32 (20), 8845-8859 DOI: 10.1021/acs.chemmater.0c02319
Neurobiology of Decision Making


• **Presentation & Knowledge Transfer:** Human Performance Tri-Service Asia Portfolio Review June 2021

New AC Poling Technique for Maximizing Dielectric and Piezoelectric Properties of Donor/Acceptor-modified PMN-PZT Single Crystals

• **Presentation:** a. Hwang-Pill Kim, Geon-Ju Lee, Sang-Goo Lee, Ho-Yong Lee, and Wook Jo, “Solution to extending operation temperatures of piezoelectric single crystals with engineered internal bias field,” 8th International Congress on Ceramics (ICC8), Virtual, Korea, April 25~30, 2021

• **Presentation:** Geon-Ju Lee, Hwang-Pill Kim, Ho-Yong Lee, Sang-Goo Lee and Wook Jo, “Influence of Alternating Current Poling on piezoelectric PMN-PT single crystal,” 8th International Congress on Ceramics (ICC8), Virtual, Korea, April 25~30, 2021

New Ideas for Advanced Relativistic Magnetrons

• **Knowledge transfer:** to NSWC-Dahlgren

• **Knowledge transfer:** Results provided at ONR Directed Energy/Couter Directed Energy Weapons Portfolio Review

Non-Invasive Measurement of Sea Ice Thickness Using Low Frequency EM Waves


• **Presentation:** ONR-Global Arctic Portfolio Seminar Series: Oceanography, May 10-14, 2021 Title: Measuring sea ice thickness using near-field interferometry and deep learning Presenter: Mohammad Ariful Haque


Optimization of Carbon Fiber Surfaces for Advanced Composites

- **Publication:** Vukovic, F., Walsh, T. “Moisture Ingress at the Molecular Scale in Hygrothermal Aging of Fiber-Epoxy Interfaces” ACS Appl. Mater. Interfaces 2020, 12, 49, 55278-55289

Optimizing Cognitive Performance by Mimicking Slow-Wave Sleep in the Awake Brain

- **Publication:** Geffen, Asher, Bland, Nicholas and Sale, Martin V (2021). Effects of slow oscillatory transcranial alternating current stimulation on motor cortical excitability assessed by transcranial magnetic stimulation. biorxiv. doi: 10.1101/2021.05.13.444101
Optimizing Cognitive Performance by Mimicking Slow-Wave Sleep in the Awake Brain (continued)

- **Presentation:** “Modulation of motor skill consolidation by slow, oscillatory tES: a research protocol”. Julia Wood, Nicholas Bland, Sonia Brownsett, Martin Sale. Australasian Brain Stimulation Society conference, July 2021
- **Presentation:** “It’s time to bin phase-bins: The cost of back-sorting for detecting phase-dependent effects”. Nicholas S. Bland. Australasian Brain Stimulation Society conference, July 2021
  - **Presentation:** “Anodal Transcranial Direct Current Stimulation to the Bilateral Dorsolateral Prefrontal Cortex Does Not Facilitate Hazard Perception Skill Acquisition”. Kieseker, G. A., Horswill, M. S., Sale, M. V. Australasian Brain Stimulation Society conference, July 2021
- **Knowledge Transfer:** Presented at the Human Performance Tri-Service Asia Portfolio Review June 2021

Probabilistic Processing of Sequential Auditory Information in Noise

- **Publication:** Fiser J; Szabó, B. Márkus, B, Nagy, M., Statistical learning of concurrent auditory signals, J of Vision. 20(11):444, DOI:10.1167/jov.20.11.444
- **Award:** István Winkler (key person) was awarded the Academy Prize for outstanding research achievements by the Hungarian Academy of Sciences in 2021

Robust Flight Control Systems for Miniature Lighter-than-Air Robots

- **Publication:** Using a robotic platform to study the influence of relative tailbeat phase on the energetic costs of side-by-side swimming in fish. https://royalsocietypublishing.org/doi/full/10.1098/rspa.2020.0810#d82875237e1

Shockwave Propagation Physics through a Medium

- **Presentation:** APS March meeting 2021, Virtual. Abstract E23.00004 : Shock compression through different media: air, water and their interface
Structural Integrity of Composite and Adhesively Bonded Aircraft Structures from the Perspective of Multiaxial Cyclic Loading

- **Presentation:** R. Jones. “On the Mechanics and Physics of AM & Cold Spray built parts, and their use in limited life UAV structures as airframe replacement parts” Plenary Address: 3rd Structural Integrity Conference and Exhibition, 19DEC2020, Indian Structural Integrity Society
- **Presentation:** R. Jones. “Crack Growth in Adhesively Bonded Structures and the Importance of Similitude” 24th International Conference on Composite Structures, JUN2021

The biomechanics of miniature active venom delivery system

- **Presentation/Knowledge Transfer** - Human Performance Tri-Service Asia Portfolio Review June 2021

The Impact of Sleep Restriction and Circadian Misalignment on Decision Making

- **Presentation/ Knowledge Transfer** - Human Performance Tri-Service Asia Portfolio Review June 2022

Transforming Additive Manufacturing via in-situ and Operando Synchrotron Imaging


Vision Enhancement Using Eye-Tracked Augmented Reality

- **Publication:** Medeiros, A. C., et al. (2021). 3D pointing gestures as target selection tools: guiding monocular UAVs during window selection in an outdoor environment. ROBOMECH Journal, 8(1), 1-19
Vision Enhancement Using Eye-Tracked Augmented Reality (continued)

- **Technology Transfer**: Research resulted in the acceptance of another grant from the Japan Society for the Promotion of Science entitled, “Development of Cognitive Symbiosis in Virtual Agents to Improve Remote Classroom Learning Outcomes”, that will help with a continuation of learning support systems and will facilitate continued collaborations between Osaka University, Augusta University, the University of California Santa Barbara, and University College London.
- **Technology Transfer**: The eye-tracked visual impairment simulation built under this grant as part of the Augusta University – Osaka University collaboration will be put into place in the physical diagnosis classes at the Medical College of Georgia at Augusta University.

Vision Enhancement Using Eye-Tracked Augmented Reality (continued)

- **Technology Transfer**: The Augusta University library has purchased hardware to run the visual impairment simulation as well as other modules for educational purposes.
- **Knowledge Transfer**: Presented at the Human Performance Tri-Service Asia Portfolio Review June 2021.
- **Award**: Dr. Jason Orlosky awarded the Osaka University Award from Osaka University, which is awarded to researchers for their outstanding research contributions to the school.
- **Award**: Dr. Jason Orlosky awarded the Boundless Teaching Award from Augusta University, which was awarded for positively impacting students in physical and or digital learning spaces and to recognize excellence in teaching.
Wave-Ice-Ocean Interactions: Measurements, Modelling and Generated Acoustic Noise

- **Publication:** Li, S., A.V. Babanin, F. Qiao, D. Dai, S. Jiang, and C. Guan, 2021: Laboratory experiments on CO2 gas exchange with wave breaking. Journal of Physical Oceanography, accepted on July 13, 2021
- **Publication:** Tavakoli, S., L. Huang, and A.V. Babanin, 2021: Drift motion of floating bodies under the action of green water. Proceedings of the ASME 2021 40th International Conference on Ocean, Offshore and Arctic Engineering OMAE2021, June 21-30, 2021, Virtual, Online, 10p
FISCAL YEAR 2021 GRANTS

ARGENTINA
- Light-Matter Interaction at the Nanoscale with Plasmonic Vortices (Consejo Nacional de Investigaciones)
- Phytochemistry and Structural Diversification of Secondary Metabolites in the Search for Antimicrobial Compounds (Instituto Multidisciplinario de Biologia Vegetal)

AUSTRALIA
- Biomechanical and Biochemical Biomarkers of Musculoskeletal Injury: A Machine Learning Approach to Injury Prediction (MACQUARIE UNIVERSITY)
- Durable Conformal Antenna on UAVs (Monash University)
- Structural Integrity Of Wire And Arc Additive Manufactured (WAAM) Parts (Swinburne University)
- High Temperature Coatings for Composites (Swinburne University)
- Controlled spatial fabrication of metalloprotein nanostructures for bio-interfacing (University Of New South Wales)
- Decentralized Planning for Adaptive Search in Heterogeneous Multi-Agent Systems with Tightly Coupled Tasks (UNIVERSITY OF TECHNOLOGY SYDNEY)
- Adapting the Transparency of Autonomous Systems to Optimise Human-Autonomy Teaming in Command and Control (C2) Settings (University of Western Australia)
- Heat tolerance in humans: Understanding the responder/non-responder phenomenon and its implications for balancing force protection with operational capacity building (University of Western Australia Centre for Water)
- The impact of A-Site dopant on the electromechanical properties of relaxor-PT material system (University Of Wollongong)

BRAZIL
- Cartilage and bone biofabrication using human adipose stem cells spheroids as building-blocks (ASSOCIACAO TECNICO CIENTIFICA PAUL EHRlich APABCAM)
- Development of three-dimensional scaffolds for regenerative medicine of skin and bone (Fundacao de Apoio Da Ufrgs - Faurgs)
- Near-Real Time Water Quality Monitoring in Ports and Hydro Ways using UAVs and Low-Cost Sensors (Fundacao de Apoio Da Ufrgs - Faurgs)

DENMARK
- Phased array quantum cascade lasers for satellite communications and infrared countermeasures (INSTITUT MINES TELECOM)
- Architectural Design of Microstructure to Reduce Hydrogen Embrittlement Sensitivity (ADMIRHE) (University of La Rochelle, LaSIE)

GERMANY
- Projected Belief Networks for Classification of Underwater Acoustic Signals (FRAUNHOFER-GESELLSCHAFT ZUR FORDERUNG DER)
- Circular Bioconversion of Epoxy-based Polymers Inspired by Nature (Technischen Universitaet Hamburg-Harburg)
## Fiscal Year 2021 Grants (continued)

### Indonesia
- Object Detection and Recognition using Knowledge Growing System (Politeknik Negeri Malang, Technische Universiteit Delft)

### Israel
- New Ideas for Advanced Relativistic Magnetrons (Technion Research & Development Foundation Ltd.)
- Bioelectrosynthesis of Cyclopropanes by Genetically Expanded and Wired P450BM3 (Ben Gurion University Of The Negev)
- Active Metamaterial-based Chaff for Radar Deception (Tel Aviv University)

### Italy
- ESTIMATOR - design optimization of coherent Mimo radar networks enabled by photonics (CONSORZIO NAZIONALE INTERUNIVERSITARIO PER LE TELE)
- Improving Knowledge Prediction & Forecasting of Ships in Waves via Hybrid ML Methods (CONSIGLIO NAZIONALE DELLE RICERCHE)
- Deciphering the novel principles of the octopus neuromuscular systems control using a bottom-up approach (Fondazione Istituto Italiano di Tecnologia)
- Liquid Phase Sintering of C Fiber Reinforced Ultra-High Temperature Ceramic Composites (INFINITE) (ISTEC CNR)

### Japan
- Towards Achieving AI for Scientific Discovery: A Grand Challenge to Promote Strategic International Research in AI (SYSTEMS BIOLOGY INSTITUTE, THE)
- Characterization of Mn Doped PIN-PMN-PT Single Crystals and Development of Quaternary Single Crystals (JFE Mineral Company, LTD)

### Netherlands
- Higher-level perception and control with a fully spiking neural network autopilot for autonomous drone flight (TECHNISCHE UNIVERSITEIT DELFT)
- Repair of thermoplastic composite aircraft structures (STICHTING KONINKLIJK NEDERLANDS LUCHT-EN RUIMTEVA)
- In-Flight Testing and Control of Cavitation and Ventilation on a Surface-Piercing Foil
- APEX Undersea Challenge: Stand-off Underwater iDentification by Operator of auto-Classified Objects (SUDOCO) (NEDERLANDSE ORGANISATIE VOOR TOEGEPAST)

### New Zealand
- Sensing flow like a fish (The University of Auckland)
OMAN
- Shelf slope dynamics in the Sea of Oman: how submesoscale processes control food and water security (Sultan Qaboos University)
- Metabarcoding the Global Fouling Community (Sultan Qaboos University)

PERU
- Indirect Excitation and Luminescence Activation Mechanisms of Rare-Earth Doped Wide Bandgap Degenerated Semiconductors and their Impact on the Host’s Optical and Electrical Properties (Pontificia Universidad Catolica del Peru)

POLAND
- Gan Substrates of the Highest Structural Quality for High Power Electronics (Instytut Wysokich Cisnien Polskiej Akademii Nauk)

SINGAPORE
- Designing quantum systems with radiative centers in two-dimensional materials (National University of Singapore)

SWEDEN
- Radiation effects on wide bandgap semiconductor devices (RISE Research Institutes of Sweden AB)

SWITZERLAND
- Synaptic and neuronal functionalities on a single oxide film (UNIVERSITE DE GENEVE)
- On-demand, Single and N-Photons Sources by Perovskite Quantum Dots (Eidgenössische Technische Hochschule ETH)

UNITED ARAB EMIRATES

UNITED KINGDOM
- Global-X Challenge: Development of the Novel Underwater Navigation System with the Wireless Muometric Positioning System (muPS) (Geoptic Infrastructure Investigations Limited)

UNITED STATES
- APEX Undersea Challenge: Undersea Object Recognition and Anomaly Detection via Manifold Mapping (Rite Solutions, inc.)
The Office of Naval Research Global: PARTNERSHIPS 2021

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– RADM Lorin Selby
Chief of Naval Research

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