



Naval Science & Technology: Enabling the Future Force

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Chief of Naval Research
GWU, April 2013



O F F I C E O F N A V A L R E S E A R C H

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GWU Partnership



Growing Together:

- Engineering
- Bio-Med
- Chemistry
- Computer Science

Investments:

- Over \$1.2m





Global Context

- **Budget Pressures**
- **Continuing Conflict in Afghanistan**
- **WMD Proliferation**
- **Violent Extremists and Non-State Actors**
- **Rising Peer Competitors**
- **Security of Global Commons (Cyber/Piracy)**
- **Climate Change & Natural Disasters**
- **Revised Defense Strategy, Re-Balance to Pacific**

An Uncertain Dynamic Environment



How the Navy Protects America: America's Away Team





How the Navy Protects America: On, Under and Over the Sea

ON
the sea



OVER
the sea



UNDER
The sea



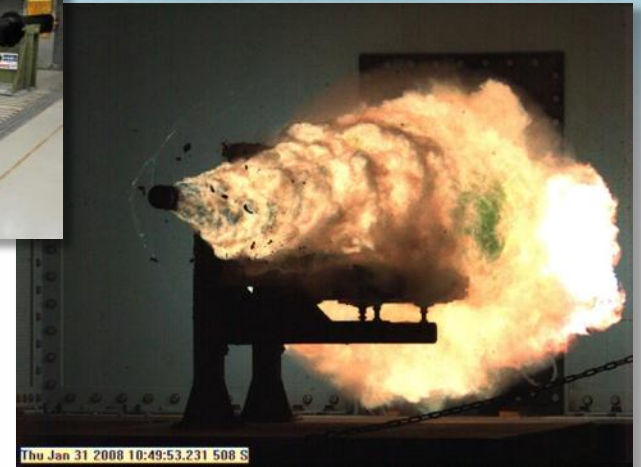


How the Navy Protects America: From the Sea





How the Navy Protects America: Warfighting Advantage Through Science & Technology





90 Years of Naval Research



estones
S ALL DOMAINS



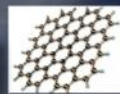
NTS-2 SATELLITE
IN NAVSTAR GPS



TIMATION AND
NAVSTAR GPS



CORONAL MASS
EJECTION



NOBEL PRIZE TO ONR
RESEARCHERS FOR GRAPHENE



FREE ELECTRON
LASER



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aerofiles.com



Revolutionary Research . . . Relevant Results



FIRST UNM
AERIAL VEHICLE

GAMMA
RADIOGRAPHY



NRL
COMMISSIONED



FIRST U.S. RADAR
PATENTS



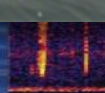
ONR FOUNDED
1946



VERTICAL TAKE-OFF
AND LANDING



BATHYSCAPHE TRIESTE
REACHES 35,800 FT.



SOUND SURVEILLANCE
SYSTEM (SOSUS)



ACOUSTIC
MICROSCOPY



HULL ANTI-FOULING
COATINGS



REMOTE ENVIRONMENT
MONITORING UNIT



ANTI-TORPEDO
TORPEDO

FIRST OPERATIONAL
GLOBAL OCEAN MODEL



QUICKCLOT
COMBAT GAITHER

GBR SENSORS
FOR FLEET SECURITY



WORLD-RECORD SETTING
33 MJ EMRG SHOT

1920s

1930s

1940s

1950s

1960s

1970s

1980s

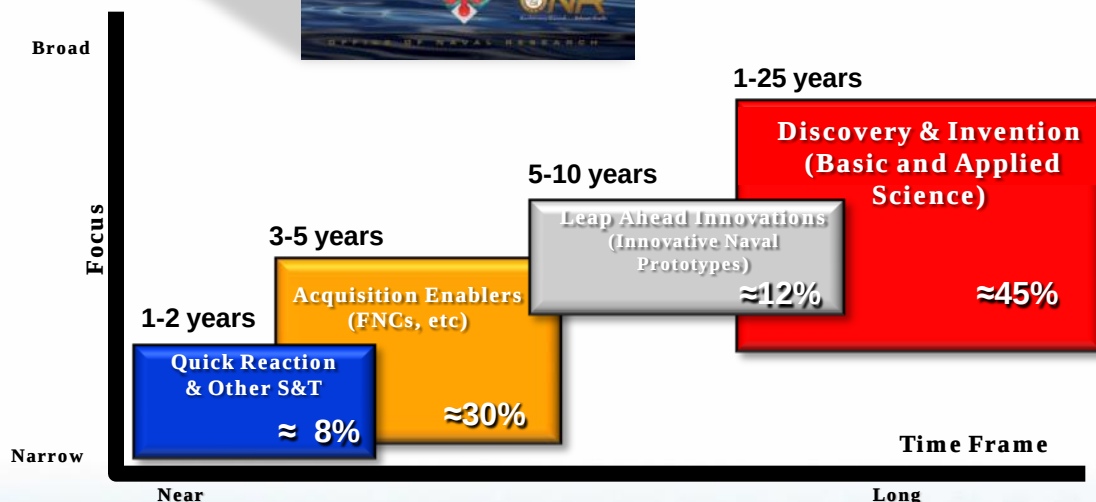
1990s

2000s

2010

& BEYOND

S&T Strategy



S&T Plan Focus Areas:

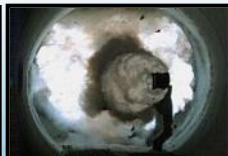
- Autonomy & Unmanned Systems
 - Assure Access to Maritime Battlespace
 - Information Dominance
 - Expeditionary & Irregular Warfare
 - Power Projection & Integrated Defense
 - Platform Design & Survivability
 - Power & Energy
 - Warfighter Performance
 - Total Ownership Cost
-
- STEM



QRS&T



FNCs



INPs



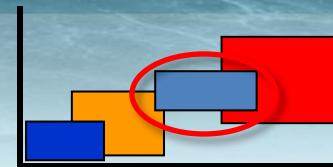
D&I



Innovative Naval Prototypes

(5-10 Year) Disruptive Technologies

- High Risk / High Payoff
- Innovative and game-changing
- Approved by Corporate Board
- Delivers prototype



Tactical Satellite



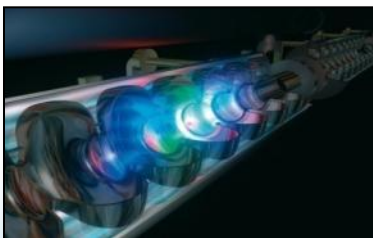
EM Railgun



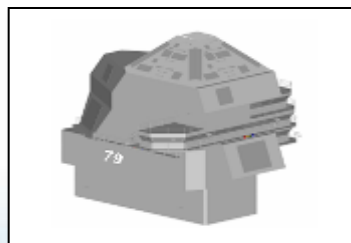
Persistent Littoral Undersea Surveillance



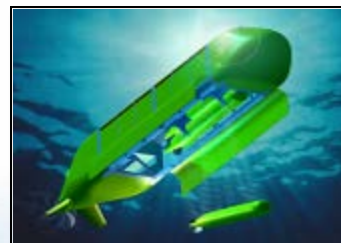
Sea Base Enablers



Free Electron Laser



Integrated Topside



Large Displacement UUV



AACUS



Directed Energy



“Speed of light” engagement with very precise, affordable real time targeting of UAVs, light aircraft and small watercraft.

Program Goal: Advanced Development Model prototype installed and tested

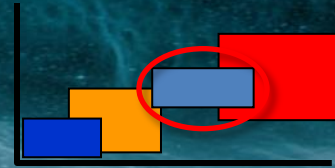
- Deploy on USS PONCE FY14

Accomplishments to date:

- Demo against UAV & ISR (2010)
- Demo against small boats (2011)
- At sea live fire testing (2011)
- Swarming Combat ID/Targeting (2011)
- At sea tests against UAV (2012)



EM Railgun



Muzzle energy:

- From 6MJ to 32MJ and beyond
- 50-100nm range capability

Raid Pulsed Power:

- 2.5X increase in energy density
- Multi-shot capable design

Bore Life:

- From 10s to 100s to 1000s
- Multiple configurations & materials

Industry Launcher Prototypes:

- From lab launcher
- To testing General Atomics and BAE guns

Projectile:

- From slugs & sand catch
- To instrumented and dispensing flight bodies on open range

Mission:

- From Land Attack
- To Multi-Mission Initiative



General Atomics



BAE



Electromagnetic Railgun INP



Basic Research

Seed corn for disruptive technologies



- Diverse portfolio
- Fosters innovation
- Long-term
- Investment in people
60+ Nobel laureates



Graphene



EW



1st U.S. Intel satellite
GRAB

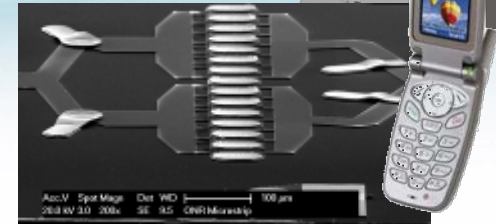


Oceanography
Autonomy

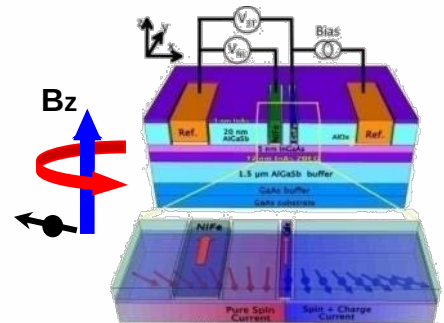


Weather Modeling

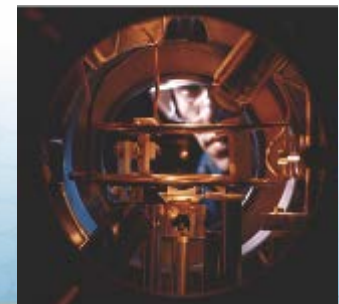
Semiconductors
GaAs, GaN, SiC



Spintronics



Laser Cooling

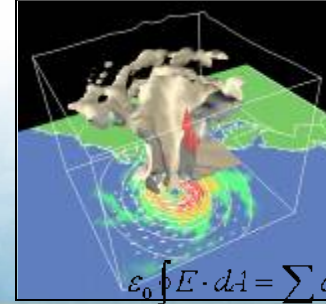
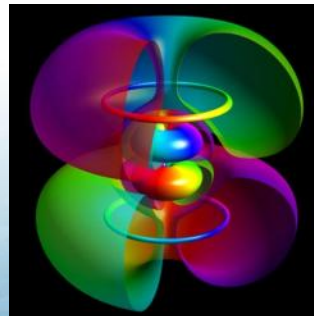


GPS



Arctic Research

Quantum
Physics



$$\epsilon_0 \oint E \cdot dA = \sum q$$



Research Opportunities

Single Investigator Research

- Long-Range Broad Agency Announcement 11-001
- Typical 3 years; average \$150K/year
- Basic & Applied Research
- Application is via the ONR Annual BAA



Young Investigator Program (YIP) Awards

University Research Initiatives

- Multi-Discipline University Research Initiative (MURI)
- Defense University Research Instrumentation Program (DURIP)
- Presidential Early Career Award for Scientists & Engineers (PECASE)



STEM Funding

- Seeks proposals in support of STEM: inspiration, engagement, education, and employment in STEM fields
- POC: Dave Han, Deputy Director of Research david.k.han@navy.mil



How We Execute



ONR Global

FFRDCs

UARCs/Academia

Industry

NRL/Warfare Centers

- 30+ Countries
- All 50 States
- 983 Companies
 - 744 small business
- 412 Universities & Nonprofit Entities
 - 3,340 Principal Investigators
 - 3,000 Grad Students



Challenges

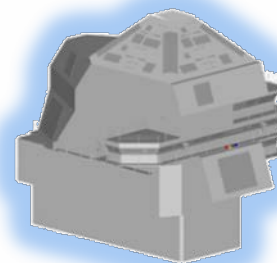
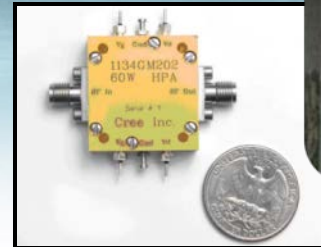
- Fully integrating manned/unmanned systems
- Improved ship, aircraft and weapon effectiveness
- Cyberspace and ensuring the electromagnetic spectrum
- Warfighter Performance (Training & Medical)
- Enabling affordability and reliability





EM-Cyber Defense

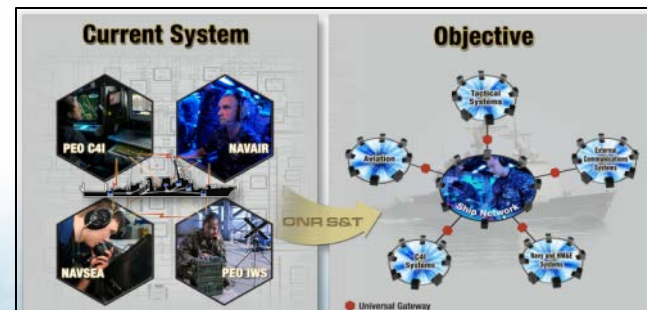
- **Computer Network Defense & Information Assurance**
 - Common Operational Security
 - Advances in GaN semi-conductors
 - High power sensors & electronics
- **Enabling Information Dominance**
 - INTOP: modular, reconfigurable
 - Combining Combat & ISR networks
 - Real-time readiness
- **Universal Gateways**
 - Enables Network-Centric operations
 - Links legacy Combat & C4I systems
 - Manpower and cost savings



Open RF
Architecture



Scalable
Systems



Ensures Data Access and Continuity of EM Operations



Naval Warfighter Performance

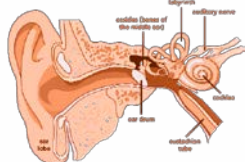
Human Systems Integration

- Manpower & Personnel
- Training
- User-Centered Design
- Command Decision Support
- Human, Social, Cultural Sciences
- Safety / Hearing

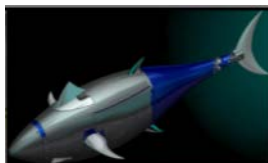


Bio-Engineered Systems

- Marine Mammal Health
- Bio-Sensors / Materials
- Microbial Fuel Cells
- Bio Robotics
- Human-Autonomy Systems



Hearing Loss

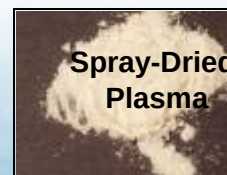


Undersea & Expeditionary Medicine

- Undersea Medicine (NNR)
- Point of Injury Care
- Automated Medical Care



TBI: Infrascanner





Arctic

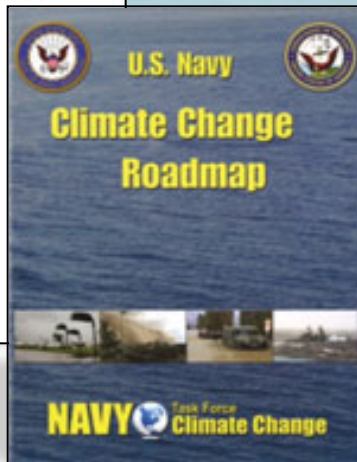
U.S. NAVY ARCTIC ROADMAP



October 2008

This document is sponsored by:
Task Force Climate Change - Headquarters of the Navy

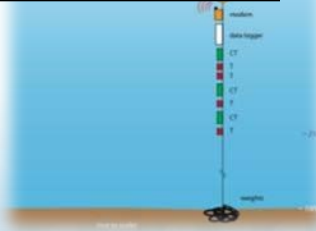
UNCLASSIFIED



Novel Sensing Systems



Real-Time Data Communication



Autonomous Platforms and Enabling Technologies

- Acoustically-navigated Gliders
- Repeated sections
- Resolves deformation scale (5 km)

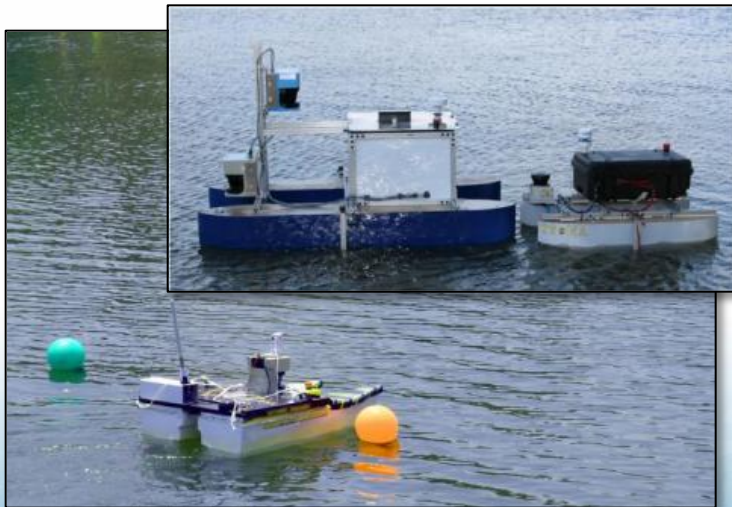
Adjust Naval Operations to Changing Conditions



STEM Opportunities



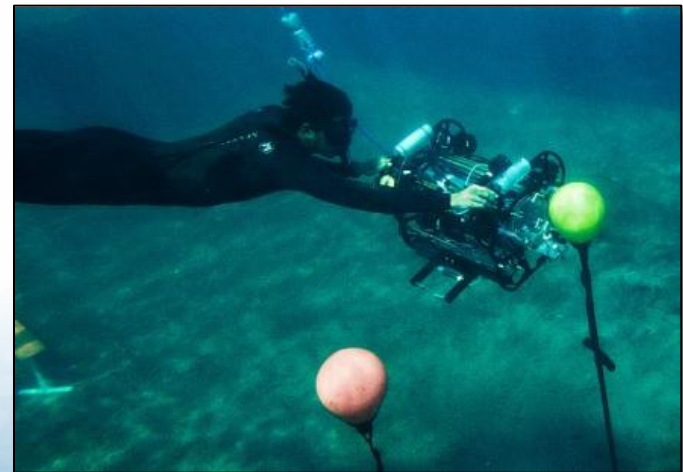
International Submarine Races



RoboBoat

For College Students:

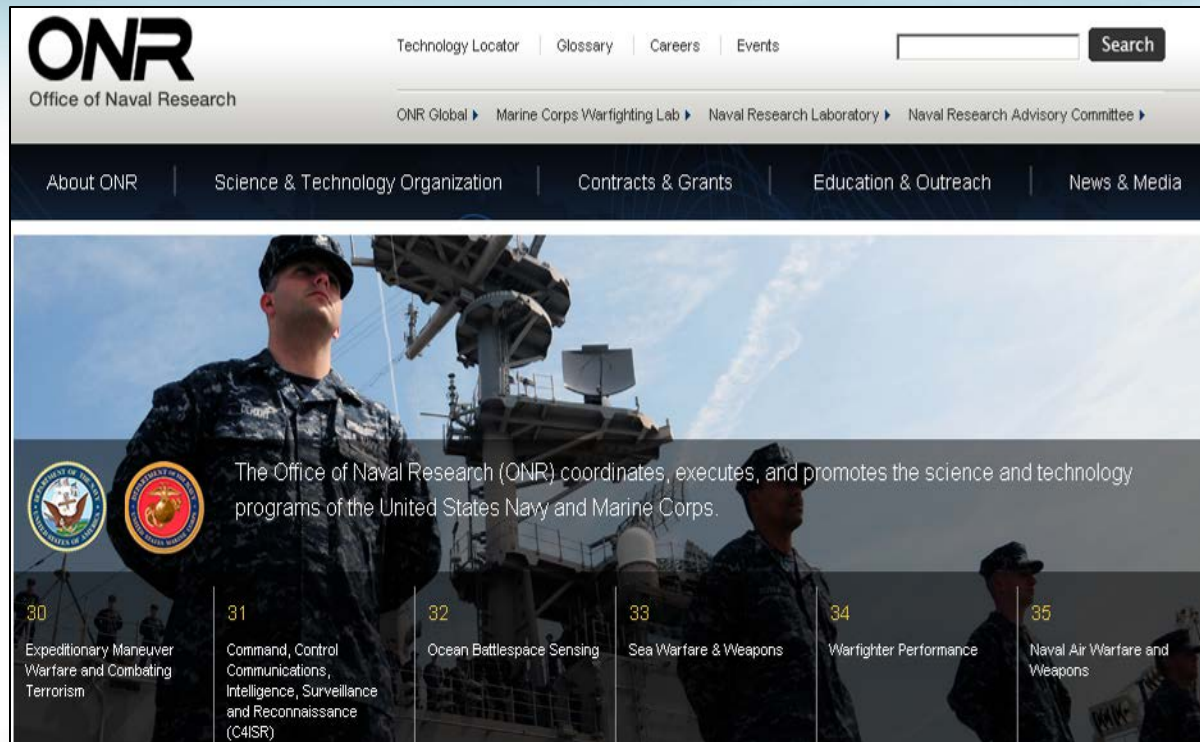
- Summer Internships at Navy Labs
- Naval Research Enterprise Intern Program (NREIP)
- Science, Mathematics & Research for Transformation
- DoD National Defense Science & Engineering Graduate Fellowship Program



RoboSub

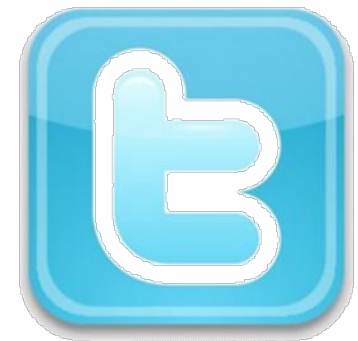


Stay in Touch



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- Back-up



ONR-Global Operating Forward

ONRG-DC

ONR Global Liaison Office
CNO Executive Panel
CNO(N2/N6)
FLT CYBERCOM/COMTENTHFLT
CNO(N81)

Mechanicsburg
NAVSUP

ONRG-London - ADs
Technical Director
Executive Officer

Naples
COMUSNAVEUR
COMUSNAF
COMSIXTHFLT

ONRG-Prague - ADs

Newport
CNO SSG

Norfolk
COMUSFLTFORCOM
COMNAVAIRFOR
COMSUBFOR
COMMARFOR
COMSECFLT
COMNECC
COMNWDC

Camp LeJeune
CG II MEF

ONRG-Tokyo - ADs

Yokosuka
C7F
Okinawa
CG III MEF

Bahrain
COMNAVCENT
COMFIFTHFLT

ONRG-Singapore - ADs
Commanding Officer

ONRG-Santiago - ADs

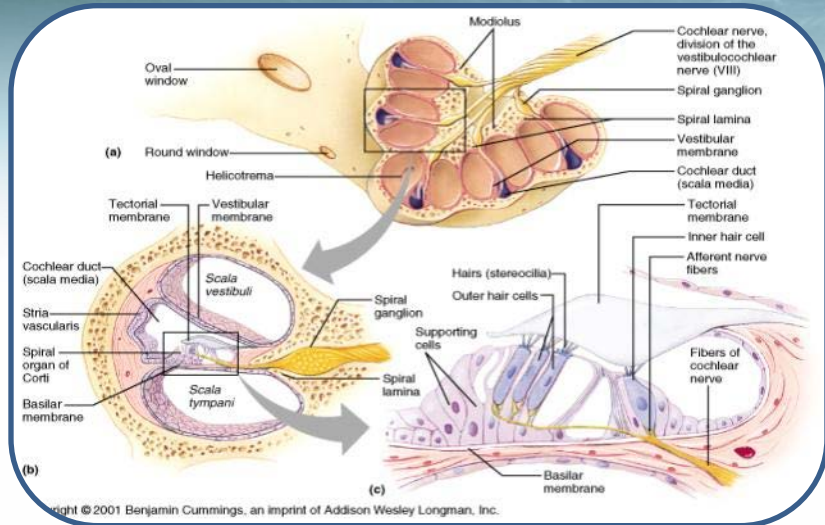
San Diego
COMTHIRDFLT
COMNAVSURFFOR
CG I MEF
NMAWC

Honolulu
USPACOM
COMPACFLT
COMMARFORPAC
COMSUBPAC

Develop Partnerships
Leverage Global S&T Advances
Avoid Technology Surprise



Noise Induced Hearing Loss



Background:

Hearing loss and tinnitus (ringing in the ears) are the two largest VA benefits. Compromised hearing for active duty military impacts mission readiness, survivability and effectiveness.

Top Research Challenges

- Develop technological solutions to measure, model, and reduce noise
- Develop effective PPE for operational environments
- Understand the etiology of NIHL and tinnitus; develop pharmaceutical interventions
- Improve hearing conservation; develop novel techniques and technologies to measure exposure, susceptibility, and hearing assessment



Mr. Yankaskas (Warfighter Performance ONR34)
kurt.d.yankaskas@navy.mil



Autonomous Critical Care System

Background:

- Over the horizon force projection with operational reach approaching 200 nautical miles (nm) as envisioned in Sea-basing will increase the risk of in-transit clinical degradation of severely wounded casualties.
- Automated critical care is designed to mitigate this risk and to maintain critically injured/ill patients for a minimum of two hours w/o degradation of clinical status.



Dr. Michael Given (Warfighter
Performance ONR34)
michael.given@navy.mil

Top Research Challenges

- Wireless Electrocardiogram
- System failure predictive algorithms
- Casualty transport via UAV



Point of Injury Care



Dr. Michael Given (Warfighter
Performance ONR34)
michael.given@navy.mil

Background:

Hemorrhage is the leading cause of preventable death on the battlefield. Administration of current resuscitation fluids provides volume but does not help control bleeding and often makes it worse by diluting remaining coagulation factors.

Top Research Challenges

- What are clinically relevant levels for coagulation factors?
- Is pre-hospital administration of dried plasma beneficial?
- How do you control internal bleeding without surgical access?