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# NRL

NAVAL RESEARCH LABORATORY

guide



NAVAL RESEARCH LABORATORY  
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[www.nrl.navy.mil](http://www.nrl.navy.mil)



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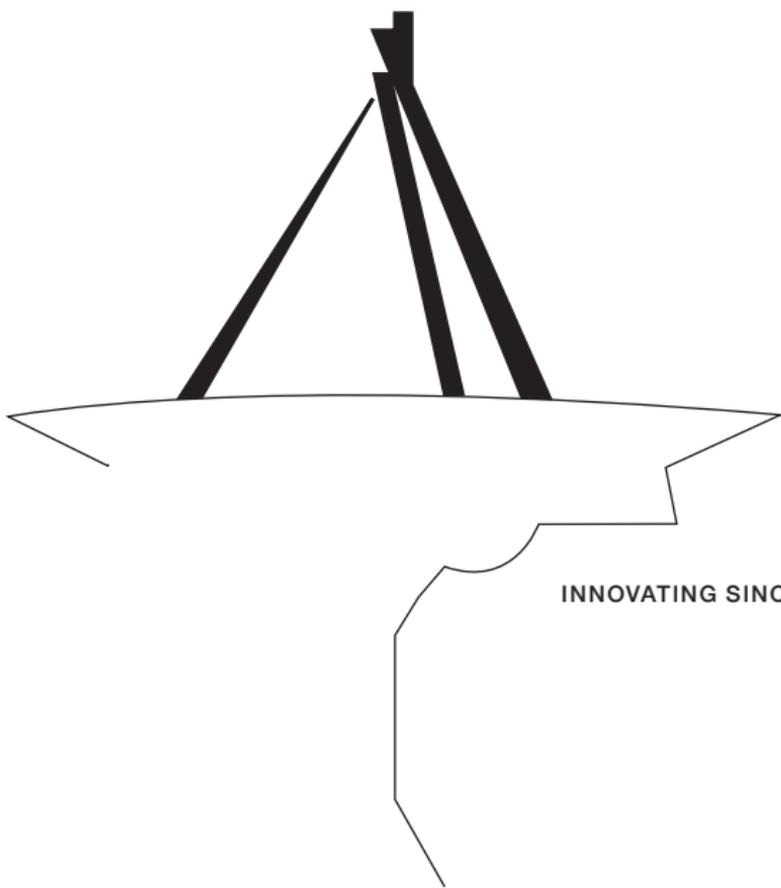
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INNOVATING SINCE 1923

## **Current Research and Development Efforts**

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### **Advanced Radio, Optical, and IR Sensors**

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  
Image processing  
VLBI/astrometry  
Optical interferometry  
Imaging spectrometry  
Liquid crystal technology

### **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**

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**

High-energy lasers  
Laser propagation  
Solid-state and fiber lasers  
High-power microwave sources  
RAM accelerators  
Pulse detonation engines  
Charged-particle devices  
Pulse power  
DE effects

### **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  
Infrared sensors  
Radiation effects and satellite survivability  
Molecular engineering

### **Electronic Warfare**

EW/C2W/IW systems and technology  
COMINT/SIGINT technology  
EW decision aids and planning/control systems  
Intercept receivers, signal processing, and identification  
systems  
Passive direction finders  
Decoys and offboard countermeasures (RF and 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

Oceanographic effects on weapons, sensors, and platforms

EM, EO, and acoustic system performance/optimization

Environmental hazard assessment

Contaminant transport

Biosensors

Microbially induced corrosion

### **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

### **Information Technology**

High-performance, all-optical networking  
Antijam communication links  
Next-generation, signaled optical network architectures  
Integrated voice and data  
Information security (INFOSEC)  
Voice processing  
High performance computing  
High performance communications  
Requirements specification and analysis  
Real-time computing  
Wireless mobile networking  
Behavior detection  
Machine learning  
Information filtering and fusion  
Integrated internet protocol (IP) and asynchronous transfer mode (ATM) multicasting  
Reliable multicasting  
Wireless networking with directional antennas  
Sensor networking  
Communication network simulation  
Bandwidth management (quality of service)  
High assurance software  
Distributed network-based battle management  
High performance computing supporting uniform and nonuniform memory access with single and multithreaded architectures  
Distributed, secure, and mobile information infrastructures  
Simulation-based virtual reality  
High-end, progressive HDTV imagery processing and distribution  
Defensive information warfare  
Virtual reality/mobile augmented reality  
3D multimodal interaction  
Model integration (physical, environmental, biological, psychological) for simulation  
Command decision support  
Data fusion

### **Marine Geosciences**

Marine seismology, including propagation and noise measurement  
Geoacoustic modeling in support of acoustic performance prediction

Geomagnetic modeling in support of nonacoustic system performance prediction  
Static potential field measurement and analysis (gravity and magnetic) in support of navigation and geodesy  
Geotechnology/sediment dynamics affecting mine warfare and mine countermeasures  
Foreshore sediment transport  
Geospatial information, including advanced seafloor mapping, imaging systems, and innovative object-oriented digital mapping models, techniques, and databases

## **Materials**

Superconductivity  
Magnetism  
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  
Paints and coatings  
Flammability  
Chemical/biological materials  
Spintronic materials and half metals  
Biomimetic materials  
Multifunctional materials  
Power and energy  
Synthetic biology

## **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/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

### **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 communications

### **Oceanography**

Oceanographic instrumentation  
Open ocean, littoral, polar, and nearshore oceanographic forecasting  
Shallow water oceanographic effects on operations  
Modeling, sensors, and data fusion  
Bio-optical and fine-scale physical processes  
Oceanographic simulation and visualization  
Coastal scene generation  
Waves, tides, and surf prediction  
Coupled model development  
Sea-ice modeling  
Coastal ocean characterization  
Oceanographic decision aids  
Global, theater, and tactical-scale modeling  
Remote sensing of oceanographic parameters  
Satellite image analysis

### **Space Systems and Technology**

Space systems architectures and requirements  
Advanced payloads and optical communications  
Controllers, processors, signal processing, and VLSI  
Precision orbit estimation

Onboard autonomous navigation  
Satellite ground station engineering and implementation  
Tactical communication systems  
Spacecraft antenna systems  
Launch and on-orbit support  
Precise Time and Time Interval (PTTI) technology  
Atomic time/frequency standards/instrumentation  
Passive and active ranging techniques  
Design, fabrication, and testing of spacecraft and hardware  
Structural and thermal analysis  
Attitude determination and control systems  
Reaction control  
Propulsion systems  
Navigation, tracking, and orbit dynamics  
Spaceborne robotics applications

### **Surveillance and Sensor Technology**

Point defense technology  
Imaging radars  
Surveillance radars  
Multifunction RF systems  
High-power 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 system  
Digital framing reconnaissance canvas  
Biologically based sensors  
Digital radars and processors

### **Undersea Technology**

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

Research in NRL's  
**DIVISIONS/DEPARTMENTS**

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## EXECUTIVE DIRECTORATE

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### **INSTITUTE FOR NANOSCIENCE, CODE 1100**

NANOINFO@NRL.NAVY.MIL

#### **NANOSCIENCE AND NANOTECHNOLOGY**

Low-power, high-speed electronics  
Lightweight, high-strength materials  
Highly sensitive molecular sensors  
Efficient energy generation and storage

### **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  
Mobility and platforms  
Sensor systems  
Power and energy systems  
Networking and communications  
Trust and assurance

## SYSTEMS DIRECTORATE

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### **RADAR DIVISION, CODE 5300**

RADARINFO@NRL.NAVY.MIL

#### **RADAR ANALYSIS**

Target signature prediction  
Electromagnetics and antennas  
Airborne early-warning radar (AEW)  
Inverse synthetic aperture radar (ISAR)  
Sea clutter modeling  
Periscope detection  
Wideband array simulation and fabrication

#### **ADVANCED RADAR SYSTEMS**

High-frequency over-the-horizon radar systems  
HF radar technology  
Signal analysis  
Real-time signal processing and equipment  
Computer-aided engineering (CAE)

Optimization techniques  
FPGA-based digital processing

#### **SURVEILLANCE TECHNOLOGY**

Shipboard surveillance radar  
Ship self-defense  
Electronic counter-countermeasures and  
    electronic protection (EP)  
Target signature and information extraction  
T/R module technologies  
Asymmetric and expeditionary warfare  
    spectrum management  
Ultrawideband technology  
Dynamic waveform diversity  
Multistatic radar network information  
Ballistic missile defense  
Mine detection

### **INFORMATION TECHNOLOGY DIVISION, CODE 5500**

ITDINFO@NRL.NAVY.MIL

#### **FREESPACE PHOTONICS COMMUNICATIONS OFFICE**

Extended spectrum communications  
Atmospheric channel effects on photonic transfer  
Studies in marine miraging  
Analog modulation techniques on freespace optical  
    carriers  
Modulating retroreflector based communications  
Signature studies for ISR  
Adaptive optics for freespace optical communications

#### **ADVERSARIAL MODELING AND EXPLOITATION OFFICE**

Behavioral indicators of hostile intent  
Suspicious behavior detection research  
Behavioral modeling, analysis, and metrics  
Deception detection research  
Geospatial modeling and simulation  
Spatially integrated social science  
Automated video analysis and retrieval

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

Intelligent decision aids  
Natural language and multimodal interfaces  
Intelligent software agents  
Machine learning and adaptive systems  
Robotics software and computer vision  
Neural networks

Novel devices/techniques for HCI  
Spatial audio  
Immersive simulation  
Autonomous and intelligent systems  
Case-based reasoning and problem-solving methods  
Machine translation technology evaluation  
Cognitive architectures  
Human-robot interaction

#### **TRANSMISSION TECHNOLOGY**

Communication system architecture  
Communication antenna/propagation technology  
Communications intercept systems  
Virtual engineering  
Secure voice technology  
Satellite and tactical networking  
Satellite communications research  
Satellite architecture analysis  
RF systems analysis

#### **CENTER FOR HIGH ASSURANCE COMPUTER SYSTEMS**

Secure Enterprise Architectures (SEA)  
Formal specification/verification of system security  
COMSEC application technology  
Technology and solutions to secure networks and databases  
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  
Computer Network Defense (CND) technology  
Hardware/software co-design  
Malicious code analysis  
Information hiding (watermarking, covert channel analysis, etc.)  
Anonymizing systems  
Quantum information science  
Logical foundations of security

#### **NETWORKS AND COMMUNICATION SYSTEMS**

Communication system engineering  
Mobile, wireless networking technology

Bandwidth management (quality of service)  
Joint service tactical networking  
Integration of communication and C2 applications  
Automated testing of highly mobile tactical networks  
Reliable multicast protocols and applications  
Communication network simulation  
Networking protocols for directional antennas  
Policy-based network management  
Tactical voice over IP  
Sensor networks  
Advanced tactical data links  
Cognitive radio technology

#### **INFORMATION MANAGEMENT AND DECISION ARCHITECTURES**

Virtual reality/mobile augmented reality  
Visual analytics  
Scientific visualization  
Computer graphics  
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

#### **CENTER FOR COMPUTATIONAL SCIENCE**

Transparent optical network research and design  
Parallel computing  
Scalable high performance computing and networking  
for Navy and DoD  
Large data in distributed computing  
Scientific visualization  
High-performance file systems  
High-definition video technology  
NRL labwide computer network and related services  
Labwide support for web, email, and other  
information services  
ATDnet and leading-edge WAN research networks

## **RUTH H. HOOKER RESEARCH LIBRARY**

Desktop/workbench access to relevant scientific resources  
NRL scientific digital archive (TORPEDO)  
Authoritative database of NRL-produced publications  
(NRL Online Bibliography)  
Comprehensive literature/citation/classified searches  
Extensive collection of print and digital books, journals,  
and technical reports

## **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  
Planar waveguide devices  
IR nonlinear materials and devices  
Ceramic laser gain materials  
Advanced solar cell 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  
Optical clocks  
Microwave photonics

#### **OPTICAL TECHNIQUES**

Fiber-optic materials and fabrication  
Fiber Bragg grating sensors/systems  
Fiber-optic sensors/systems (acoustic, magnetic,  
gyroscopes)  
Integrated optics

### **TACTICAL ELECTRONIC WARFARE DIVISION, CODE 5700**

EWINFO@NRL.NAVY.MIL

#### **OFFBOARD COUNTERMEASURES**

Expendable technology and devices  
Unmanned air vehicles  
Offboard payloads  
Decoys

#### **AIRBORNE ELECTRONIC WARFARE SYSTEMS**

Counter ISR  
Wireless network analysis  
Jamming technology and deception  
Communications CM

#### **SHIPS ELECTRONIC WARFARE SYSTEMS**

Ships systems development  
Jamming technology and deception  
EW antennas  
High power microwaves (HPM) research

#### **ELECTRONIC WARFARE SUPPORT MEASURES**

Intercept systems and direction finders  
RF signal simulators

Systems integration  
Command and control interfaces  
Signal processing

**ADVANCED TECHNIQUES**

Analysis and modeling simulation  
Experimental systems  
EW concepts  
Infrared technology

**INTEGRATED EW SIMULATION**

Hardware-in-the-loop simulation  
Data management technology  
Flyable ASM seeker simulators  
Foreign materiel exploitation (FME)

**EW MODELING AND SIMULATION**

High-fidelity threat models and simulations  
Advanced system visualization  
EW tactical decision aids  
RF environmental and propagation modeling

**MATERIALS SCIENCE AND  
COMPONENT TECHNOLOGY  
DIRECTORATE**

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**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 S&T  
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  
Dynamical gridding algorithms  
Advanced graphical and parallel processing systems  
Solar and heliospheric modeling  
Microfluidics  
Fluid structure interaction  
Shock and blast containment

## **CHEMISTRY DIVISION, CODE 6100**

CHEMINFO@NRL.NAVY.MIL

### **CHEMICAL DIAGNOSTICS**

Alternate energy sources  
Atmosphere analysis and control  
Environmental chemistry/microbiology  
Ion/molecule processes  
Kinetics of gas phase reactions  
Laboratory on a chip  
Methane hydrates  
Optical diagnostics of chemical reactions  
Trace analysis

### **MATERIALS CHEMISTRY**

Bio-inspired materials  
Degradation and stabilization mechanisms  
Functional organic coatings  
High-temperature resins  
Magnetic resonance  
Novel nanotubes and nanofibers  
Polymer characterization  
Reactive nanometals  
Synthesis and evaluation of innovative polymers and composites

### **CENTER FOR CORROSION SCIENCE AND ENGINEERING**

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

### **SURFACE/INTERFACE CHEMISTRY**

Adhesion  
Bio/organic interfaces

Chemical/biological sensors  
Diamond films  
Electrochemistry  
Plasmonics  
Energy storage materials  
Nanostructured materials and interfaces  
Surface/interface analysis  
Surface properties of materials  
Surface reaction dynamics  
Synchrotron radiation applications  
Tribology

**SAFETY AND SURVIVABILITY**

Chemometrics/data fusion  
Combustion dynamics  
Fire protection and suppression  
Mobility fuels  
Modeling and scaling of combustion systems  
Personnel protection  
System automation  
Trace analysis

**MATERIALS SCIENCE AND TECHNOLOGY DIVISION,  
CODE 6300**

MATERIALINFO@NRL.NAVY.MIL

**MATERIALS AND SENSORS**

Laser direct write  
THz sources, devices, and sensors  
Spintronic materials and devices  
Magnetic materials  
Superconducting materials  
Optoelectronic materials  
Electroceraic materials  
Multiferroic materials  
Radar absorbing materials  
Analysis of extrasolar materials  
Chemical sensors  
Nonlinear dynamics and chaos theory  
Nanoplasmonic biosensors  
Thin film deposition for devices  
Ion implantation  
Glass fiber processing and characterization  
Polymer synthesis and characterization  
Personal protective equipment  
Remote explosives detection  
Automated learning

## **MULTIFUNCTIONAL MATERIALS**

### 3D materials science

- Image-based microstructural modeling

- Materials by design

- Nano-, micro-, mesoscale material characterization

- Grain boundary engineering

- Atom probe tomography

### Physical metallurgy

- Ferrous, nonferrous, and intermetallic alloys

- Powder metallurgy

- Microwave sintering

- Rapid solidification

- Rail gun materials

- Friction stir welding and joining technologies

- Heat treating and phase transformations

### Biomechanical surrogate development for warfighter protection

- Biomechanical simulation

- Personal protective equipment

### Composite material systems

- Multifunctional structures

- Armor

- Porovascular structures

### Corrosion simulation and control

- Modeling of electrochemical corrosion systems

- Evaluation of cathodic protection performance

### Advanced ceramics

- High energy density dielectrics

- High temperature ceramics

- Thermal barrier coatings

## **COMPUTATIONAL MATERIALS SCIENCE**

### Condensed matter theory

### Electronic structure of solids and clusters

### Molecular dynamics

### Quantum many-body theory

### Theory of magnetic materials

### Theory of alloys

### Materials for power and energy

### Semiconductor and surface physics

### Theoretical studies of phase transitions

### Atomic physics theory

### Protein modeling

### Continuum multiphysics modeling

### Reduced order modeling

### Multiphysics simulation of materials behavior

### Development of high-performance computational methods

## **PLASMA PHYSICS DIVISION, CODE 6700**

PLASMAINFO@NRL.NAVY.MIL

### **RADIATION HYDRODYNAMICS**

Radiation hydrodynamics of Z-pinches and laser-produced plasmas

X-ray source development

Cluster dynamics in intense laser fields

Plasma kinetics for directed energy and fusion

Plasma discharge physics

Dense plasma atomic physics, equation of state

Numerical simulation of high-density plasma

Laser driven ion/neutron sources

### **LASER PLASMA**

Nuclear weapons stockpile stewardship

Laser fusion, inertial confinement

Megabar high-pressure physics

Rep-rate KrF laser development

High power electron beam applications

Laser fusion technology

Laser fusion energy

Detection of chemical/biological/nuclear materials

### **CHARGED PARTICLE PHYSICS**

Applications of modulated electron beams

Rocket, satellite, and ISS natural and active experiments

Laboratory simulation of space plasmas

Large-area plasma processing sources

Surface modification of energy sensitive materials

Atmospheric and ionospheric GPS sensing

Ionospheric effects on communications

Electromagnetic launchers

Radiation belt remediation

### **PULSED POWER PHYSICS**

Production, focusing, and propagation of intense electron and ion beams

High-power, pulsed radiography

Plasma and bremsstrahlung radiation sources

Capacitive, inductive, and battery energy storage

Nuclear weapons effects simulation

Electromagnetic launchers

Detection of Special Nuclear Materials

Advanced energetics via stimulated nuclear decay

### **BEAM PHYSICS**

Directed energy and laser propagation in 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  
Free electron lasers and laser synchrotrons  
Theory and simulation of space and solar plasmas  
Global ionospheric and space weather modeling  
Underwater laser interactions

## **ELECTRONICS SCIENCE AND TECHNOLOGY DIVISION, CODE 6800**

ELECINFO@NRL.NAVY.MIL

### **NANOSCIENCE AND NANOTECHNOLOGY**

Nanoelectronics  
Plasmonics  
Energy harvesting  
Quantum information  
Sensing

### **SURFACE AND INTERFACE SCIENCES**

Epitaxial growth of graphene  
Growth of hyper-abrupt junctions  
Atomic layer deposition of dielectrics

### **ELECTRONIC MATERIALS**

Advanced elemental and compound semiconductors,  
high- $\kappa$  dielectrics, and second-order materials  
Unique materials characterization  
Fabrication of electronic devices with high degree of  
complexity and precision

### **COMPUTATIONAL MODELING AND SIMULATION**

First principles atomistic calculations  
Device modeling activities  
Modeling coherent interaction of electromagnetic  
fields with electron beams

### **POWER ELECTRONICS**

SiC and GaN epitaxial growth research  
Characterization of defects in SiC and GaN  
Development of advanced SiC and GaN power  
device processes  
Reliability of SiC and GaN power devices

### **MICROWAVE, MILLIMETER, AND SUB-MILLIMETER TECHNOLOGY**

Millimeter-wave, sub-millimeter-wave and terahertz  
technology  
Vacuum electronics  
Solid-state electronics  
Filters and control components

**OPTOELECTRONICS**

Design and synthesis of new materials in the IR spectrum region

**PHOTOVOLTAICS**

High-efficiency technologies for portable photovoltaic power systems

**RADIATION EFFECTS**

Particle irradiation

Photon irradiation

Displacement damage dose effects in materials and devices

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

BIOMOLINFO@NRL.NAVY.MIL

**BIOLOGICALLY DERIVED MICROSTRUCTURES**

Self-assembly, molecular machining

Synthetic membranes

Nanocomposites

Tailored electronic materials

Molecular engineering, biomimetic materials

Molecular imprinting

Viral scaffolds

Multifunctional decontamination coatings

**BIOSENSORS**

Binding polypeptides and proteins

Cell-based biosensors

DNA biosensors

Fiber-optic biosensors

Flow immunosensors

Array-based sensors

Optical biosensors

Microfluidics and microarrays

**NOVEL MATERIALS**

Soil/groundwater explosives detection

Single chain and single domain antibodies

Nanoparticles and quantum dots

Nano- and mesoporous materials

Quantum dot and protein conjugates

Biomimetic materials

**MOLECULAR BIOLOGY**

Genomics and proteomics of marine bacteria

Tissue engineering

Gene arrays, biomarkers

System and synthetic biology

## **ENERGY HARVESTING**

Biomaterials for charge storage  
Ocean floor biofuel cell  
Photo-induced electron transfer

# **OCEAN AND ATMOSPHERIC SCIENCE AND TECHNOLOGY DIRECTORATE**

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## **ACOUSTICS DIVISION, CODE 7100**

ACOUSINFO@NRL.NAVY.MIL

### **PHYSICAL ACOUSTICS**

Structural acoustics  
Quantum effects in phononic crystals  
Nanomechanical devices  
Fiber-optic acoustic sensors  
Acoustic transduction  
Inverse scattering  
Target strength/radiation modeling  
Flow-induced noise and vibration  
Active sonar classification  
Underwater distributed, networked sensing  
AUV-based sensing

### **ACOUSTIC SIGNAL PROCESSING AND SYSTEMS**

Underwater acoustic communications and networking  
Limits of array performance  
Waveguide invariant processing  
Acoustic field uncertainty  
Acoustic interactions with transonic/supersonic flows  
Acoustic noise forecasting  
Long-range underwater communications  
Underwater distributed sensing networks  
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  
Underwater acoustic network warfare

## **ACOUSTIC SIMULATION, MEASUREMENTS, AND TACTICS**

Ocean acoustic propagation and scattering models

Fleet application acoustic models

High-frequency seafloor and ocean acoustic  
measurements

Riverine acoustics

Distributed sensing networks

Incorporating uncertainty in predictive models

Tactical acoustic simulations and databases

Warfare effectiveness studies and optimization

Environmental assessment and planning tools

## **REMOTE SENSING DIVISION, CODE 7200**

REMSENINFO@NRL.NAVY.MIL

### **REMOTE SENSING**

Sensors

SAR

Imaging radar

Passive microwave imagers

CCDs and focal plane arrays

Thermal IR cameras

Fabry-Perot spectrometers

Imaging spectrometers

Radio interferometers

Optical interferometers

Adaptive optics

Lidar

Spaceborne and airborne systems

Research areas

Radiative transfer modeling

Coastal oceans

Marine ocean boundary layer

Polar ice

Middle atmosphere

Global ocean phenomenology

Environmental change

Ocean surface wind vector

Soil moisture

Ionosphere

Data assimilation

### **ASTROPHYSICS**

Optical interferometry

Radio interferometry

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

#### **PHYSICS OF ATMOSPHERIC/OCEAN INTERACTION**

Mesoscale, fine-structure, and microstructure  
Aerosol and cloud physics  
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 algorithm/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

### **OCEANOGRAPHY DIVISION, CODE 7300**

NRL/STENNIS SPACE CENTER, MISSISSIPPI  
OCEANINFO@NRL.NAVY.MIL

#### **OCEAN DYNAMICS AND PREDICTION**

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

## 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

## Acoustic effects

- Sound speed variation for acoustic propagation

- Internal waves, solitons, and bores for beam focusing

- Wave bubble entrainment and noise generation

## **OCEAN SCIENCES**

### Dynamical processes

- Optical turbulence

- Biological sensing and modeling

- Optical thin layers

- Coastal current systems

- Waves and bubbles

### Coupled systems

- Air/ocean/acoustic coupling

- Coupled bio/optical/physical processes

- Coupled physical/sediment processes

### Remote sensing applications

- 3D optical profiling

- Color/hyperspectral signatures

- Ocean optics

- Sea surface salinity

### Microbiologically influenced corrosion

- Metal–microbe interaction

## **MARINE GEOSCIENCES DIVISION, CODE 7400**

NRL/STENNIS SPACE CENTER, MISSISSIPPI

GEOSCIINFO@NRL.NAVY.MIL

## **MARINE GEOLOGY**

- Sedimentary processes

- Sediment microstructure

- Pore fluid flow

- Diapirism, volcanism, faulting, mass movement

- Biogenic and thermogenic methane

Hydrate distribution, formation, and dissociation  
Small-scale granular/fluid dynamics

#### **MARINE GEOPHYSICS**

Seismic wave propagation  
Physics of low-frequency acoustic propagation  
Acoustic energy interaction with topography and inhomogeneities  
Gravimetry and geodesy  
Geomagnetic modeling

#### **MARINE GEOTECHNIQUE**

Acoustic seafloor characterization  
Geoacoustic modeling  
Geotechnical properties and behavior of sediments  
Measurement and modeling of high-frequency acoustic propagation and scattering  
Mine burial processes  
Marine biogeochemistry  
    Animal–microbe–sediment interactions  
    Early sediment diagenesis  
Biominalization of palladium species  
Physics-based and numerical modeling of sediment strength

#### **GEOSPATIAL SCIENCES AND TECHNOLOGY**

Digital database design  
Digital product analysis and standardization  
Data compression techniques and exploitation  
Hydrographic survey techniques  
Bathymetry extraction techniques from remote and acoustic imagery  
Modeling of nearshore morphodynamics  
Geospatial portal design with 2D and 3D interfaces  
Characterization of the littoral from airborne platforms

#### **IN SITU AND LABORATORY SENSORS**

High-resolution subseafloor 2D and 3D seismic imaging  
Laser/hyperspectral bathymetry/topography  
Swath acoustic backscatter imaging  
Sediment pore water pressure, permeability, and undrained shear strength  
Compressional and shear wave velocity and attenuation  
Airborne geophysics, gravity, and magnetics  
Seafloor magnetic fluctuation  
Sediment microfabric change with pore fluid and/or gas change  
Instrumented mine shapes  
Bottom currents and pressure fluctuations

## **MARINE METEOROLOGY DIVISION, CODE 7500**

NRL/MONTEREY, CALIFORNIA

METEORINFO@NRL.NAVY.MIL

### **ATMOSPHERIC DYNAMICS AND PREDICTION**

Global to tactical scale  
Deterministic and probabilistic forecasting  
Large eddy simulation  
Boundary layer processes  
Land surface processes and modeling  
Coastal processes and modeling  
Arctic processes and modeling  
Urban effects  
Coupled ocean/atmosphere phenomena  
Madden Julian oscillation  
Atmospheric waves and scale interactions  
Coupled littoral prediction  
Hydrology and hydrological cycle  
Tropical cyclones  
Aerosol particles  
Gravity waves  
Predictability  
Ensembles design  
Advanced numerical methods  
GPU-based computing

### **DATA ASSIMILATION**

Hybrid ensemble-variational techniques  
3D and 4D variational analysis  
Ensemble Kalman Filter (EnKF)  
Quality control and bias correction  
Tropical cyclone initialization  
Remotely sensed data assimilation  
Adjoint technique and applications  
Radar data assimilation  
Targeted observing strategies  
Data selection techniques  
Aerosol and trace gas assimilation  
Observing system assimilation experiment

### **TACTICAL ENVIRONMENTAL SUPPORT**

Rapid environmental assessment  
Through-the-sensor measurements  
Atmospheric impact on weapons systems  
Data fusion  
Nowcasting  
Visualization  
Verification and validation  
Information assurance

Expert systems  
Aviation risk assessment

#### **ATMOSPHERIC PHYSICS**

Air-sea interaction  
Cloud and aerosol microphysics  
Radiative transfer  
Cloud and aerosol radiative properties  
Aerosol characterization  
Tropical cyclone structure  
Gravity wave drag  
Mobile Atmospheric Aerosol and Radiation Laboratory  
Platform Coastal Facility for Atmospheric Research  
Aircraft Aerosol and Radiation Instrumentation  
Packages  
Aerosol and Radiation Instrumentation Calibration  
Facilities

#### **SATELLITE DATA/IMAGERY**

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

#### **DECISION AIDS**

Probabilistic decision aids  
Refractivity/ducting  
Ceiling/visibility  
Fog/turbulence/icing  
Atmospheric acoustics  
EM/EO propagation  
Tropical cyclones/consensus forecasts  
Port studies  
Typhoon havens  
Forecaster handbooks  
Quantification of uncertainty  
Counter-piracy guidance  
Tropical cyclone sortie guidance  
Forecast difficulty guidance  
Ship wind and wave limits  
Optimal ship routing-fuel savings

## **SPACE SCIENCE DIVISION, CODE 7600**

SPASCIINFO@NRL.NAVY.MIL

### **GEOSPACE SCIENCE AND TECHNOLOGY**

Conduct research to observe, understand, model, and forecast the Earth's geospace environment and its connections to its lower and upper boundaries, to facilitate and create functional capabilities.

### **HIGH-ENERGY SPACE ENVIRONMENT**

Advance the understanding of the high-energy environment through development and deployment of advanced detectors, simulation of the environments and operations concepts, and interpretation and theoretical modeling of the observed phenomena, to address priority S&T goals.

### **SOLAR AND HELIOSPHERIC PHYSICS**

Develop improved heliospace environment understanding, awareness, sensors, forecast capabilities, and monitoring tools that predict operational impacts and enable real-time threat warning, and transition these developments as needed.

## **NAVAL CENTER FOR SPACE TECHNOLOGY**

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### **SPACE SYSTEMS DEVELOPMENT DEPARTMENT, 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

**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 AND AIRBORNE MISSION DEVELOPMENT**

Mission development and requirements definition

Systems engineering and analysis

Concepts of operations and mission simulations

Mission evaluation and performance assessments

**PRECISION NAVIGATION AND TIME**

Advanced navigation satellite technology

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 DEPARTMENT, CODE 8200**

SPAENGINFO@NRL.NAVY.MIL

### **DESIGN, TEST, AND PROCESSING**

Preliminary and detailed design of spacecraft mechanical components, structures, and mechanisms

Fabrication, assembly, integration, and testing of spacecraft and payloads

Vibration, shock, acoustic, and thermal vacuum testing of components, systems, payloads, and spacecraft

Integration of spacecraft onto launch vehicles

Systems engineering for new spacecraft proposals

### **SPACE MECHANICAL SYSTEMS DEVELOPMENT**

Development, integration, and transition of prototype spacecraft systems and experimental payloads

Structural design and analysis

Large space structures

Thermal design, analysis, fabrication, integration, test, and flight operation

Pumped and advanced multiphase heat transfer devices

Computational fluid dynamics (CFD) techniques for space systems

Integrated structural/thermal/optical or RF design and analysis

Mission integration and development

Mission assurance, configuration control, and safety

Systems engineering and management

### **CONTROL SYSTEMS**

Attitude determination and control systems

Precision pointing

Optical line-of-sight stabilization

Propulsion systems

Precision cleaning and component testing

Propellant and pressurization systems

Hydraulic and pneumatics control

Test systems and services

Analytical design and mission planning

Navigation, tracking, and orbit dynamics

Expert systems

Flight operations support

Computer simulation and animation

Computer animation

Robotics systems engineering

Proximity operations

Autonomous servicing and inspection

Autonomous inspection  
End effector design  
Compliance control  
Trajectory planning  
Machine vision  
Fault detection, isolation, and recovery  
Electrodynamic tethers  
Robotic control algorithms and software  
Robotic actuation and sensing

#### **SPACE ELECTRONIC SYSTEMS DEVELOPMENT**

Space system concept definition, design, and implementation including hardware and software  
Detailed electrical design of electronic and electromechanical systems and components  
Implementation of real-time flight software and embedded command, control, and telemetry software  
Implementation of spacecraft ground system software, including integration and test and operations (Neptune/CGA)  
Mission Tasking Software (VMOC)  
Spacecraft antenna systems, receivers, transmitters, and radiometers  
Space hardware design, fabrication, test, and integration  
Launch and on-orbit support  
Space test systems and electronic launch support equipment  
Spacecraft power systems – collection, storage, conversion, and distribution  
Spacecraft TT&C and control systems  
Space communications



## Doing Business with NRL

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### **Technology Transfer Office**

NRL has a long history of working with industry and academia to assist in the transfer of its inventions for nonmilitary applications. Many of NRL's research efforts result in materials, techniques and other products that have additional applications in the commercial or civilian sectors. NRL developments in areas such as radar, radio, satellite navigation, fire fighting, and a wide variety of materials and coatings have made significant contributions to the safety and welfare of 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 the private sector for the public good.

The Technology Transfer Office markets NRL's technologies in various ways, including distributing and posting fact sheets describing available technologies, participating in NRL exhibits at scientific and Navy conferences, working with local economic development groups, and through NRL's social media program.

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

E-MAIL: [TECHTRAN@RESEARCH.NRL.NAVY.MIL](mailto:TECHTRAN@RESEARCH.NRL.NAVY.MIL)

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

### **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 the Navy and benefit the non-Navy party. 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, state and local governments, and licensees of inventions owned by federal agencies.

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 the development of intercascade lasers, a breathalyzer to detect tetrahydrocannabinol as a signature compound for marijuana, chalcogenide fibers for use as mid-infrared fibers, a modification of an existing particle analyzer to enable remote monitoring of engine fluids to detect wear, radiation dosimeters, and other technological advances that have impacted the military and the civilian sectors. Information on our CRADA process, including the CRADA boilerplate and questionnaire can be found at <http://www.nrl.navy.mil/techtransfer/cradas.php>.

E-MAIL: [TECHTRAN@RESEARCH.NRL.NAVY.MIL](mailto:TECHTRAN@RESEARCH.NRL.NAVY.MIL)

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

### **Licensing of Navy Inventions**

Since the enactment of FTTA, the effort to encourage commercial use of government-funded technology has expanded in the federal laboratories. Title 35, Section 209, of the United States Code authorizes federal agencies to license their patentable inventions. 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 900 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. NRL has licenses with small and large U.S. businesses, and 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 at <http://www.nrl.navy.mil/techtransfer/licenses.php>). 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.

Key items in the application are: the field of use and the type of license (non-exclusive, partially exclusive, or exclusive). Partially exclusive means exclusive in a field of use. For partially exclusive or 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.

For partially exclusive or exclusive licenses, if the application is acceptable and reasonable terms and conditions can be negotiated successfully, an "Intent to Grant" notice is published in the Federal Register 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@RESEARCH.NRL.NAVY.MIL](mailto:TECHTRAN@RESEARCH.NRL.NAVY.MIL)

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

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## **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 will be based on a scientific peer review of proposals submitted in response to each BAA. The major purpose of the evaluation will be to determine the relative merit of the technical approach of each proposal. Business and contractual aspects, including cost realism, will also be 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, is available at [http://heron.nrl.navy.mil/contracts/baa/baa\\_2013/index03.html](http://heron.nrl.navy.mil/contracts/baa/baa_2013/index03.html).

### **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 as Requests for Proposals (RFPs) and NRL acquisitions are announced on the Federal Business Opportunities (FedBizOpps) website under Department of the Navy (USN), Office of Naval Research (ONR). ONR is NRL's parent organization. NRL RFPs are also available via link from the NRL Contracting Division website.

Purchases at or below the simplified acquisition threshold, orders against GSA schedule contracts, and MILSTRIP requisitions are processed by the Purchasing Branch (Code 3410) in the NRL Supply and Information Services Division (Code 3400).

More information on "Doing Business" with the Naval Research Laboratory is available at <http://heron.nrl.navy.mil/contracts/>.

## **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. For grants, contact the Contracting Division at (202) 767-5227.

## Career Opportunities at NRL

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[HTTP://HROFFICE.NRL.NAVY.MIL/JOBS](http://hroffice.nrl.navy.mil/jobs)

NRL is always looking to recruit talented individuals in many fields of science. In addition to vacancies announced at <http://hroffice.nrl.navy.mil/jobs/vacancy.htm>, there are many programs for postdocs and students.

### Research Associateships

Every year, NRL hosts several postdoctoral research associates through the National Research Council (NRC) and American Society for Engineering Education (ASEE) postdoctoral associateship and fellowship programs. These competitive positions provide postdoctoral scientists and engineers opportunity to pursue research at NRL in collaboration with NRL scientists and engineers. Research associates are guest investigators, not employees of the 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@hro.nrl.navy.mil](mailto:nrc@hro.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. Fellowship 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 seven 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@hro.nrl.navy.mil](mailto:asee@hro.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@hro.nrl.navy.mil](mailto:sfrp@hro.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@hro.nrl.navy.mil](mailto:usna@hro.nrl.navy.mil).

### **Student Programs**

The **NAVAL RESEARCH ENTERPRISE INTERN PROGRAM (NREIP)** offers summer appointments at Navy laboratories to current college sophomores, juniors, seniors, and graduate students from participating schools. Application is online at [www.asee.org/nreip](http://www.asee.org/nreip) through the American Society for Engineering Education. 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](mailto: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. Contact NRL's program coordinator at (202) 767-8323 or ndseg@hro.nrl.navy.mil.

The **PATHWAYS INTERN PROGRAM** (formerly STEP and SCEP) is designed to provide students enrolled in a wide variety of educational institutions, from high school to graduate level, with opportunities to work at NRL and explore Federal careers while still in school and while getting paid for the work performed. Students can work full-time or part-time on a temporary or non-temporary appointment. Students must be continuously enrolled on at least a half-time basis at a qualifying educational institution and be at least 16 years of age. The primary focus of our **Non-temporary** intern appointment is to attract students enrolled in undergraduate and graduate programs in engineering, computer science, or the physical sciences. Students on non-temporary appointments are eligible to remain on their appointment until graduation and may be noncompetitively converted to a permanent appointment within 120 days after completion of degree requirements. Conversion is not guaranteed. Conversion is dependent on work performance, completion of at least 640 hours of work under the intern appointment before completion of degree requirements, and meeting the qualifications for the position. The **Temporary** intern appointment is initially a one year appointment. This program enables students to earn a salary while continuing their studies and offers them valuable work experience. Our Intern Program opportunities are announced on USAJOBS. For additional information on our Intern Program, contact (202) 767-8313.

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 understand-

ing 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 test scores. The NRL program is one of the largest in DoD. For detailed information visit <http://seap.asee.org/> or contact NRL's program coordinator at (202) 767-8324 or [seap@hro.nrl.navy.mil](mailto:seap@hro.nrl.navy.mil).



## CAREERS AT NRL

- Research Chemist
- Chemical Engineer
- Computer Scientist
- Computer Engineer
- Meteorologist
- Materials Research Engineer
- Metallurgist
- Mathematician
- Geologist
- Research Biologist
- Electrical Engineer
- Electronics Engineer
- Mechanical Engineer
- Aerospace Engineer
- Research Physicist
- Astrophysicist
- Oceanographer
- Geophysicist

Please use the Division or Department e-mail addresses in this guide to submit a resumé.

Current job vacancies can be found at:  
<http://hroffice.nrl.navy.mil/jobs/vacancy.htm>

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February 2015

CAPT Mark C. Bruington, USN  
Commanding Officer

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The Naval Research Laboratory has major facilities on the banks of the Potomac River in southwest Washington, DC; at the Stennis Space Center, Mississippi; and in Monterey, California. NRL was dedicated on July 2, 1923, and is the Navy and Marine Corps' only corporate laboratory, charged with the mission of conducting a broadly based, multidisciplinary program of scientific research and advanced technological development.

Research is directed toward maritime applications of new and improved materials; techniques; equipment; systems; ocean, atmospheric, and space sciences; and related technologies. The Navy has established NRL as its "lead laboratory" in space technology, fire research, artificial intelligence, tactical electronic warfare, and microelectronic devices.



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The Naval Research Laboratory nurtures a multidisciplinary research environment to stimulate and support creative and innovative concepts in the physical sciences, engineering, and information technology. Young scientists and engineers are encouraged to team with the Lab's world-renowned researchers to promote individual creativity and to develop new technologies in support of the Navy, the Marine Corps, and the Nation.

For information or to submit a resumé, simply use the e-mail link found in each research division of this guide.