

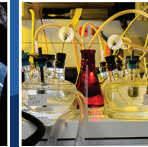
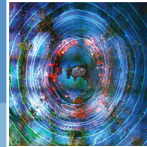
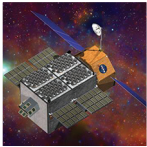
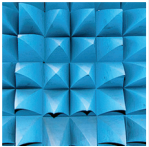
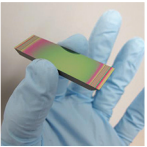
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U.S. NAVAL RESEARCH LABORATORY

www.nrl.navy.mil

NRL GUIDE



U.S. NAVAL RESEARCH LABORATORY
4555 Overlook Avenue, S.W.
Washington, DC 20375-5320

www.nrl.navy.mil

The U.S. Naval Research Laboratory has major facilities on the banks of the Potomac River in southeast Washington, D.C., at the Stennis Space Center, in Mississippi, in Key West, Florida, and in Monterey, California. NRL was dedicated on July 2, 1923, and is the Navy and the Marine Corps' corporate laboratory charged with the mission of conducting basic and applied research in a broad, multidisciplinary program to advance science and technological development for the National Defense Strategy. For more information, visit the NRL website or join the conversation on Twitter, Facebook, LinkedIn, Instagram, and YouTube.



WASHINGTON, DC



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STENNIS SPACE CENTER, MS



We provide the advanced scientific capabilities required to bolster our country's position of global naval leadership. Here, in an environment where the nation's best scientists and engineers are inspired to pursue their passion, everyone is focused on research that yields immediate and long-range applications in the defense of the United States.

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Find out more at:

www.nrl.navy.mil



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For technical questions or to submit a resumé, simply use the email link found in the heading for each research division in this guide.

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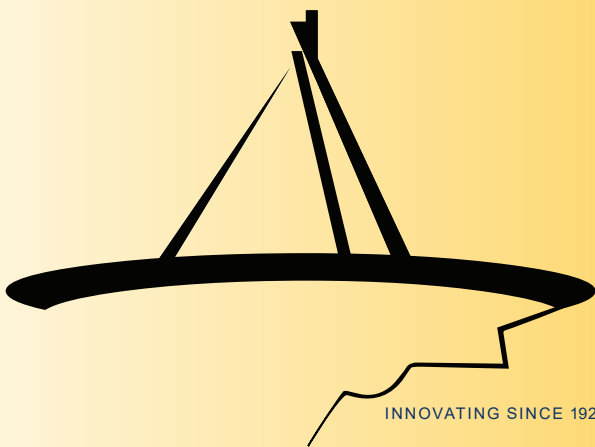
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INNOVATING SINCE 1923

Current Research and Development Efforts

Advanced Radar Sensors and Technologies

Advanced optical sensors
EM/EO/meteorological/oceanographic sensors
Satellite meteorology
Precise space tracking
Radio/infrared astronomy
Infrared sensors and phenomenology
UV sensors and middle atmosphere research
VLBI/astrometry
Optical interferometry
Imaging spectrometry
Liquid crystal technology
High dynamic range, non-field distorting EO and MO sensors

Autonomous Systems

Algorithms for control of autonomous systems
Cognitive robotics
Human-robot interaction
Perception hardware and algorithms
High-level reasoning algorithms
Machine learning and adaptive algorithms
Sensors for autonomous systems
Power and energy for autonomous systems
Networking and communications for mobile systems
Swarm behaviors
Test and evaluation of autonomous systems

Computer Science and Artificial Intelligence

Reservoir computing for data and systems analysis
Standard computer hardware, development environments, operating systems, and run-time support software
Methods of specifying, developing, documenting, and maintaining software
Human-computer interaction
Intelligent systems for resource allocation, signal identification, operational planning, target classification, and robotics
Parallel scientific libraries
Algorithms for massively parallel systems
Digital progressive HDTV for scientific visualization
Adaptive systems: software and devices
Advanced computer networking
Simulation management software for networked high performance computers
Interactive 3D visualization tools and applications
Real-time parallel processing

Scalable, parallel computing
Petaflop computing, globally distributed file systems,
terabit-per-second networking

Directed Energy Technology and Railguns

High-energy lasers
Laser propagation
Solid-state and fiber lasers
High-power microwave sources
Electromagnetic launchers (railguns)
Pulse detonation engines
Charged-particle devices
Pulsed power
DE effects
Underwater laser acoustic sources
Wireless recharging (power beaming)

Electronic Electro-optical Device Technology

Integrated optics
Radiation-hardened electronics
Nanotechnology
Microelectronics
Microwave and millimeter-wave technology
Hydrogen masers for GPS
Aperture syntheses
Electric field coupling
Vacuum electronics
Focal plane arrays
Radiation effects and satellite survivability
Molecular engineering

Advanced Electronic Protection Distributed Techniques

EW/C2W/IW systems and technology
SIGINT (COMINT/ELINT) technology
EW decision aids and planning/control systems
Intercept receivers, signal processing, and identification systems
Passive direction finders
Decoys and offboard countermeasures (RF and EO/IR)
Expendable autonomous vehicles/UAVs
Repeaters/jammers and EO/IR active countermeasures and techniques
Platform signature measurement and management
Threat and EW systems computer modeling and simulations
Visualization
Hardware-in-the-loop and flyable ASM simulators
Missile warning infrared countermeasures
RF environment simulators
EO/IR multispectral/hyperspectral surveillance

Enhanced Maintainability, Reliability, and Survivability Technology

- Coatings
- Friction/wear reduction
- Water additives and cleaners
- Fire safety
- Laser hardening
- Satellite survivability
- Corrosion control
- Automation for reduced manning
- Radiation effects
- Mobility fuels
- Chemical and biological sensors
- Environmental compliance

Environmental Effects on Naval Systems

- Meteorological effects on communications
- Meteorological effects on weapons, sensors, and platform performance
- Air quality in confined spaces
- Electromagnetic background in space
- Solar and geomagnetic activity
- Magnetospheric and space plasma effects
- Nonlinear science
- Ionospheric behavior and effects on sensors and communications
- Oceanographic effects on weapons, sensors, and platforms
- EM, EO, and acoustic system performance/optimization
- Environmental hazard assessment
- Contaminant transport
- Biosensors
- Microbially induced corrosion
- Laboratory simulation of space plasmas

Imaging Research/Systems

- Remotely sensed signatures analysis
- Real-time signal and image processing algorithms/systems
- Image data compression methodology
- Image fusion
- Automatic target recognition
- Scene/sensor noise characterization
- Image enhancement/noise reduction
- Scene classification techniques
- Radar and laser imaging systems studies
- Coherent/incoherent imaging sensor exploitation
- Remote sensing simulation
- Hyperspectral imaging
- Microwave polarimetry
- Image processing

Information Technology

- Voice processing
- High-performance computing

High-performance communications
Requirements specification and analysis
Real-time computing
Machine learning
Information filtering and fusion
Bandwidth management (quality of service)
High-assurance software
Distributed network-based battle management
High-performance computing supporting uniform and non-uniform memory access with single and multithreaded architectures
Distributed, secure, and mobile information infrastructures
Network and communications security
High-performance, heterogeneous physical layer networked communications systems
Resilient, anti-jam networked communication links
Wireless mobile networking and tactical mobile area networks (MANETs)
Next-generation tactical data links
Spectrum agility/co-existence
Dynamic spectrum access, cognitive radio networks software defined networked communications systems
Integrated internet protocol (IP) and asynchronous transfer mode (ATM) multicasting
Reliable multicasting protocols, routing and transport mechanisms
Information theory and networked communications systems optimization
Communications systems integration and rapid capability development
Automated/distributed sensor communications networks
Communication network modeling, simulation, emulation
High-performance, heterogeneous physical layer networked communications systems
Resilient, anti-jam networked communication links
Communication system engineering and information theory
Mobile, wireless networking technology
Joint service tactical-edge networking
Automated testing of highly mobile tactical networks (Tactical MANETs)
Reliable multicast routing, protocols, and applications
Communication network modeling, simulation, and emulation
Distributed sensor networks
Advanced tactical data links
Cognitive radio and software-defined networking technology
Communications channel optimization and agility
Communications systems integration and rapid capability development
Spectrum agility/co-existence

Marine Geosciences

- Marine seismology with both conventional and unique instrumentation, including analysis of acoustic reflections for seafloor physical and acoustic properties, and indications of fluid and gas seeps, methane gas, and methane hydrate, in support of acoustic performance prediction
- Numerical simulation and prediction of seafloor sediment properties
- Generation and analysis of interface (Scholte) waves in support of mine warfare and mine countermeasures
- Laboratory measurements of a wide variety of sediment physical and acoustic properties.
- Acoustic, electro-optic, and electromagnetic sensing for seafloor mapping and characterization
- Modeling, simulation, and prediction of nearshore and riverine processes
- Geospatial science and technology for enabling information dominance
- Geotechnical investigations of seafloor structure and strength

Materials

- Superconductivity
- Magnetism
- Ferroelectrics
- Dielectrics
- Biological materials
- Materials processing
- Advanced alloy systems
- Solid free-form fabrication
- Environmental effects
- Energetic materials/explosives
- Aerogels and underdense materials
- Nanoscale materials
- Nondestructive evaluation
- Ceramics and composite materials
- Thin film synthesis and processing
- Electronic and piezoelectric ceramics
- Thermoelectric materials
- Active materials and smart structures
- Computational material science
- Computational fluid dynamics
- Paints and coatings
- Flammability
- Chemical/biological materials
- Spintronic materials and half metals
- Bio-derived/biomimetic materials
- Ecosystems biology
- Molecular scaffolding and structures
- Multifunctional materials

Power and energy
Synthetic biology
Microwave and high pressure processing
Additive manufacturing
Laser processing and modifications

Meteorology

Global, theater, tactical-scale, and on-scene numerical weather prediction
Data assimilation and physical initialization
Atmospheric predictability and adaptive observations
Adjoint applications
Marine boundary layer characterization
Air/sea interaction; process studies
Coupled air/ocean/wave/ice/land model development
Tropical cyclone forecasting aids
Satellite data interpretation and application
Aerosol transport modeling
Meteorological applications of artificial intelligence and expert systems
On-scene environmental support system development/nowcasting
Tactical database development and applications
Meteorological tactical decision aids
Meteorological simulation and visualization
Earth system prediction capability
Impact of measurements on atmospheric prediction

Ocean Acoustics

Underwater acoustics, including propagation, noise, and reverberation
Fiber-optic acoustic sensor development
Deep ocean and shallow water environmental acoustic characterization
Undersea warfare system performance modeling, unifying the environment, acoustics, and signal processing
Target reflection, diffraction, and scattering
Acoustic simulations
Tactical decision aids
Sonar transducers
Dynamic ocean acoustic modeling
Underwater acoustic communication

Ocean Sciences

Ocean and seabed instrumentation
Open ocean, littoral, polar, and nearshore oceanographic and seabed forecasting
Numerical simulation of seabed properties (acoustic bottom loss)
Shallow water ocean and seabed effects on operations
Modeling, sensors, and data fusion
Ocean data assimilation

Reduced order modeling
Physics parameterization
Seismic/acoustic acquisition, modeling, and inversion
Bio-optical processes
Oceanographic processes observation: mixing, waves, and circulation
Waves, tides, and surf prediction
Sea ice modeling and prediction
Coupled ocean-ice-wave-air-land modeling and prediction
Coupled data assimilation
Global, theater, and tactical scale modeling and prediction
Remote sensing of oceanographic parameters
Satellite image analysis
In-water sensing of ocean optics and biology
Bioluminescence and bioluminescence potential
Microbiologically influenced corrosion
Turbulence effects on ocean optics
Generation and analysis of interface (Scholte) waves in support of mine warfare and mine countermeasures
Laboratory measurements of a wide variety of sediment physical and acoustic properties.
Acoustic, electro-optic, and electromagnetic sensing for seafloor mapping and characterization
Modeling, simulation, and prediction of nearshore and riverine processes
Geotechnical investigations of seafloor structure and strength
Next generation planning, charting and navigation systems
Convergence of human factors and machine learning
Hydrographic survey and data processing techniques

Space Systems and Technology

Advanced payloads and optical communications
Atomic time/frequency standards/instrumentation
Attitude determination and control systems
Controllers, processors, signal processing, and VLSI
Environmental simulations
Hypersonic systems design and analysis
Launch and on-orbit support
Maritime space sensor CONOP development
Mechanical systems for spacecraft
Onboard autonomous navigation
Passive and active ranging techniques
Precise Time and Time Interval (PTTI) technology
Precision orbit estimation, dynamics, and space object tracking
Reaction control, propulsion systems, and thruster and cathode systems
Robotics learning and machine learning
Robotic manipulation and locomotion technologies
Satellite ground station engineering integration, and operations solutions

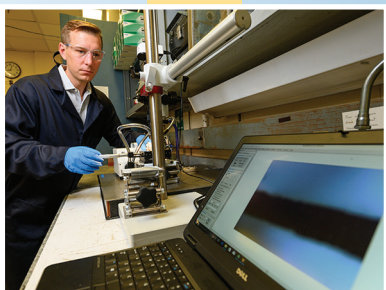
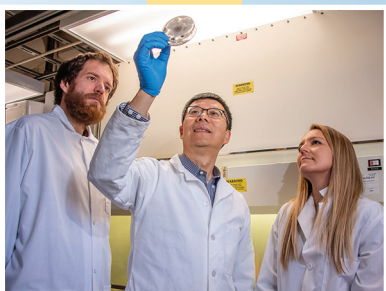
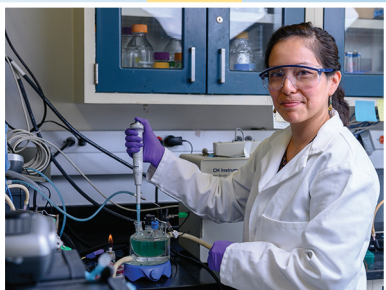
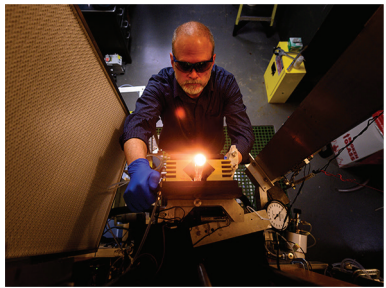
Satellite Command and Control (C2) software
Satellite Mission Management (MM) software
Satellite Ground Resource Management (GRM) software
Space systems architectures and requirements
Spacecraft antenna systems
Spacecraft power systems and analog systems design and test
Spacecraft test systems software
Structural and thermal systems design and analysis
Tactical communication systems
Two-phase heat transfer systems
Unmanned robotic systems

Radar, Surveillance, and Sensor Technology

Imaging radars
Radar imaging and automatic target recognition
Distributed radar
Multifunction RF systems
Millimeter-wave radar
Target classification/identification
Airborne geophysical studies
Fiber-optic sensor technology
Undersea target detection/classification
EO/IR multispectral/hyperspectral detection and classification
Sonar transducers
Electromagnetic sensors, gamma ray to RF wavelengths
SQUID for magnetic field detection
Low observables technology
Ultrawideband technology
Interferometric imagery
Microsensor systems
Digital framing reconnaissance canvas
Biologically based sensors
Cylindrical and ultrawideband antennas
Computational electromagnetics
Electronic protection
Radar systems engineering
Advanced signal processing
Optimization techniques
Software systems engineering
High frequency over the horizon radar

Undersea Technology

Autonomous vehicles
Bathymetric technology
Anechoic coatings
Acoustic holography
Unmanned undersea vehicle dynamics
Weapons launch



NRL RESEARCH DIVISIONS

EXECUTIVE DIRECTORATE

KNOWLEDGE MANAGEMENT DECISION SUPPORT OFFICE, CODE 1050

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Ruth H. Hooker Research Library
NRL Online Bibliography
Reference and citation services
Collections of print and digital books, journals, and
technical reports
Command data strategies
Analytics for process data
Analytics of research outputs
Command records management
NRL History office

INSTITUTE FOR NANOSCIENCE, CODE 1100

NANOINFO@NRL.NAVY.MIL

NANOSCIENCE AND NANOTECHNOLOGY

Low-power, high-speed electronics
Lightweight, high-strength materials
Molecular sensors
Efficient energy generation and storage
Quantum information technology
Bio/inorganic hybrids
Neuroelectronics

LABORATORY FOR AUTONOMOUS SYSTEMS RESEARCH, CODE 1700

LASRINFO@NRL.NAVY.MIL

AUTONOMOUS SYSTEMS RESEARCH

Multidisciplinary research, development, and integration
in autonomous systems
Software for intelligent autonomy
Novel human-systems interaction technology
Prototyping highbay for flight controls development
and mixed reality
Desert highbay, with climbing wall and sandstorm
capability
Tropical highbay for experiments in a jungle environ-
ment with programmable rain events
Littoral highbay with underwater localization, wave
generator, and shoreline environment
Modular work areas for short term visitors

Areas for outdoor experimentation
Nylon 3-D printing service

SYSTEMS DIRECTORATE

RADAR DIVISION, CODE 5300

RADARINFO@NRL.NAVY.MIL

RADAR ANALYSIS

Modeling and simulation

Target signature prediction, control, and measurement

Computational electromagnetics and antenna design

Inverse synthetic aperture radar (ISAR)

Automatic Target Recognition (AI/ML)

Wideband array simulation and development

Cylindrical array design and development

ADVANCED RADAR SYSTEMS

High-frequency over-the-horizon radar technology and systems

Multifunction systems (radar/electronics warfare/communications)

Software systems engineering and software development

Real-time signal and data processing equipment

Standards-based software and system design and development

Computer-aided engineering (CAE)

ADVANCED CONCEPTS GROUP

Millimeter-wave radar

Unmanned aircraft systems (UAS) radar

Microelectronics design and development

Microwave power beaming

SURVEILLANCE TECHNOLOGY

Air and missile defense radar technologies

Airborne radar concepts and technologies

Distributed radar systems engineering

Optimization techniques and resource management

Advanced signal processing algorithms

Electronic counter-countermeasures and electronic protection (EP)

Target signature information extraction

Spectrum management

**INFORMATION TECHNOLOGY DIVISION,
CODE 5500**

ITDINFO@NRL.NAVY.MIL

**NAVY CENTER FOR APPLIED RESEARCH IN
ARTIFICIAL INTELLIGENCE**

Adaptive systems
Autonomous and intelligent systems
Cognitive architectures and models
Cognitive science
Cognitive robotics
Distributed autonomous systems
Human/autonomous system interaction and
collaboration
Human-robot interaction and teaming
Intelligent decision aids
Machine learning (e.g., deep learning, reinforcement
learning, Bayesian models)
Mixed-reality systems
Perception and computer vision
Robotics software

**CENTER FOR HIGH ASSURANCE COMPUTER
SYSTEMS**

Hypervisor technology for computational platforms
Formal specification/verification of system security
Technology and solutions to secure networks
Software engineering for secure systems
Key management and distribution solutions
Information systems security (INFOSEC) engineering
Formal methods for requirements specification and
verification
Security product development
Secure wireless network and wireless sensor technology
Network security protocol modeling, simulation, and
verification
Cross-domain solution technology development
Hardware/software co-design
Network inspection technology
Cyber systems engineering
Security posture assessments
Malicious code analysis
Autonomous cyber operations
Dynamic mission mapping of cyber key terrain
Anonymizing systems
Distributed trust
Stealthy communications
Assurance of cyber-physical systems
Infrastructure resiliency

NETWORKS AND COMMUNICATION SYSTEMS

High-performance, heterogeneous physical layer
networked communications systems
Resilient, anti-jam networked communication links
Communication system engineering and information
theory
Mobile, wireless networking technology
Joint service tactical-edge networking
Tactical data link modeling, simulation, and emulation
Distributed sensor networks
Advanced tactical data links
Cognitive radio and software-defined networking
technology
Communications channel optimization and agility
Communications systems integration and rapid
capability development
Spectrum agility/co-existence

INFORMATION AND DECISION SCIENCES

Virtual environments, augmented reality, and mixed
reality
Visual analytics
Scientific and information visualization
Human-computer interaction
Service oriented architecture
Service orchestration
Data and information management
Human-centered design
Parallel and distributed computation
Distributed modeling and simulation
Natural environments for distributed simulation
Intelligent decision support
Information sharing
Semantic web technology
Data mining
Software agents for data fusion
Information geometry
Stochastic processes in human cognition
Computer vision
Algorithms for control of autonomous systems
Selection test development
Personnel selection and job placement
Human performance modeling
Physiological assessment
Adversarial machine learning
Game theoretic and multi-agent decision making
Comprehension and complexity of visual data
representations

CENTER FOR COMPUTATIONAL SCIENCE

Transparent optical network research and design
Parallel and novel computing architectures
Scalable high-performance computing and networking
for Navy and DoD
Secure high performance communications technologies
Distributed computing
Scientific visualization
High-performance and distributed file systems
High-definition video streaming technology
Automated testing of highly mobile tactical networks
(Tactical MANETs)
Reliable multicast routing, protocols, and applications
Communication network modeling, simulation, and
emulation
ATDnet and leading-edge WAN Layer 0, 1, and 2
research networks

OPTICAL SCIENCES DIVISION, CODE 5600

OPTINFO@NRL.NAVY.MIL

OPTICAL MATERIALS AND DEVICES

Advanced infrared optical materials
IR fiber-optic materials and devices
IR fiber chemical and environmental sensors
IR transmitting windows and domes
Transparent ceramic armor materials
Metamaterials
Quantum optics and processes
Planar waveguide devices
IR nonlinear materials and devices
Ceramic laser gain materials
Advanced photovoltaic materials
Fiber lasers/sources and amplifiers
Radiation effects

OPTICAL PHYSICS

Laser materials diagnostics
Nonlinear frequency conversion
Optical instrumentation and probes
Optical interactions in semiconductor superlattices
and organic solids
Laser-induced reactions
Organic light-emitting devices
Nanoscale electro-optical research
Aerosol optics

APPLIED OPTICS

UV, optical, and IR countermeasures
Ultraviolet component development
Missile warning sensor technology
UV, visible, and IR imager development
Multispectral/hyperspectral sensors
Multispectral/hyperspectral/detection algorithms
Framing reconnaissance sensors
Novel optical components
Sensor control and exploitation system development
IR low observables
EO/IR systems analysis
Atmospheric IR measurements
Airborne IR search and track technology

PHOTONICS TECHNOLOGY

Fiber and solid-state laser/sources
High-speed (<100 fs) optical probing
High-power fiber amplifiers
High-speed fiber-optic communications
Antenna remoting
Free space communication
Photonic control of phased arrays
Micro-electro-optical-mechanical systems
Microwave photonics

OPTICAL TECHNIQUES

Fiber-optic materials and fabrication
Fiber Bragg grating sensors/systems
Fiber-optic sensors/systems (acoustic, magnetic, gyroscopes)
Photonic integrated circuits

TACTICAL ELECTRONIC WARFARE DIVISION, CODE 5700

EWINFO@NRL.NAVY.MIL

OFFBOARD COUNTERMEASURES

Decoys and offboard payloads
Expendable technology and devices
Unmanned air vehicles

EW SUPPORT MEASURES

Radar signal intercept/electronic intelligence (ELINT)
Signal demodulation/feature extraction
Multiplatform geolocation
Advanced real-time digital signal processing

AEROSPACE EW SYSTEMS

Airborne radar CM systems
Communications CM technique development
RF-enabled cyber
Cognitive EW

SURFACE EW SYSTEMS

Shipboard EA systems
High-power EA transmitters
EA techniques and vulnerabilities
Signal processing for EA

ADVANCED TECHNIQUES

High-fidelity physics-based ASM modeling
New EW techniques
EO/IR EW modeling and flyable simulators
Experimental and developmental EO/IR CM systems

INTEGRATED EW SIMULATION

Hardware-in-the-loop simulation
Flyable ASM seeker simulators
Central Target Simulator
Foreign Military Equipment exploitation

EFFECTIVENESS OF NAVAL EW SYSTEMS

SIMDIS
Scenario Builder
High-level analysis and modeling simulation

SIGNATURE TECHNOLOGY OFFICE

Electromagnetic scattering fundamentals
Low observable materials

MATERIALS SCIENCE AND COMPONENT TECHNOLOGY DIRECTORATE

LABORATORIES FOR COMPUTATIONAL PHYSICS AND FLUID DYNAMICS, CODE 6040

COMPHYSINFO@NRL.NAVY.MIL

REACTIVE FLOWS

Fluid dynamics in combustion
Turbulence in compressible flows
Multiphase flows
Turbulent jets and wakes
Jet noise
Detonation engines

Propulsion systems analysis
Contaminant transport modeling
Fuel cells
Fire and explosion mitigation

COMPUTATIONAL PHYSICS DEVELOPMENTS

Laser-plasma interactions
Inertial confinement fusion
Space debris elimination
Solar physics modeling
Many-core computing
Advanced graphical and parallel processing systems
Solar and heliospheric modeling
Microfluidics
Fluid structure interaction
Shock and blast containment
Bio-inspired propulsion for micro air vehicles and
unmanned underwater vehicles

CHEMISTRY DIVISION, CODE 6100

CHEMINFO@NRL.NAVY.MIL

MATERIALS CHEMISTRY AND DYNAMICS

Bio-inspired materials
Biological laser printing
Degradation and stabilization mechanisms
Functional organic coatings
High-temperature resins
Ion/molecule processes
Kinetics of gas phase reactions
Magnetic resonance
Novel nanotubes and nanofibers
Optical diagnostics of chemical reactions
Polymer characterization
Reactive nanometals
Synthesis and evaluation of innovative polymers and
composites

CORROSION SCIENCE AND ENGINEERING

Aquatic invasive organism control
Biofouling control
Cathodic protection
Corrosion control engineering
Corrosion science
Electrochemical systems
Environmental fracture and fatigue
Marine coatings
Materials failure analysis

SURFACE/INTERFACE CHEMISTRY

Adhesion and adhesives
Alternative energy sources
Battery safety
Bio/organic interfaces
Chemical/biological sensors
Diamond films
Electrochemistry
Energy storage materials
Nanostructured materials and interfaces
Marine biofouling surface/interface chemistry
Microbiology
Nanomechanics
Plasmonics
Surface/interface analysis
Surface properties of materials
Surface reaction dynamics
3D Printing of novel organic/inorganic materials
Tribology

SAFETY AND SURVIVABILITY

Analytical chemistry
Trace chemical sensing
Explosives detection
Mobility fuel chemistry
Machine learning/Cheminformatics
Fire suppression technology
Surfactant and emulsion chemistry and mechanics
Solid and liquid fuel combustion
Oil spill remediation
Personnel protection
Damage control
Firefighting doctrine
Theoretical chemistry
Modeling and simulation of nanoscale systems
Quantum computing methods

MATERIALS SCIENCE AND TECHNOLOGY DIVISION, CODE 6300

MATERIALINFO@NRL.NAVY.MIL

MULTIFUNCTIONAL MATERIALS

Integrated computational materials engineering (ICME)
Nanoscale, microscale, mesoscale material
characterization and manufacturing
Phase transformation and microstructural evolution in
material systems

Microstructure and process control in additive manufacturing
Multiple principal element alloys
Atom probe tomography
Computational simulations of materials in extreme environments (e.g., electromagnetic launch, blast, ballistic events)
Computational simulations of manufacturing processes
Multifunctional composite material systems
Magneto-electric sensors
Energy harvesting materials and devices
Nonlinear multiferroic materials
Corrosion, fatigue, and fracture of naval materials
High pressure synthesis
High energy density dielectrics
Bulk nanostructured ceramics
Ceramic thermal and environmental barrier coatings
Biomechanical simulation and response of live cell cultures
Surrogate model development for the warfighter
Personal protection equipment
Metamagnetic transitions for ultra low power and ultra high frequency devices
Advanced computational modeling development including finite element, crystal plasticity and uncertainty quantification
3D material characterization to elucidate microstructure-property relationship
Automated serial sectioning for statistically large, high resolution 3D material characterization data sets
Microstructural evolution of anisotropic polycrystalline systems
Digital twin and structural health monitoring
Neuromorphic computing for structural performance characteristics

MATERIALS AND SYSTEMS

Laser direct write
Terahertz sources, devices, and sensors
Graphene heterostructures and devices
Magnetic materials
Superconducting materials
Optoelectronic materials
Electroceramic materials
Multiferroic materials
Radar absorbing materials
Analysis of extrasolar materials

Chemical sensors
Additive manufacturing and flexible electronics
Thin film deposition for devices
Glass fiber processing and characterization
Polymer synthesis and characterization
Personal protective equipment
Remote explosives detection
Aberration-corrected STEM for single-atom spectroscopy and tomography
Photo-emission materials
Phase-change materials
Nuclear materials analysis
Materials and systems for carbon capture and energy storage

MATERIALS PHYSICS AND TECHNOLOGY

Condensed matter theory
Electronic structure of solids and clusters
Molecular dynamics
Quantum many-body theory
Theory of magnetism, magnetic materials and alloys
Materials for power and energy
Semiconductor and surface physics
Theoretical studies of phase transitions
Atomic physics theory
Quantum dots
Computational biophysics and protein modeling
Continuum multiphysics modeling
Reduced order modeling
Multiphysics simulation of materials behavior
Development of high-performance computational methods
Spintronic/magneto-electronic materials and devices
Nonlinear dynamics and chaos theory
Nanoplasmonic biosensors
Automated learning
Quantum information
Radiation in matter
Data and systems analysis
Robotic multi-axial material testing and characterization
Full field displacement vector and strain tensor field components measurements
Inverse methods for multiphysics material systems
Data- and model-driven process to performance relations for additive manufacturing
Development of digital twin technologies for qualification and condition-based maintenance

Topological materials
Two dimensional materials beyond graphene
Van der Waals heterostructures

PLASMA PHYSICS DIVISION, CODE 6700

PLASMAINFO@NRL.NAVY.MIL

RADIATION HYDRODYNAMICS

Radiation hydrodynamics and non-local thermodynamic equilibrium ionization kinetics of Z-pinches and laser-produced plasmas
X-ray source development
High-energy density physics and inertial confinement fusion
Low-temperature plasma and discharge physics
Dense plasma atomic physics, equation of state
Laser driven ion/neutron sources

SPACE AND LABORATORY PLASMAS

High-energy density physics in support of nuclear stockpile stewardship
Laser inertial confinement fusion
High-energy ArF and KrF laser development
Massively parallel radiation hydrocode development and utilization
High-power laser matter interaction experiments
Advanced high-energy pulse power and electron beam diodes
Laser fusion energy
Applications of high-power pulsed-electron beams

CHARGED PARTICLE PHYSICS

Applications of modulated and CW electron beams
Rocket, satellite, and International Space Station natural and active experiments
Laboratory simulation of space plasmas
Space plasma theory and numerical simulation
Plasma processing sources
Surface modification of energy sensitive materials
Atmospheric and ionospheric GPS sensing
Ionospheric effects on communications
Electromagnetic launchers
Radiation belt remediation
Atmospheric pressure plasma applications
Microelectromagnetic pulses generated by hypervelocity impacts

DIRECTED ENERGY PHYSICS BRANCH

Nuclear weapons effects simulation
High-power, pulsed radiography
Plasma, bremsstrahlung, and neutron radiation sources
Electromagnetic launchers
Production, focusing, and propagation of intense electron and ion beams
Capacitive, inductive, and battery energy storage

BEAM PHYSICS

Directed energy and high-power laser propagation through the atmosphere
Advanced accelerators and radiation sources
Microwave, plasma, and laser processing of materials
Microwave sources: magnicons and gyrotrons
Nonlinear stochastic dynamical systems
Ultrahigh-intensity laser-matter interactions
Underwater laser interactions

ELECTRONICS SCIENCE AND TECHNOLOGY DIVISION, CODE 6800

ELECINFO@NRL.NAVY.MIL

QUANTUM OPTOELECTRONICS

PHOTON DETECTION & CONVERSION

Infrared sensor materials and devices
High-efficiency photovoltaic and power beaming systems
Stimulation of neurons with visible and infrared light

PHOTOPHYSICS & RADIATION EFFECTS

Radiation effects and hardening for space and strategic applications
Time-resolved spectroscopy, photophysics, and molecular energy transfer
Optical simulation of space radiation effects

NANO-OPTOELECTRONICS

Polaritonic materials and metamaterials
Physics-based electromagnetic modeling and design of metamaterials
Nanocrystal synthesis and optoelectronics

QUANTUM SCIENCE & TECHNOLOGY

Solid-state quantum optics
Quantum sensing
Nonlinear nanophotonic devices

ELECTROMAGNETICS TECHNOLOGY

SOLID-STATE CIRCUITS & DEVICES

Microwave and millimeter-wave active and passive devices
Compact acoustic wave devices for advanced filtering

Neuromorphic computing devices

Small- and large-signal RF characterization techniques

THIN FILM MATERIALS

Metal-oxide and metal-nitride molecular beam epitaxy

Atomic layer deposition/epitaxy of insulators, semi-conductors, and metals

Materials characterization and defect-property relationship determination

Thin film heterostructure simulation and design

THEORY & COMPUTATION

1D/2D/3D Physics-based solid-state and vacuum device modeling

Machine learning algorithm application

First principles atomistic calculations

3D GPU-based modeling coherent interaction of electromagnetic fields with electron beams

VACUUM ELECTRONICS & MATERIALS

Meso- to micro-scale fabrication techniques for vacuum electronic devices

Physics-based design tools for vacuum electronic devices

Microwave and millimeter-wave vacuum electronic device design, fabrication, and test

Electro- and magneto-active ceramic and polymer materials development

POWER ELECTRONICS & ADVANCED MATERIALS

HIGH POWER DEVICES

Si, SiC, GaN, Ga₂O₃, and diamond power switching devices

Solid state devices for pulsed power

Thermal management in wide and ultrawide-bandgap devices

Doping of semiconductor materials

Reliability of power devices

WIDE & ULTRAWIDE BANDGAP MATERIALS

SiC, GaN, and Ga₂O₃ epitaxial growth research

Engineered nanocomposite materials

Surface science and atomic layer epitaxy

Characterization of defects SiC, GaN, and Ga₂O₃ bulk material

Spectroscopic evaluation of wide bandgap materials

NOVEL MATERIALS & APPLICATIONS

Graphene, transition metal dichalcogenides, and other low dimensional material growth

Ion beam processing of materials

Nanoscale fabrication, 2D layer stacking, 3D nano-lithography

Vapor and gas sensing
Optical characterization of materials

**CENTER FOR BIO/MOLECULAR SCIENCE
AND ENGINEERING, CODE 6900**

BIOMOLINFO@NRL.NAVY.MIL

BIOLOGICALLY DERIVED STRUCTURES

Self-assembly
Molecular engineering
Synthetic structures
Nanocomposites
Tailored electronic and optical materials
Molecular imprinting
Viral scaffolds
Multifunctional materials

CHEM/BIOSENSORS

Distributed and autonomous sensing
Biosensors for underwater chemical sensing
DNA biosensors
Array-based sensors
Optical biosensors
Microfluidics and microarrays
Electrochemical sensors
Multifunctional recognition/reporter molecules

NOVEL MATERIALS

Soil/groundwater explosives detection
Single chain and single domain antibodies
Nanoparticles and quantum dots
Energetic materials
Nanoporous and mesoporous materials
Quantum dot and protein conjugates
Biomimetic materials
Multifunctional decontamination coatings
Molecularly templated nanomaterials

MOLECULAR BIOLOGY

Genomics, transcriptomics, proteomics and
metabolomics of microbes and microbial consortia
Systems and synthetic biology
Biomarker discovery
Molecular epidemiology of pathogenic
microorganisms
Antimicrobial resistance
Tissue engineering
Rational and machine-learning-based biomolecular
design

Genetic engineering of cell free systems
Next Generation Sequencing and rapid sequence analysis

ENERGY HARVESTING

Biomaterials for charge storage
Ocean floor biofuel cell
Photo-induced electron transfer
Novel photo-active polymers

OCEAN AND ATMOSPHERIC SCIENCE AND TECHNOLOGY DIRECTORATE

ACOUSTICS DIVISION, CODE 7100

ACOUSINFO@NRL.NAVY.MIL

PHYSICAL ACOUSTICS

Structural acoustics
Synthetic aperture sonar (SAS) signal processing
Broadband structural acoustics sonar (acoustic color
and AI for MCM, CUUV and ASW)
Target scattering modeling for multi-statics
Zero and low Doppler sonar signal processing
Buried object detection and classification
Acoustic stealth for underwater systems
Autonomy for unmanned underwater vehicles (UUV)
Acoustics transduction for broadband systems
Single crystal materials for transduction
Nearfield acoustic and EM holography
Compact range scattering and radiation (CRSR)
Fiber-optic sensors
Hydrogen in graphene storage for fuel cells
Control of phonon transport in thin films
Fundamental loss mechanisms in thin films
Terahertz (THz) acoustics
Nanomechanical resonators and devices

ACOUSTIC SIGNAL PROCESSING AND SYSTEMS

Underwater acoustic communications and networking
Underwater acoustic network warfare
Long-range underwater communications
Underwater distributed sensing networks
Limits of array performance
Waveguide invariant processing
Acoustic field uncertainty
Acoustic noise forecasting
Ocean boundary scattering

- Acoustic propagation
- Acoustic inversion
- Characterization of reverberation
- Acoustic metamaterials
- Acoustics of microfluidic bubbly emulsions
- Active sonar performance modeling
- Compressive sensing
- Acoustic classification
- Nonlinear propagation

ACOUSTIC SIMULATION, MEASUREMENTS, AND TACTICS

- Ocean acoustic propagation and scattering models
- Fleet application acoustic models
- High-frequency seafloor and ocean acoustic measurements
- Riverine acoustics
- Incorporating uncertainty in predictive models
- Tactical acoustic simulations and databases
- Warfare effectiveness studies and optimization

REMOTE SENSING DIVISION, CODE 7200

REMSININFO@NRL.NAVY.MIL

REMOTE SENSING

Sensors

- SAR
- Passive microwave imagers
- CCDs and focal plane arrays
- Thermal IR cameras
- Hyperspectral imaging systems
- Radio interferometers
- Optical interferometers
- Adaptive optics
- Lidar
- Spaceborne and airborne systems
- Microwave radiometers
- Passive radars
- Optical polarimetric imagers
- Autonomous platforms

Research areas

- Radiative transfer modeling
- Coastal oceans
- Marine ocean boundary layer
- Polar ice
- Snow depth
- Middle atmosphere

Global ocean phenomenology
Environmental change
Ocean surface wind vector
Soil moisture
Ionosphere
Data assimilation
Space Domain Awareness
Cryosphere
Thermosphere
Sea floor characterization
Physical oceanography
Biological oceanography
Shallow benthic characterization
Ionospheric remote sensing

ASTROPHYSICS

Optical interferometry
Radio interferometry
Fundamental astrometry and reference frames
Fundamental astrophysics
Star formation
Stellar atmospheres, envelopes, and evolution
Interstellar medium, interstellar scattering pulsars
Low-frequency astronomy
Exoplanet astronomy

PHYSICS OF ATMOSPHERIC/OCEAN INTERACTION

Mesoscale, fine-structure, and microstructure
Aerosol and cloud physics
Marine aerosol production
Mixed layer and thermocline applications
Sea-truth towed instrumentation techniques
Turbulent jets and wakes
Nonlinear and breaking ocean waves
Stratified and rotating flows
Turbulence modeling
Boundary layer hydrodynamics
Marine hydrodynamics
Computational hydrodynamics

IMAGING RESEARCH/SYSTEMS

Remotely sensed signatures analysis/simulation
Real-time signal and image processing algorithms/
systems
Image data compression methodology
Image fusion
Automatic target recognition
Scene/sensor noise characterization
Image enhancement/noise reduction

Scene classification techniques
Radar and laser imaging systems studies
Coherent/incoherent imaging sensor exploitation
Numerical modeling simulation
Environmental imagery analysis

OCEAN SCIENCES DIVISION, CODE 7300

NRL/STENNIS SPACE CENTER, MISSISSIPPI

OCEANINFO@NRL.NAVY.MIL

OCEAN DYNAMICS AND PREDICTION

Coupled systems

Air-ice-ocean-wave coupling

Ocean-acoustic coupling

Data assimilation through coupled systems

Circulation

Global resolution of circulation and mesoscale fields

Littoral circulation at the coast, bays, and estuaries

Satellite observation processing and assimilation

UUV adaptive sampling

Observation system simulation experiments

Ice volume and ice drift

Tidal currents and heights

Ocean data assimilation

Forecasting uncertainty

Surface effects

Surface wave effects globally and into bays

Wave breaking

Mixed layer dynamics

Swell propagation and dynamics

Phase averaged wave evolution

Phase resolved wave dynamics

Nearshore

Wave breaking at the shore

Rip currents at the shore

Tidal currents and heights into rivers

Nonlinear wave interaction

Sensor deployment optimization

Inundation

Acoustic effects

Sound speed variation for acoustic propagation

Internal waves, solitons, and bores for beam focusing

Wave bubble entrainment and noise generation

Surface wave generation of ambient noise

OCEAN SENSING AND PROCESSES

Dynamical processes

Optical turbulence

- Biological sensing and modeling
- Optical thin layers
- Ocean current systems
- Fronts, eddies, and filaments
- Internal waves
- Flow over topography
- Waves, bubbles, and surface foam
- Ocean turbulence and mixing
- Air–sea interaction
- Coupled systems
 - Coupled bio/optical/physical processes
 - Coupled physical/sediment processes
- Remote sensing applications
 - 3D optical profiling
 - Color/hyperspectral signatures
 - High resolution image analysis
 - Ocean optics
 - Upper layer heat content
 - Sea surface salinity
 - LIDAR/LASERS
 - Bioluminescence and bioluminescence potential
 - Intermediate trophic levels
- Microbiologically influenced corrosion
 - Metal–microbe interaction

SEAFLOOR SCIENCES

- Geologic Process Modeling and Inversion
 - Sediment transport, mass movement
 - Bottom roughness evolution
 - Heat and fluid flux
 - Biogenic/thermogenic methane and hydrate distribution, formation, dissolution
 - Diapirism, volcanism, faulting
- Seabed Prediction
 - Machine learning prediction of global physical properties – Seabed Characterization
 - Global measured and predicted bathymetry
 - Coastal and riverine hydrodynamic and morphodynamic properties
 - Mine and UXO burial and mobility observations and predictions
 - Sediment strength
- Acoustic modeling and inversion
 - Physics of high- and low-frequency acoustic propagation
 - High-resolution subseafloor 2D and 3D seismic imaging

Littoral and sediment dynamics
Small-scale granular and fluid dynamics
Aeolian sediment transport observations and modeling
Unmanned systems integration
Sensor development and seabed observing systems
Integrated acoustic/optical system for combined
mapping of bathymetry/topography
High-speed, small-scale particle image velocimetry for
laboratory and field
Instrumented mine/UXO shapes
Unmanned and remotely operated underwater vehicles
for bathymetry, and seafloor sampling
In situ littoral morphodynamics (bottom roughness
and sediment resuspension)
Multi-property sediment core logging

CENTER FOR GEOSPATIAL SCIENCES

High performance data distribution
Next generation planning, charting and navigation
systems
Convergence of human factors and machine learning
Data compression techniques and exploitation
Hydrographic survey and data processing techniques
Incorporating uncertainty and human factors in
decision making

MARINE METEOROLOGY DIVISION, CODE 7500

NRL/MONTEREY, CALIFORNIA
METEORINFO@NRL.NAVY.MIL

ATMOSPHERIC DYNAMICS AND PREDICTION

Global to tactical scale
Deterministic and probabilistic numerical weather
prediction
Large eddy simulation
Boundary layer processes
Land surface processes and modeling
Coastal processes and modeling
Arctic processes and modeling
Coupled ocean, atmosphere, wave, ice, and land surface
phenomena
Madden Julian oscillation
Atmospheric waves and scale interactions
Hydrology and hydrological cycle
Tropical cyclones
Aerosol particles
Gravity waves
Predictability
Advanced numerical methods

DATA ASSIMILATION

Hybrid ensemble-variational techniques
3D and 4D variational analysis
Ensemble Kalman Filter (EnKF and LETKF)
Quality control and bias correction
Tropical cyclone initialization
Remotely sensed data assimilation
Radar data assimilation
Targeted observing strategies
Data selection techniques
Aerosol and trace gas assimilation
Impact of observations of forecasts

TACTICAL ENVIRONMENTAL SUPPORT

Rapid environmental assessment
Atmospheric impact on weapons systems
Data fusion
Nowcasting
Visualization
Verification and validation
Information assurance
Expert systems
Aviation risk assessment
Unmanned aviation systems

ATMOSPHERIC PHYSICS

Air-sea interaction
Cloud and aerosol microphysics
Fire weather, smoke emission, and pyroCbs
Radiative transfer
Cloud and aerosol radiative properties
Aerosol analysis and prediction
Gravity wave drag
Aerosol and radiation instrumentation
Instrumentation calibration facilities

SATELLITE DATA AND IMAGERY

Automated cloud properties
Sensor calibration and validation
Nighttime environmental analysis
Tropical cyclone characterization
Dust, smoke, and aerosols monitoring
Satellite imagery analysis and enhancement
Rain rate and snow cover
Precipitation and cloud climatology
Future satellite and constellation assessment
Tactical meteorology
Training and public outreach

DECISION AIDS

Probabilistic decision aids
Refractivity and ducting
Ceiling and visibility
Fog, turbulence, and icing
Atmospheric acoustics
EM and EO propagation
Tropical cyclone forecasts
Port studies
Typhoon havens
Forecaster handbooks
Quantification of uncertainty
Counter-piracy guidance
Tropical cyclone sortie guidance
Ship wind and wave limits
Optimal ship routing and fuel savings
Directed energy applications
Battlespace management aids
Machine learning applications
METOC services
Forensic meteorology

SPACE SCIENCE DIVISION, CODE 7600

SPASCIINFO@NRL.NAVY.MIL

Development and test facilities for satellite, sounding
rocket, and balloon instruments
Solar Coronagraph Optical Test Chamber (SCOTCH)
Sun Earth Connection Coronal and Heliospheric
Investigation (SECCHI) satellite instrument suite
Solar Orbiter Heliospheric Imager (SoloHI) satellite
instrument
Wide-field Imager (WISPR) satellite instrument
Large Angle Spectrometric Coronagraph (LASCO)
satellite instrument
Compact Coronagraph (CCOR-1, CCOR-2) satellite
instruments
VERY high angular Resolution Imaging Spectrometer
(VERIS) sounding rocket
EUV imaging spectrometer (EIS) satellite instrument
The Narrow Field Imager (NFI) satellite instrument
EUV High-throughput Spectroscopic Telescope (EUVST)
satellite instrument
Suborbital Instrument Assembly and Test Facility
Fermi Gamma-ray Space Telescope
Compton Spectrometer and Imager (COSI) satellite
instrument

Glowbug gamma-ray burst satellite instrument
Radiation Instrumentation (GARI, NeRDI, SIRI) satellite instrument series
StarBurst Pioneer gamma-ray burst satellite instrument
SuperMISTI reconfigurable and adaptable stand-off gamma ray and neutron radiation detection systems
Space borne high energy radiation detection
Neutron Characterization Laboratory
Gamma ray imaging laboratory
Pulsar discovery and characterization
Radiation processes and transport
SoftWare for Optimization of Radiation Detectors (SWORD)
Special Sensor Ultraviolet Limb Imager (SSULI) satellite instrument
Michelson Interferometer for Global High-resolution Thermospheric Imaging (MIGHTI) satellite instrument
Next-Generation Ionospheric Model for Operations (NIMO)
Whole Atmosphere-Ionosphere Predictive Modeling Coordinated Ionospheric Reconstruction Cubesat Experiment (CIRCE)
Experiment for Characterizing the Lower Ionosphere & Prediction of Sporadic-E (ECLIPSE)
Tiny Remote-sensing Instrument for Thermospheric Oxygen and Nitrogen (TRITON)
Lasersheet Debris Sensor

NAVAL CENTER FOR SPACE TECHNOLOGY

SPACE SYSTEMS DEVELOPMENT DIVISION, CODE 8100

SPASYSINFO@NRL.NAVY.MIL

ADVANCED SPACE/AIRBORNE/GROUND SYSTEMS TECHNOLOGIES

Space systems architectures and requirements
Advanced payloads and optical communications
Controllers, processors, signal processing, and VLSI data management systems and equipment
Embedded algorithms and software
Satellite laser ranging

ASTRODYNAMICS

Precision orbit estimation
Onboard autonomous navigation

Onboard orbit propagation
GPS space navigation
Satellite coverage and mission analysis
Geolocation systems
Orbit dynamics
Interplanetary navigation

COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS, INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE

Communications theory and systems
Satellite ground station engineering and
implementation
Transportable and fixed ground antenna systems
High-speed fixed and mobile ground data collection,
processing, and dissemination systems
Tactical communication systems
Multi-INT/multi-domain data fusion
Maritime domain awareness
Near-real-time data analytics
Signal/waveform generation and collection

SPACE AND AIRBORNE PAYLOAD DEVELOPMENT

Space and airborne system payload concept definition,
design, and implementation; hardware and software
Detailed electrical/electronic design of electronic and
electromechanical payload and systems and
components
Design and verification of real-time embedded multi-
processor software
Payload antenna systems
Space and airborne payload fabrication, test, and
integration
Launch and on-orbit payload support

LASER COMMUNICATIONS RESEARCH

Ship-to-ship laser communications
Space-to-ground laser communications
Satellite laser ranging for precise orbit determination
Space-to-air laser communications
Space-to-space laser communications

SPACE AND AIRBORNE MISSION DEVELOPMENT

Mission development and requirements definition
Systems engineering and analysis
Concepts of operations and mission simulations
Mission evaluation and performance assessments

POSITIONING, NAVIGATION, AND TIME

Advanced navigation satellite technology
Alternative Positioning, Navigation, and Timing (APNT)
Geospatial information systems
Precise Time and Time Interval (PTTI) technology
Atomic time/frequency standards/instrumentation
Passive and active ranging techniques
Precision tracking of orbiting objects from space/ground
National and international standards for timekeeping/
Universal Coordinated Time/UTC (NRL)

SPACECRAFT ENGINEERING DIVISION, CODE 8200

SPAENGINFO@NRL.NAVY.MIL

SYSTEM INTEGRATION

Preliminary and detailed design of spacecraft mechanical components, structures, and mechanisms
Systems engineering for new spacecraft proposals
Fabrication, assembly, integration, and testing of spacecraft and payloads
Mechanisms development from initial concept to the final integrated system on launch vehicles
Highbay integration & assembly space and modern machine shop
Integrated thermal structures and two-phase thermal management system design
Morphing hypersonic vehicle structure, actuator, and control system design
Space robotics mechanism design, integration, and testing

DESIGN AND VERIFICATION

Research, development, and verification of mechanical systems for spacecraft and near space systems
Prototype spacecraft systems and experimental payloads
Environmental simulation tests of spacecraft and spacecraft systems
Vibration, shock, acoustic, and thermal vacuum testing of components, systems, payloads, and spacecraft
Detailed modeling, simulation, and testing of aerospace structural systems and precision morphing space structures
Thermal systems design, analysis, fabrication, integration, test, and flight operations
Pumped and advanced multiphase heat transfer systems and devices
Fiber-reinforced polymers and vascular composites design, analysis, fabrication, and test

Computational fluid dynamics, direct simulation Monte Carlo, and hypersonic flow simulation techniques for space systems

Vibration test lab, acoustic chamber facility, modal survey test system, loads test equipment, thermal and thermal vacuum test facilities, spin balance machine, and mass properties testing facilities

Hypersonic Systems Wind Tunnel Test Facility

DYNAMICS AND CONTROL SYSTEMS

Spacecraft attitude control, reaction control, robotics, and propulsion systems

Space object tracking, remote ground sensing, and in-space sensing

Spacecraft propulsion technologies; thruster and cathode systems, including hydraulic and pneumatic technologies supporting multiple platforms and applications

Advanced robotics concepts, unmanned robotic systems, robotics systems engineering, machine learning, and autonomous servicing, inspection, and assembly operations

Robotic manipulation and locomotion technologies to support terrestrial and undersea robotic missions

Advanced methodologies in space situational awareness, and analysis of dynamic systems and satellite mission planning analysis

Navigation, tracking, and orbit dynamics; orbital debris analysis and mitigation

Advanced Mission Simulation and Planning

Zero-gravity/Frictionless and Proximity Testing Operations

Orbital Proximity Operations Simulation

Precision Line of Sight stabilization and control

System Identification and Empirical Modeling of complex dynamical systems

Neuromorphic computing and sensing, applied to robotics control and free space optical communications

ELECTRONICS AND SOFTWARE

Space system concept definition, design, and implementation; detailed electrical and software design, development, and fabrication

Whole of program system engineering for entirety of mission

Advanced and unique antenna systems for space, software defined receivers and transmitters, wideband communications systems, EMI/EMC research, and small satellite solutions

Advanced millimeter-wave technology applications for new space systems

Advanced COTS software defined radio technology
Spacecraft demonstration missions of all sizes with RF and
Microwave technology
Antenna test lab, near field scanner, RF test and Measure-
ment Labs
Space qualified digital electronics for use in satellite
computing, processing, and storage
Integrator of components, sub-systems and systems for high
reliability space qualified programs
Electrical functional testing, thermal vacuum cycling,
vibration and acoustic testing, and electromagnetic and
radio frequency testing
Complex power, sensor, and interconnected systems
enabling control, data acquisition, and processing
Space hardware design, fabrication, test, and integration
Power generation, control, storage, conversion and
distribution
Design, build, and implementation of space test systems
and electronic launch support equipment
Operational flight software for spacecraft command,
control, data acquisition, and processing
Test software for running space test systems and
verification of unit and system performance

MISSION OPERATIONS

Innovative, resilient, and secure multi-mission satellite
operations solutions
Command and control (C2) of satellites via the Blossom
Point Tracking Facility
Ground systems architecture solutions from initial concept
through on orbit operations
Mission Management software (VMOC®) and C2 space
ground system software (NEPTUNE®)



DOING BUSINESS / CAREER OPPORTUNITIES

Doing Business with NRL

Technology Transfer Office

NRL has a long history of working with industry and academia to assist in the transfer of its technologies for applications with both government and private sector benefit. Many of NRL's research efforts result in materials, techniques, and other products that have additional applications in the commercial world. NRL developments in areas such as radar, semiconductors, optics, satellite navigation, firefighting, and a wide variety of materials and coatings have made significant contributions to the civilian sector. Technology transfer ensures full use of the results of the nation's federal investment in research and development by transferring federally owned or originated technology to private industry for the public good.

The Technology Transfer Office works to identify partners for the commercialization of NRL's technologies through a variety of channels, including working with partnership intermediaries, participating in NRL exhibits at conferences, and working with a myriad of organizations focusing on innovative commercialization opportunities.

Mechanisms for technology transfer include Cooperative Research and Development Agreements (CRADAs) and licensing of inventions and software.

Cooperative Research and Development Agreements (CRADAs)

To promote the timely transfer of technology from government laboratories to the private sector and to improve the competitiveness of U.S. industry, Congress passed the Federal Technology Transfer Act (FTTA) of 1986. With this legislation, Congress authorized federal organizations to enter into CRADAs with nonfederal parties. The objective of a Navy CRADA is cooperative research that will enhance the mission of NRL and benefit the collaborator. The CRADA defines the individual responsibilities of the Navy and non-Navy parties toward achieving the objective, as well as rights to intellectual property developed under the CRADA. The Navy party in a CRADA may provide personnel, facilities, and equipment to perform the cooperative research. The non-Navy party may provide personnel, facilities, equipment, and funding. CRADAs can be established with industrial organizations, industrial development organizations, nonprofit organizations, universities, and state and local governments.

NRL signed the Navy's first CRADA in 1989. Since that time, the Laboratory has continued to pursue and promote

this program actively. NRL has entered into CRADAs directed at optical fiber development, solar array concentrators, photovoltaic modules for power conversion, unmanned aerial vehicles (UAVs), artificial intelligence machine algorithm development for a variety of applications, fabrication of 3D printed nanostructured ceramics, and other technological advances that have impacted the military and the civilian sectors. Information on our CRADA process can be found on the Technology Transfer website.

Licensing of Navy Inventions and Software

Since the enactment of FTTA, the effort to encourage commercial use of government-funded technology has expanded in the federal laboratories. Under law, federal agencies are authorized to license their patentable inventions. More recently, the Navy has been given the authorization to license Navy-developed software as well. A license grants the licensee the right to make, use, import, and sell a product based on the licensed technology in exchange for royalty payments that are shared by the Laboratory and the inventors. NRL supports an active licensing program and has over 1200 patents and patent applications available for licensing in fields as diverse as advanced materials, chemistry, biotechnology, optics, ocean and atmospheric sciences, electronics, radar, and satellite technology, as well as a growing portfolio of licensable software. NRL has licenses with small and large U.S. businesses, as well as foreign and multinational businesses.

To begin the process of acquiring a license, the potential licensee is required to fill out the Application to Practice a Navy Invention (found on the Technology Transfer website). This application must include a detailed business/commercialization plan that covers the important aspects of product development, marketing, and sales, including a development plan with milestones, timelines, and relevant expertise; the source of funding for development of the invention; the risks associated with the technology and the market; and a projected sales forecast with the underlying assumptions used to generate the forecast. NRL also offers commercial evaluation licenses for companies looking to assess the market opportunity for a given NRL technology. All NRL licenses include both geographic and application-based fields of use as well as a level of exclusivity (generally partially exclusive or non-exclusive). Partially exclusive means exclusive in a field of use.

For partially exclusive licenses, the licensee's plan submitted with the application must meet certain

determinations from the federal regulations showing that exclusive licensing is a reasonable and necessary incentive to attract the investment of risk capital necessary to bring the invention to practical application. The proposed scope of exclusivity must not be greater than the licensee capabilities for developing and commercializing the technology, and granting the license must not substantially lessen competition. If a partially exclusive license application is acceptable and reasonable terms and conditions are negotiated successfully, an “Intent to Grant” notice must be published for a minimum of 15 calendar days before a license can be executed. The Intent to Grant notice lists the company name and the field of use for the license.

Typical financial components to each license are: (1) a lump-sum upfront fee paid on execution of the license, (2) milestone fees, (3) a running royalty for sales other than to the federal government, and (4) a minimum annual royalty.

E-MAIL: TECHTRAN@NRL.NAVY.MIL

URL: [HTTP://WWW.NRL.NAVY.MIL/TECHTRANSFER](http://WWW.NRL.NAVY.MIL/TECHTRANSFER)

Work for Nonfederal Parties

NRL has many unique capabilities that may enhance the R&D efforts of organizations external to NRL. NRL may sell testing and other services, articles, models, and software if: NRL's capabilities are unique; the sale would not constitute undue competition with industry; making them available for sale is in the interest of national defense; the sale requires no more than incidental subcontracting; and the nonfederal party agrees to hold harmless and indemnify the United States. The Navy requires advance payment, but incremental funding by task is often acceptable. The procedures for the approval of sales to nonfederal entities are covered in NRL Instructions.

Call (202) 767-2244 if you have any questions regarding work for nonfederal parties.

Letters of Intent

With increasing frequency, funding agencies are sponsoring R&D programs that are performed by “teams” consisting of industry, national laboratory, and/or university members. NRL participates actively in such programs that are funded by ONR, DARPA, and other public and private funding agencies. At the proposal phase of such programs, NRL may submit a letter of intent to the team lead that describes the work NRL will perform on a best efforts basis if the proposal is funded.

Whenever possible, NRL arranges for direct funding of its efforts by a sponsoring U.S. government agency via the Economy Act. In the event that NRL cannot be directly funded by a federal sponsor, NRL will use its best efforts to negotiate an authorized agreement under applicable law and regulation with the team lead under which NRL will perform and be compensated for its assigned tasks under the proposal.

Call (202) 767-2244 if you have any questions regarding Letters of Intent.

Memoranda of Understanding

NRL scientists participate actively with scientists from other federal laboratories and organizations on projects of national interest. Such collaborations among federal organizations may be formalized with a Memorandum of Understanding or a Memorandum of Agreement that defines the scope of the work and the responsibilities of each federal party toward achieving the objectives. NRL has entered into Memoranda of Understanding or Agreement with the Army, Navy, Air Force, Marine Corps, Department of Energy, and other U.S. government activities.

Call (202) 767-2244 if you have any questions regarding establishing MOUs and MOAs with NRL.

Funding External Activities

NRL is the Navy's corporate laboratory, conducting basic, applied, and advanced research for the Navy in a variety of scientific and technical disciplines. The basic research program is driven by perceptions about future requirements of the Navy. In addition to actively performing research, NRL supports various R&D projects that directly relate to its ongoing work. This support is provided through contracts and grants with industrial firms, colleges and universities, and nonprofit organizations.

Performers are competitively selected after review of proposals submitted in response to Broad Agency Announcements (BAAs) or Requests for Proposals (RFPs).

Proposals may be submitted by any nongovernmental entity, including commercial firms, institutions of higher education with degree-granting programs in science or engineering (universities), or by consortia led by such concerns. NRL encourages small businesses, veteran-owned small businesses, service-disabled veteran-owned small businesses, small disadvantaged businesses, HUBZone small businesses, woman-owned small businesses, and historically black colleges and universities and minority institutions to submit proposals in response to its business opportunities.

Broad Agency Announcements

BAAs are issued under the provisions of paragraphs 35.016 and 6.102(d)(2) of the Federal Acquisition Regulation. Proposals may range from theoretical studies to proof-of-concept to include fabrication and delivery of a prototype. BAA topics include all NRL sites located in the Washington, DC area, the Stennis Space Center, MS, and Monterey, CA. Proposals submitted in response to a BAA announcement that are selected for award are considered to be the result of full and open competition and are in full compliance with the provisions of Public Law 98-369, “The Competition in Contracting Act of 1984.” The North American Industry Classification System (NAICS) Code is 541712 — Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology).

The selection of proposals for contract award are based on a scientific peer review of proposals submitted in response to each BAA. The major purpose of the evaluation is to determine the relative merit of the technical approach of each proposal. Business and contractual aspects, including cost realism, are also considered as part of the evaluation. Selection of proposals for award will be based on the potential benefits to the government weighed against the cost of the proposals, in view of the availability of funds.

Current BAA information, including award considerations and instructions for submitting proposals, can be obtained via the NRL website at <http://www.nrl.navy.mil/doing-business/contracting-division/baa>.

Commercial Contracts/Procurements

NRL also contracts with commercial firms, nonprofit organizations, and academic institutions to obtain specific products and services. These contracts and purchases are for equipment (either complete systems or components), professional and technical services supporting the Laboratory’s ongoing R&D programs, and special projects. NRL contract opportunities are announced via Federal Business Opportunities (FedBizOpps) website under the Department of the Navy (USN) Office of Naval Research (ONR). ONR is NRL’s parent organization. A link to FedBizOpps is available on the NRL Contracting Division website.

More information on “Doing Business” with the Naval Research Laboratory is available at <http://www.nrl.navy.mil/doing-business/contracting-division>.

Grants

A grant is another mechanism used by NRL to fund outside activities. Grants are made primarily to educational and nonprofit organizations for proposals submitted under BAAs. NRL occasionally enters into cooperative agreements for research traineeships or fellowships and awards small grants for S&T conferences and symposia. More information about grants may be obtained by submitting a message to the "Contracts Help" category via the "Contact Us" sidebar at <https://www.nrl.navy.mil/doing-business/contracting-division>.

Career Opportunities at NRL

[HTTPS://WWW.NRL.NAVY.MIL/CAREERS](https://www.nrl.navy.mil/careers)

The U.S. Naval Research Laboratory is always looking to recruit talented individuals in many fields of science. Programs for PostDocs, faculty, and students, and direct hire authorities for civilian positions are announced at www.nrl.navy.mil/careers.

Research Associateships

Every year, NRL hosts several postdoctoral research associateship programs through the National Research Council (NRC) and the American Society for Engineering Education (ASEE). These competitive positions provide postdoctoral scientists and engineers an opportunity to pursue research at NRL in collaboration with NRL scientists and engineers. Research associates are guest investigators, not employees of the U.S. Naval Research Laboratory.

NRL/NRC COOPERATIVE RESEARCH ASSOCIATESHIP PROGRAM: The NRC conducts a national competition to recommend and make awards to outstanding scientists and engineers at recent postdoctoral levels for tenure as guest researchers at participating laboratories. The objectives of the NRC program are (1) to provide postdoctoral scientists and engineers of unusual promise and ability opportunities for research on problems, largely of their own choice, that are compatible with the interests of the sponsoring laboratories and (2) to contribute thereby to the overall efforts of the federal laboratories. The program provides an opportunity for concentrated research in association with selected members of the permanent professional laboratory staff, often as a climax to formal career preparation.

NRL/NRC Postdoctoral Associateships are awarded to persons who have held a doctorate less than five years at the time of application and are made initially for one year, renewable for a second and possible third year. Information and applications may be found at <http://www.national-academies.org/rap>. Contact NRL's program coordinator at (202) 767-8323 or nrc@nrl.navy.mil.

NRL/ASEE POSTDOCTORAL FELLOWSHIP PROGRAM:

The ASEE program is designed to significantly increase the involvement of creative and highly trained scientists and engineers from academia and industry in scientific and technical areas of interest and relevance to the Navy. Associateship awards are based upon the technical quality and relevance of the proposed research, recommendations by the Navy laboratory, academic qualifications, reference reports, and availability of funds.

NRL/ASEE Fellowship awards are made to persons who have held a doctorate for less than five years at the time of application and are made for one year, renewable for a second and possible third year. Information and applications may be found at <http://www.asee.org/nrl/>. Contact NRL's program coordinator at (202) 767-8323 or asee@nrl.navy.mil.

Office of Naval Research Summer Faculty Research and Sabbatical Leave Program

This program provides for university faculty members to work for ten weeks (or longer, for those eligible for sabbatical leave) with professional peers in participating Navy laboratories on research of mutual interest. Applicants must hold a teaching or research position at a U.S. college or university. Contact NRL's program coordinator at sfrp@nrl.navy.mil.

NRL/United States Naval Academy Cooperative Program for Scientific Interchange

This program allows faculty members of the U.S. Naval Academy to participate in NRL research. This collaboration benefits the Academy by providing the opportunity for USNA faculty members to work on research of a more practical or applied nature. In turn, NRL's research program is strengthened by the available scientific and engineering expertise of the USNA faculty. Contact NRL's program coordinator at usna@nrl.navy.mil.

Student Programs

The **NAVAL RESEARCH ENTERPRISE INTERNSHIP PROGRAM (NREIP)** offers summer appointments at Navy laboratories to current undergraduate and graduate students from accredited U.S. colleges and universities. Application is online at <https://navalsteminterns.us/nreip/> through Saxmon One. Electronic applications are sent for evaluation to the point of contact at the Navy laboratory identified by the applicant. Contact NRL's program coordinator at nreip@nrl.navy.mil.

The **NATIONAL DEFENSE SCIENCE AND ENGINEERING GRADUATE FELLOWSHIP PROGRAM** helps U.S. citizens obtain advanced training in disciplines of science and engineering critical to the Navy. The three-year program awards fellowships to recent outstanding graduates to support their study and research leading to doctoral degrees in specified disciplines such as electrical engineering, computer sciences, material sciences, applied physics, and ocean engineering. Award recipients are encouraged to continue their study and research in a Navy laboratory during the summer. Visit <https://ndseg.org> for more information.

The **SCIENTIFIC, TECHNICAL, ENGINEERING AND MATHEMATICS (STEM) STUDENT EMPLOYMENT PROGRAM (SSEP)** is a direct hire authority for undergraduate- and graduate-degree seeking students enrolled in STEM majors. Students can work full-time or part-time and those on appointments scheduled to last longer than 90 days will earn annual and sick leave each pay period.

To be eligible for the program, students must be continuously enrolled in a STEM degree program on at least a half-time basis at a qualifying education institution. Students hired into the NP career track (Science & Engineering Professional) must maintain a 3.0 GPA (based on a 4.0 scale) in a related degree field. Students hired into positions in the NR career track (Science & Engineering Technical) must maintain a 2.5 GPA (based on 4.0 scale). Conversion to permanent, although not guaranteed, may be available upon degree program completion. U.S. Citizenship is required for all entry-level positions. For more information and to apply visit: www.nrl.navy.mil/careers/students/ssep or contact the Human Resources Office at (202) 767-8313.

The **PATHWAYS INTERN PROGRAM** is available to students enrolled in a wide variety of educational institutions from high school to graduate level. Pathways applicants apply to vacancy announcements and are selected from certificates. Interns work full-time or part-time and

those on appointments scheduled to last longer than 90 days will earn annual and sick leave each pay period.

To be eligible for the program, students must be continuously enrolled in high school or in a college degree program on at least a half-time basis at a qualifying education institution. Students hired into positions in the NR career track (Science & Engineering Technical) must maintain a 2.5 GPA (based on 4.0 scale). Conversions to permanent, although not guaranteed, may be available when students complete at least 640-hours before completing the degree program requirements. U.S. Citizenship is required for all entry-level positions.

Pathways internship openings are announced quarterly on the USAJOBS website. Students **MUST** apply to USAJOBS vacancy announcements in order to be considered for a Pathways intern position. Visit our website for more information on how to apply and vacancy announcement dates. For more information, contact NRL's Human Resources Office at (202) 767-8313 or intern@nrl.navy.mil.

The **STUDENT VOLUNTEER PROGRAM** helps students gain valuable experience by allowing them to voluntarily perform educationally related work at NRL. It provides exposure to the work environment and also provides an opportunity for students to make realistic decisions regarding their future careers. Applications are accepted year-round. For additional information, contact (202) 767-8313.

The **DoD SCIENCE AND ENGINEERING APPRENTICESHIP PROGRAM (SEAP)** provides an opportunity for high school students who have completed at least Grade 9 and are at least 15 years of age to serve as junior research associates. Under the direction of a mentor, for eight weeks in the summer, students gain a better understanding of research, its challenges, and its opportunities through participation in scientific, engineering, and mathematics programs. Criteria evaluated for acceptance are science and mathematics courses completed and grades achieved; scientific motivation, curiosity, and the capacity for sustained hard work; a desire for a technical career; teacher recommendations; and exceptional grade point averages (GPA). The NRL program is one of the largest in DoD. For detailed information visit <https://navalsteminterns.us/seap/index.html> or contact NRL's program coordinator at (202) 767-8324 or seap@nrl.navy.mil.

The **SUMMER RESEARCH PROGRAM FOR HISTORICALLY BLACK COLLEGE OR UNIVERSITY (HBCU) OR MINORITY INSTITUTION (MI) STUDENTS** is a ten-week

summer internship program that provides opportunities for undergraduate and graduate students to participate in research under the guidance of a mentor at the Naval Research Laboratory. Preference is given to students planning careers in science, technology, engineering, and mathematics (STEM) disciplines. Applicants must be U.S. citizens or have permanent residency and be enrolled at an HBCU, MI, or Tribal College or University. Participating students receive a stipend. Information and application materials are available at: [TWCIAS-NRL HBCU Information Page](https://nrl.e.twc.edu/). Online applications can be found at <https://nrl.e.twc.edu/>.

Civilian Employment and Direct Hire Authorities – Scientific and Engineering Opportunities with Advanced Degrees, Bachelor’s Degrees, and Veterans

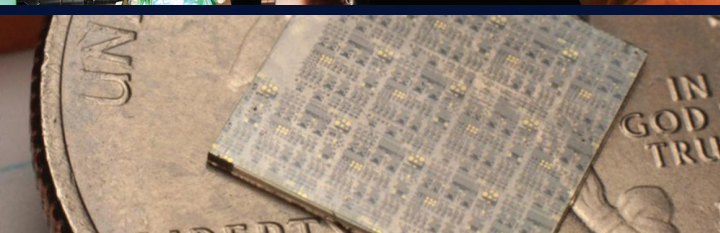
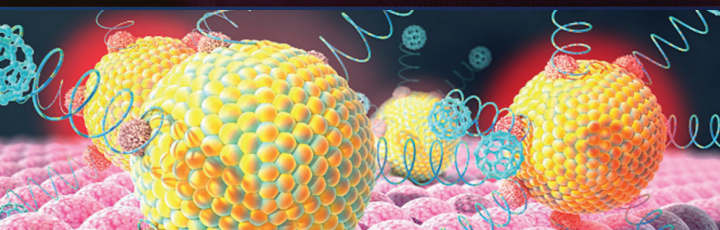
For direct hire opportunities for Science and Engineering (S&E) professionals with advanced degrees, bachelor’s degrees, and veterans, applications are accepted on a continuous basis. Applicants must submit resume and transcripts. Candidates must meet minimum qualification standards as described in the Office of Personnel Management’s (OPM) operating manual, “Qualification Standards for General Schedule Positions.” Qualified candidates may be appointed to S&E positions in fields such as aerospace, ceramics, chemical, computer, electronics/electrical, materials and mechanical engineering, astronomy, biology, chemistry, computer science, engineering psychology, geology, geophysics, materials science, mathematics, metallurgy, meteorology, physical science, physics, and oceanography.

Qualified veteran candidates may be appointed to positions in the fields mentioned above, OR to any technician position that is in direct support of research and development, i.e., engineering technician, electronics technician, physical science technician, etc. Veteran candidates appointed to a technician position must meet minimum qualification requirements as described in OPM’s operating manual, operating manual, “Qualification Standards for General Schedule Positions” and meet any possible selective placement factor identified for the position to be filled.

As the corporate research laboratory of the Navy and U.S. Marine Corps, NRL conducts a broad program of scientific research and advanced technology development. The broad-based scientific research that NRL provides serves as the foundation to develop solutions and deliver new technologies. NRL's scientists and engineers conduct basic and applied research across a wide spectrum of scientific disciplines for both immediate and long-range national defense needs. NRL's research is primarily sponsored by government agencies including the Office of Naval Research, Naval Systems Commands and Warfare Centers, Air Force, Army, DARPA, Department of Energy, and NASA.

- Autonomous & Unmanned Systems
- Chemical & Biological Sciences
- Computational Physics
- Electronics
- Environments (Sea/Air/Space)
- Information and Social Sciences
- Materials
- Nanotechnology
- Optical Sciences
- Power & Energy
- Quantum Research
- Space Sciences





CAREERS AT NRL

- Aerospace Engineer
- Astrophysicist
- Biologist
- Chemical Engineer
- Chemist
- Civil Engineer
- Computer Engineer
- Computer Scientist
- Electrical Engineer
- Electronics Engineer
- Engineering Psychologist
- Environmental Engineer
- Geologist
- Geophysicist
- Materials Engineer
- Mathematician
- Mechanical Engineer
- Metallurgist
- Meteorologist
- Oceanographer
- Physical Scientist
- Physicist

You may use the Division email addresses in this guide to submit a resumé, or visit <https://www.nrl.navy.mil/careers> for a list of current vacancies and for information on other avenues for submitting a resumé for direct hire.

Cleared for public release.

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