The National Academies of
SCIENCES · ENGINEERING · MEDICINE

FEDERAL FACILITIES COUNCIL

Panel 1: Developing Innovation Ecosystems and Partnerships

Thomas Mulkern

Army Research Laboratory Open Campus

Overview

Thomas Mulkern
Tech Transfer and Outreach
U.S. Army Research Laboratory

Mission

DISCOVER, INNOVATE, and TRANSITION Science and Technology to ensure dominant strategic land power

Vision

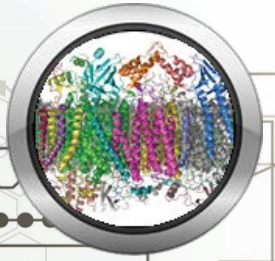
The Nation's Premier Laboratory for Land Forces.

Computational Sciences

Analysis & Assessment

Information Sciences

Extramural Basic Research



Materials Research

Sciences for Lethality & Protection

Sciences for Maneuver

Human Sciences

Making today's Army and the next Army obsolete

Open Campus Initiative

Past: Current Defense Laboratory Model

Gates and high walls provide 20th century security, but are barriers to 21st century innovation

Defense laboratories relatively unchanged since inception (NRL 1923)

Present & Future: Open Campus Initiative

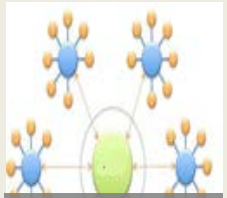
Reduction in barriers to facilitate collaboration with academia, industry, and small business

Less bureaucracy and paperwork

Open areas for researchers and access to existing facilities

Collaboration between ARL and external scientists

Career path for students and scientists



Hub and Spoke Model

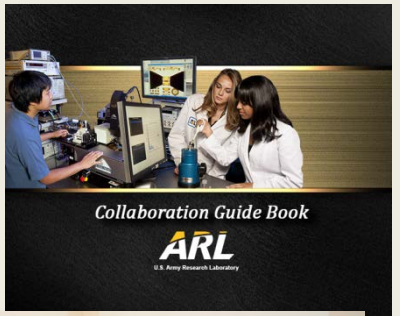
Collaborator presence through EUL

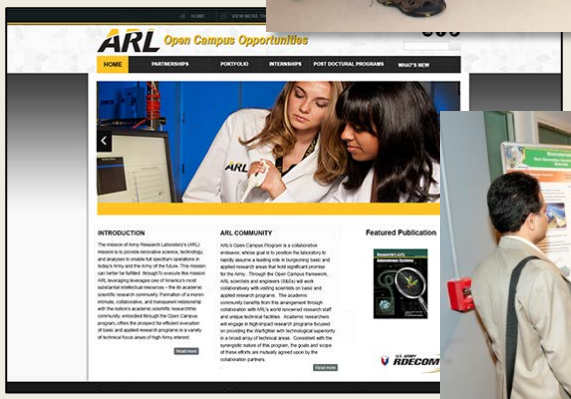
Novel staff opportunities

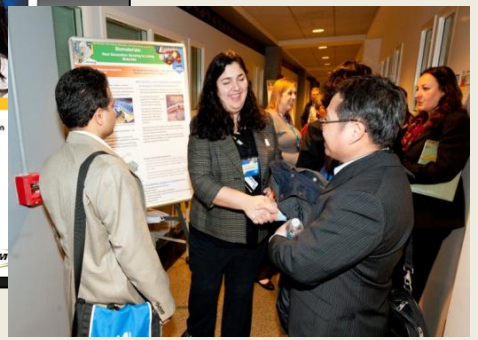
An enhanced defense research environment that fosters discovery and innovation through collaboration on fundamental research

People

- **Flexible Work Places and Schedules**
- **Collaborators Handbook designed to be used as a working guide and to ensure a common understanding of office procedures, safety, security and other needed topics**
- **OC tool to track collaborators coming in/out**
- **Direct Hire Authority**
  - **Enables very rapid hiring of top talent**
- **Revision to Sabbatical Policy**
- **Faculty Appointments**
  - Professors can be ARL employees up to 130 days per year
  - First Faculty Appointment is Dr. Stephen Bayne at Texas Tech University
- **Entrepreneurial Separation Program**
  - When a current ARL civilian employee decides to pursue an entrepreneurial opportunity, the employee resigns from Federal service
  - Employee is eligible for “priority consideration” for up to 5 years from the date of separation

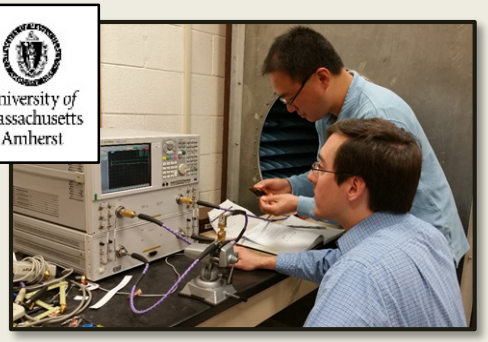






Expanding the Ecosystem Through Research Exchanges

Prof. Patrick Mather,
Syracuse University
One year sabbatical at ARL to investigate the rate dependent mechanics of polymer blends



Dr. Steven Keller, ARL
Three year detail at UMass Amherst on conductive textile and flexible antenna research and fabrication

Debra and Brendan Patton, ARL
One year detail beginning October 2016 to Australia's Defence Science & Technology Laboratory.

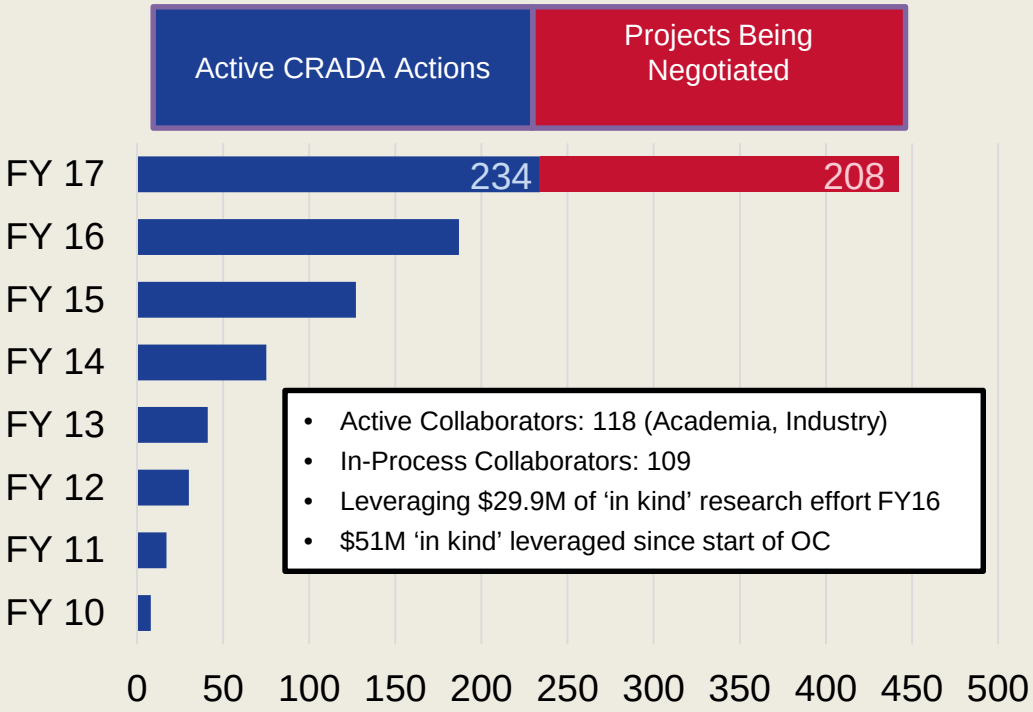
Brittany Beidleman, USC
Undergraduate Student
Summer '16 project focused on visualizing terrain in augmented reality

International Collaborators

Country	2014 to 3/2017
Australia	2
Bangladesh	2
Brazil	2
Canada	1
Chile	1
China	18
Czech Republic	1
Denmark	1
Dominican Rep	1
France	2
Germany	5
India	16
Iran	3
Israel	1
Italy	2
Macedonia	1
Norway	1
Pakistan	1
Romania	1
South Korea	6
Turkey	4
Vietnam	1
	73

Collaborative Mechanisms

- Cooperative Research and Development Agreements (CRADAs)
- Patent License Agreements
- Educational Partnerships
- Partnership Intermediary Agreements



International CRADAs

Australia - University of Wollongong
Australia - Australia National University
Australia - University of Sydney
Australia - Corrosion Technical Products (Extrin)
Brazil - Pontifical Catholic University of Rio de Janeiro
Canada - RightBlue Labs
Germany – Fraunhofer
Hungary - Budapest University of Technology and Economics
Israel - Ben Gurion University
Mexico – CONACyT
New Zealand - University of Auckland
Norway - University of Oslo
Singapore - Nanyang Technological University
South Korea - Korea Institute of Ocean Science and Technology
United Kingdom - University of South Hampton

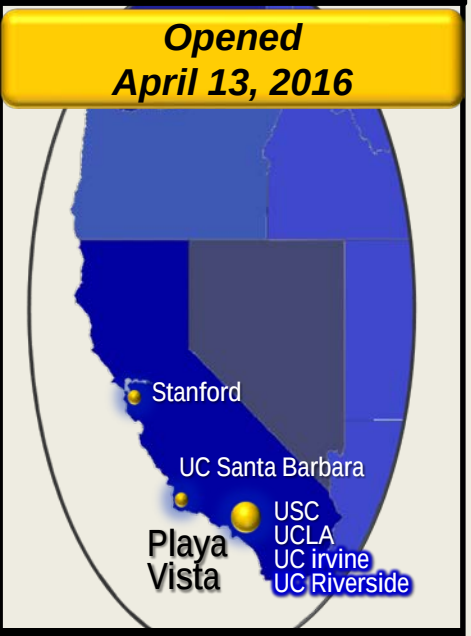
U.S. ARMY RDECOM®

ARL Extended

ARL

ARL WEST

Opened April 13, 2016



Human Info Interaction, Intelligent Systems, Embedded Processing, and Cybersecurity

Regional Director: Cindy Bedell

ARL CENTRAL

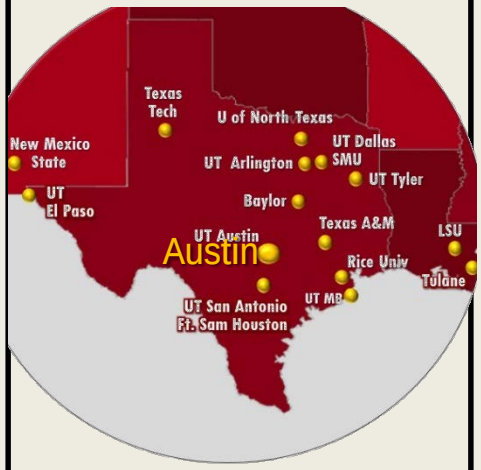
Under Development

Impact Physics, Quantum Science & Engineering, High Performance Computing, Propulsion Science, Materials

Strategy Dev.: Mark Tschopp

ARL SOUTH

Announced November 16, 2016

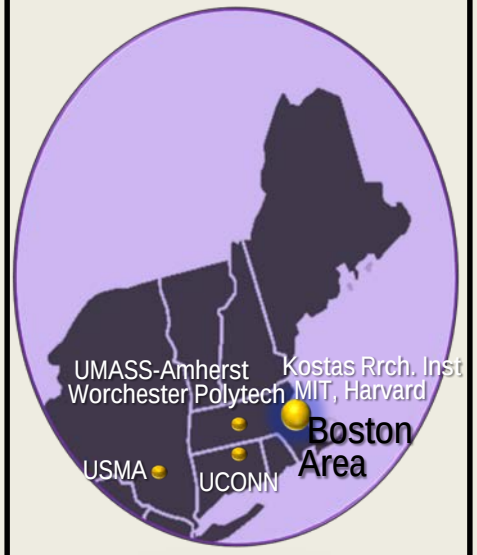


Materials & Manufacturing, Biosciences, Energy & Power, Cybersecurity, Intelligent Systems

Regional Director: Heidi Maupin

ARL NORTHEAST

Under Development



Cyber Electromagnetic, Intelligent Systems, Manufacturing Science, Protection

Strategy Dev.: Vic Champagne

Goals:

- Establish regional laboratories to jointly solve Army technology needs
- Establish close ties with academia, start-ups & established companies
- Access large pool of subject matter experts from academia & industry
- Capitalize on strong academic institutions & graduates with regional preference

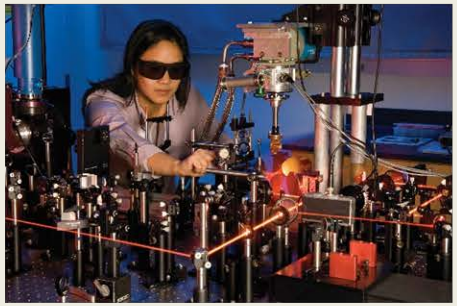
open campus

U.S. Army Research Laboratory

ARL

Open Campus Overview:

- **Open Campus:** Started in FY14 to ***link government assets with the global research community*** with partners and ARL scientists and engineers working side-by-side in specialized research facilities.
- **Collaboration focused on Army Challenges:** Centered on mutual scientific interest and investment by all partners.
- **Outreach:** Participants collaborate side-by-side on-site at each others facilities to engage in mission-critical research that ***expands the broader DoD network beyond federal laboratories***.
- **Attracting Talent:** More than 775 visiting researchers, including 73 from 23 different nations, have collaborated with ARL via Open Campus since inception.
- **Expanded S&T Research Ecosystem**: ARL established hubs in California and Texas, and is exploring hubs in Illinois and Massachusetts, to accelerate collaboration and outcomes; **Research Centers** bring together a consortia of partner organizations that leverage expertise, facilities, and capabilities to target critical national defense issues.



"A well-defined and managed technology pipeline starts from basic research in the labs and ends with the deployed system via the centers."

- Defense Science Board Task Force on Defense Research Enterprise Assessment, January, 2017

Army Benefits as of August 2017:

$51M
in-kind contributions

$29.9M
in-kind contributions in FY16 alone

118
Active CRADAs

52
CRADAs with Academia

66
CRADAs with Industry

700
visiting researchers

80
visiting researchers from

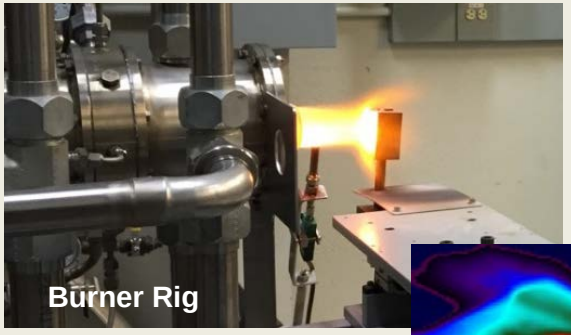
22
different nations

U.S. ARMY RESEARCH LABORATORY ARL 25 YEARS 1992-2017

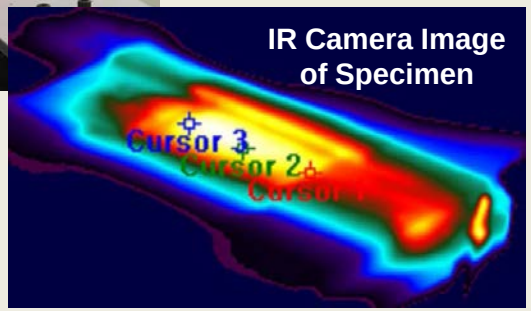
Backup

Advanced High Temperature Ceramics for Propulsion Applications

- Boeing developed Gas Turbine Engine exhaust ceramic matrix composite materials. ARL tested these materials at its Vehicle Research Laboratory.
- Preliminary investigations on Ox-Ox ceramic matrix composite materials show promise for use in future gas turbine engine exhaust and nacelle structures.
- Ongoing collaboration will impact disruptive levels of high power density, durability, reliability and reduced life cycle cost of future, ultra-efficient, Army rotorcraft engines.

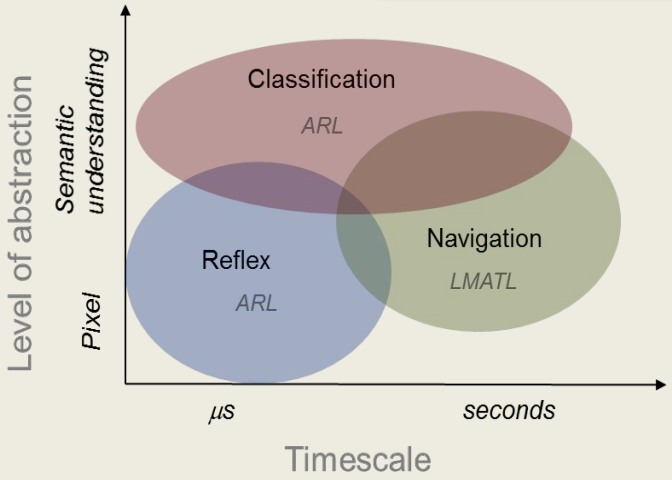


BOEING



ARL POC: Anindya Ghoshal (Sciences for Maneuver)

LOCKHEED MARTIN

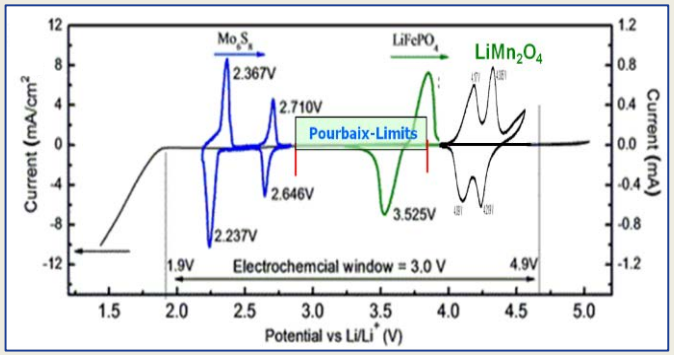


Neuromorphic Computing for Adaptive Control of Robotic Systems

- New start in FY17; ARL growth area; LMATL researcher approved for a one year research sabbatical to ARL
- Will develop sensors and embedded methods to extract salient information from the sensed environment to enable high-speed autonomous vehicle operation, improved soldier-borne localization, and real-time adaptive model learning and refinement in unknown environments.

ARL POC: Allison Mathis (Sciences for Maneuver) / Brian Satterfield LM(ATL)

Open Campus: Working with Academia



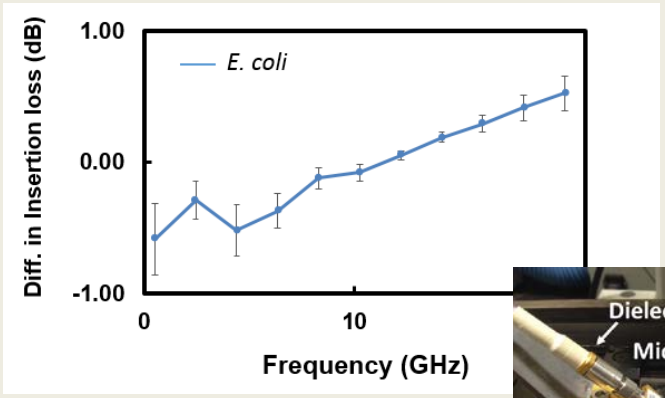
Aqueous Lithium Ion Batteries

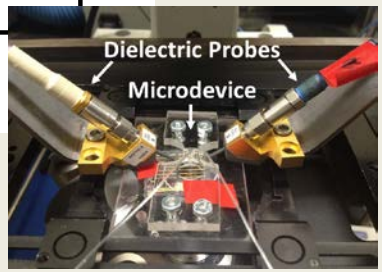
- Collaboration with the Univ. of Maryland through the Center for Research in Extreme Batteries
- Exploring “Water-in-salt” electrolytes to dramatically increase the safety of and maintain the properties of commercial Li-ion batteries.
- Successfully created a completely non-flammable Li-ion battery with performance approaching that of commercial Li-ion batteries

High Voltage Aqueous Li ion Batteries: Xu (ARL), Wang (UMD)

Novel Electronic Devices to Measure Biological Processes

- Collaboration (recent start) with Lehigh University’s Prof. Cheng, who is on sabbatical at ARL
- Investigating methods to measure and model fermentation processes by real-time monitoring of cell-membrane potentials
- Co-developing electronic devices in ARL cleanroom





Measurement & setup with waveguide in microfluidic channel

Rate-Activated Tether for Reduction in Ground Impact-Induced TBI

- Collaboration with NFL/Under Armour/GE/ARL
- Concept: Use tether to reduce head velocity during backward falls, and severity of head-to-ground impact
- Rate-activated tether provides over 100X more force during high speed extension, compared to low speed extension

Comprehensive Threat Protection for Army Vehicles

- Longstanding collaboration with BAE Systems to improve armor technology for combat vehicle application
- Focused on the design, development and integration of integrated blast and ballistic protection kits.
- State-of-the-art reactive armor and new base armor configurations
- Vehicle weight reduction

BAE SYSTEMS
INSPIRED WORK