Dr. Mark J. Valco
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
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.
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.

- Fluids, Structures & Dynamics
- Actuation and Mechanisms
- Platform Configuration Concepts

- 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.
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
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.
The Nation’s Premier Laboratory for Land Forces

Sciences for Maneuver
Research Facilities

ARL Vehicle Research Laboratory
Aberdeen Proving Ground, MD

Intelligent Systems 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

Energy & Power Research
Adelphi, MD

Aeromechanics Research
(ARL Field Element)
NASA Langley Research Center

The Nation’s Premier Laboratory for Land Forces
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

Multi-Disciplinary / Multi-Campaign

Indoor Experimentation Facility (Bldg 507) at Adelphi, MD

Cognitive Robotics Lab at APG, MD

Free Flight Facility at APG, MD

Micro-Systems Wind Tunnel at APG, MD

Robotics Research Facility at Ft. Indiantown Gap, PA
• 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

http://www.arl.army.mil/opencampus/
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
Research Facility Tours

Sciences for Maneuver Campaign and Analysis & Assessment Campaign

Tours SM5, SM7, SM9
- Propulsion
- Airbase Experimental Facility 6/7

Tours SM6, SM8, SM10
- Intelligent Vehicles
- Logistics & Sustainment
- Airbase Experimental Facility 6/7

Vehicle Research Laboratory
Aberdeen Proving Ground, MD

Airbase Experimental Facility
Aberdeen Proving Ground, MD
The Nation’s Premier Laboratory for Land Forces

UNCLASSIFIED

Sciences for Maneuver Campaign Taxonomy

Level 1

1. Energy & Propulsion
2. Logistics & Sustainability
3. Platform Mechanics
4. Vehicle Intelligence

Level 2

1. Energy Storage for Mobility
2. Reliability
3. Fluids, Structures & Dynamics
4. Perception
5. Power/Energy Conversion
6. Mechanism State Awareness (health)
7. Actuation and Mechanisms
8. Intelligence & Control
9. Distribution and Transfer
10. Platform Configuration Concepts
11. Human-Robot Interaction
12. Intelligent Power

UNCLASSIFIED