



Sciences for Maneuver Campaign

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Sciences for Maneuver Campaign

U.S. Army Research Laboratory



Science & Technology enabled air and ground platform capabilities to significantly increase Army:

- Force effectiveness
- Rapid expeditionary global responsiveness

in complex environments.

Mobility technologies to enable adaptive vehicle configurations and subsystem architectures critical to the future Army's:

- Deployment
 - Maneuverability
 - Sustainment



Level 2

Energy &
Propulsion

Logistics &
Sustainability

Platform
Mechanics

Vehicle
Intelligence



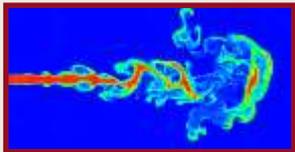
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Sciences for Maneuver Campaign
Energy & Propulsion



ENERGY & PROPULSION: Exploit innovations in energy sources, storage, generation, conversion, transmission, distribution, and management to provide technologies and configurations to **improve operational effectiveness and efficiency** of Army platforms ensuring military power projection superiority.



Fuel Injection & Combustion



Turbine Engine Efficiency and Sand Tolerance



Lightweight Hybrid Gears



ARL-Developed Power Electronics Components



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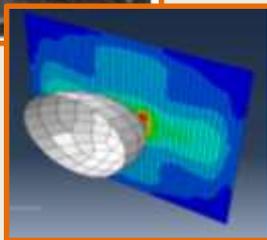
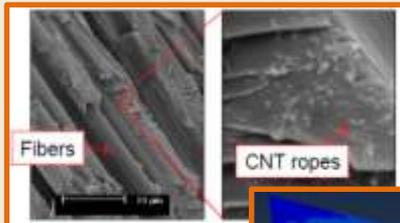
Sciences for Maneuver Campaign
Logistics & Sustainability



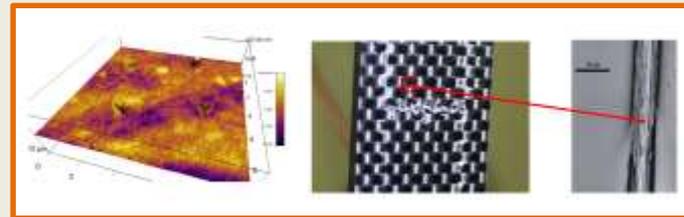
LOGISTICS AND SUSTAINABILITY: Fundamental research to enable the **rapid and accurate assessment of health status, usage and readiness** of Army platforms, sub-systems, and components to provide unmatched **adaptable maneuverability, reliability, affordability, and availability.**

Reliability

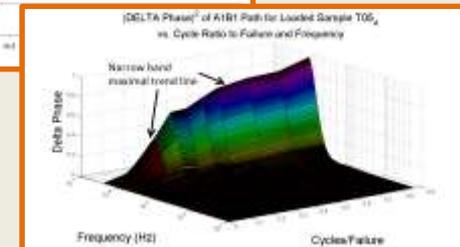
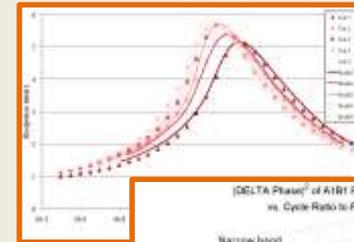
Mechanism State Awareness (health)



Extremely Lightweight, Adaptive, Durable & Damage Tolerant (XLADD) Structures



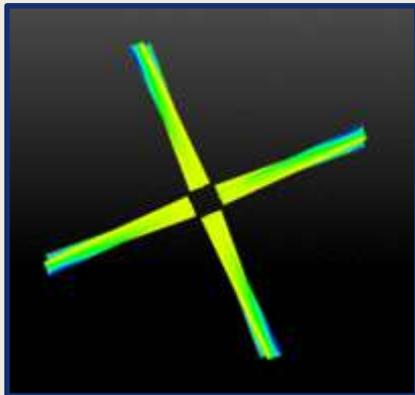
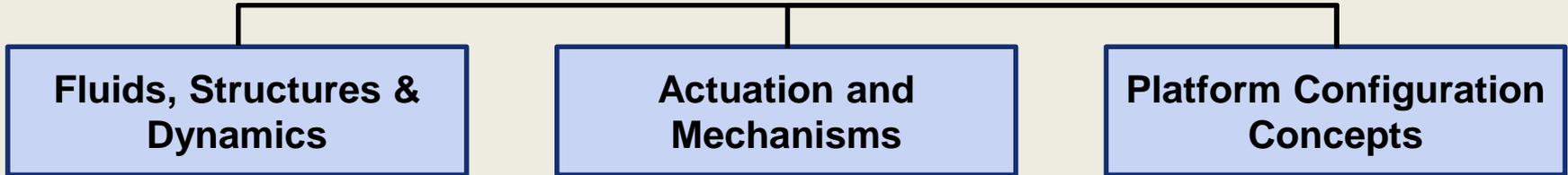
Failure Characterization and Precursor Detection & Identification



Damage Indication & Remaining Useful Life (State Awareness) Models



PLATFORM MECHANICS: Fundamental research to enable highly-maneuverable high-speed air and ground vehicle platforms and subsystems for the future Army, ranging from large combat/cargo vehicles to micro-scale devices.



Rotor Aeromechanics

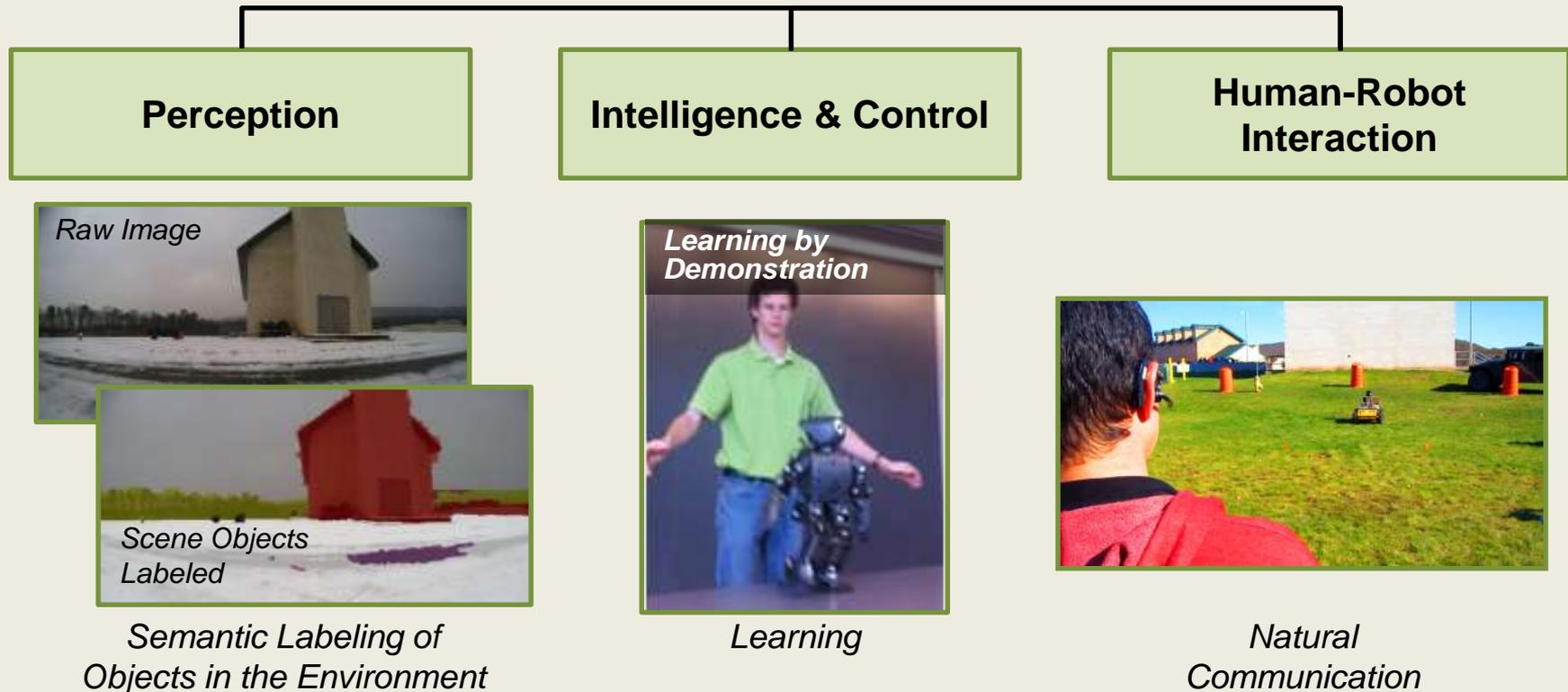


Adaptive Wing Span Mechanisms



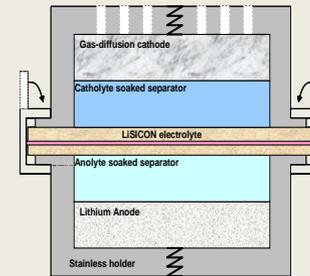
Platform Capability Assessment & Tradeoff Environment

VEHICLE INTELLIGENCE: Focus on fundamental research to enable effective teaming of Soldiers and unmanned vehicles to conduct maneuver and military missions. Centered on enhancing autonomous capabilities of unmanned / intelligent systems in real world environments.



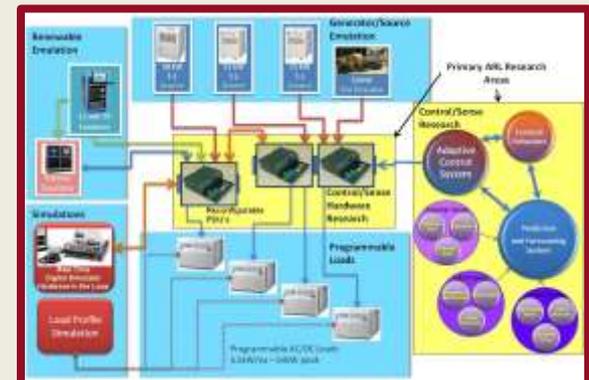
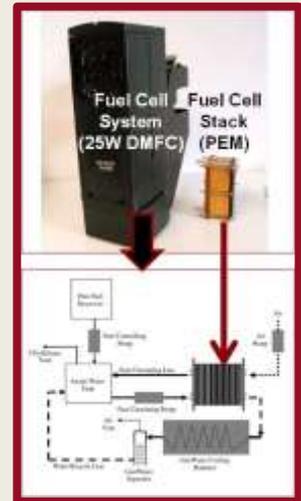
Key Campaign Initiative: Advanced, Electrical Power Technologies and Components

- Improve mission effectiveness of Army platforms through development of energy and power underpinning materials and devices to enable electric-based component technologies.
- Reduce logistics burden through the development of more efficient electrical power generation, distribution, and conversion components and systems.



Fuel Cell Energy Conversion

Advanced Battery Energy Storage



Intelligent Power Distribution



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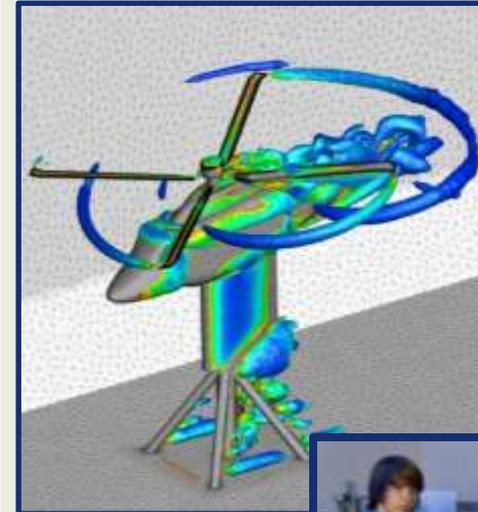
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Sciences for Maneuver Campaign
Platform Mechanics KCI

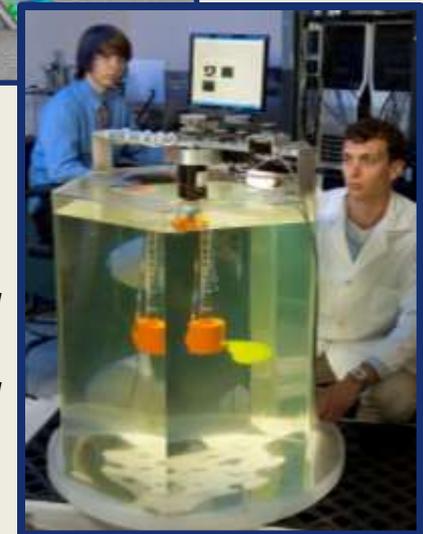


Key Campaign Initiative: Discover & Advance VTOL Innovations, Novel Concepts, and Ideas (DAVINCI)

- Technologies to enable fielding of next generation VTOL platforms and application to current platforms to produce significantly increased speed without degradation of hover efficiency
- Technologies to enhance maneuverability in complex environments at higher operating speeds
- Next generation micro and small unmanned autonomous air vehicles



*Rotorcraft
Aeroelasticity
Research*



*Small
Autonomous
System Airfoil
Research*



Key Campaign Initiative: Force Projection & Augmentation through Intelligent Vehicles

- Army development of autonomous and semi-autonomous operational capabilities to increase lethality and protection, and augment, enable and, in some cases, replace Soldiers, thus freeing them to maneuver and operate to their advantage.
- Technological advances for affordable, interoperable autonomous and semi-autonomous systems that improve effectiveness of Soldiers and units.



*Intelligent Systems Research
Reason, Learn, Plan, Act*



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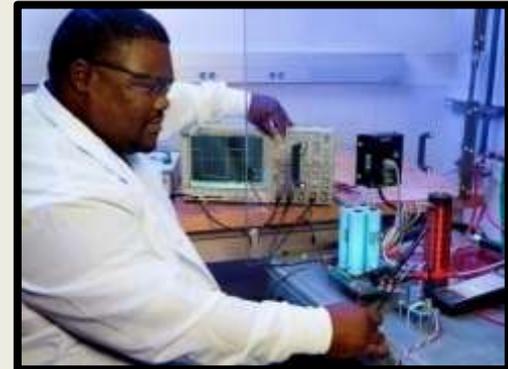
Sciences for Maneuver Research Facilities



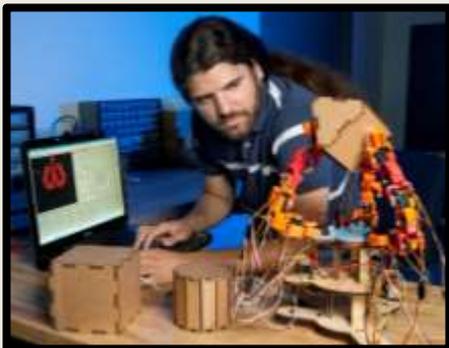
Intelligent Systems Research
Adelphi, MD



ARL Vehicle Research Laboratory
Aberdeen Proving Ground, MD



Energy & Power Research
Adelphi, MD



Autonomous Systems Research
Aberdeen Proving Ground, MD



Robotics Research
Ft. Indiantown Gap, PA



Propulsion Research
(ARL Field Element)
NASA Glenn Research Center



Aeromechanics Research
(ARL Field Element)
NASA Langley Research Center



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**ARL Intelligent Vehicle Systems
Research Center**



Technology Discovery & Innovation for Future Army Intelligent Unmanned Vehicles

Artificial Intelligence

- Semantic Perception
- Machine Learning
- Abstract Reasoning

Human-Machine Interaction

- Cognitive Models
- Human-Machine Communication
- Trust

Multi-Modal Control

- Distributed/Embedded
- Hybrid Mobility/Manipulation



Cognitive
Robotics Lab
at APG, MD



Free Flight Facility
at APG, MD



Micro-Systems
Wind Tunnel
at APG, MD



Indoor Experimentation Facility (Bldg 507)
at Adelphi, MD



Robotics Research Facility
at Ft. Indiantown Gap, PA

Multi-Disciplinary / Multi-Campaign

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The Nation's Premier Laboratory for Land Forces



Energy & Propulsion

- **Power Electronics for Tactical Energy Networks and Mobile Platforms**
- **Soldier and Small System Energy Harvesting**
- **Fuel Processing Power Sources**
- **High-Efficiency Gas Turbine Engine Components**
- **Tribology and Lubrication Science for High-Performance Power Transmission**
- **Combustion Sciences for Advanced Propulsion Systems**
- **Innovative Propulsion Technologies for Unmanned Aircraft Systems**
- **Probabilistic-Diagnostic Informed Innovations for Power Transmission Lightweighting**
- **Advanced Power Transfer Components and Concepts**

<http://www.arl.army.mil/opencampus/>



Platform Intelligence

- **Meta-Cognition, Self-reflection and Proprioception**
- **Semantic Spatial Understanding**
- **Intelligent Vehicle Technology Experimentation**
- **Human-robot Interaction**
- **Bot-Language**
- **Computational Intelligence**
- **Autonomous Mobile Robot Exploration with an Information-Gain Metric**
- **Hybrid Training Methods for Visual Classification and Autonomous Navigation**
- **Reasoning Under Uncertainty**
- **Size, Weight, Power, and Processing Constrained Sensors & Controls**
- **Automated Vehicle Routing**

<http://www.arl.army.mil/opencampus/>



Logistics & Sustainability

- **Extremely Lightweight, Adaptive, Durable, Damage Tolerant (XLADD) Structures for Future Vertical Lift**
- **Virtual Risk-informed Agile Maneuver Sustainment (VRAMS)**

Platform Mechanics

- **Aeromechanics for Rotorcraft and Unmanned Aerial Systems**
- **Mission-Driven Microsystem Design and Validation**
- **Mechanics of Handheld Aerial Mobility**
- **Rotorcraft Capability Assessment and Tradeoff Environment**
- **Advanced Rotorcraft Aeromechanics Research**
- **Mobility and Manipulation for Next-Generation Unmanned Systems**

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Campaign Poster Locations

➤ Mallette Center, 1st Floor, Room 10 A/B

▪ VEHICLE INTELLIGENCE

➤ Mallette Center, 2nd Floor, Room 15

▪ ENERGY & PROPULSION

▪ LOGISTICS & SUSTAINABILITY

▪ PLATFORM MECHANICS





Sciences for Maneuver Campaign and Analysis & Assessment Campaign

Tours SM5, SM7, SM9

- Propulsion
- Airbase Experimental Facility 6/7



Vehicle Research Laboratory
Aberdeen Proving Ground, MD

Tours SM6, SM8, SM10

- Intelligent Vehicles
- Logistics & Sustainment
- Airbase Experimental Facility 6/7



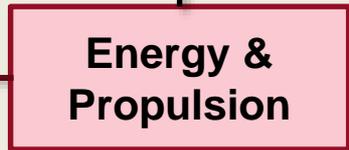
Airbase Experimental Facility
Aberdeen Proving Ground, MD



Level 1



Level 2



Level 3

