

Topic: N13A-T028

Electric Drivetrain Technologies, LLC

Hybrid, Ultra-High-Speed, High Efficiency, Power Dense, Electronically Controlled Energy Conversion Unit for Ship Systems, Unmanned Vehicles, and Robotics Applications

Electric Drivetrain Technologies LLC. is in the business to develop state of the art technology with military applications and then leverage the technology for industrial/commercial use. The company and its principals have designed key components for high speed motor/generator systems successfully for over 20 years. The technology is a very high speed mechanical energy storage system which can rapidly absorb and release electrical energy. The system will address the Navy's needs for shipboard power distribution systems with pulse power loads. We have multiple parallel paths for critical items to mitigate any risks in case any single component and/or development step pose challenges. We are looking for a partner that can incorporate our technology into products for the military and preferably also commercial products.

Technology Category Alignment:

Satellite Communications (SATCOM)

Robotics/Automated Material Handling Equipment

Shipyards/Shipbuilding

Supply; Storage

Satellite Communications (SATCOM)

Satellite Communications (SATCOM)

Supply; Storage

Supply; Storage

Satellite Communications (SATCOM)

Shipyards/Shipbuilding

Robotics/Automated Material Handling Equipment

Robotics/Automated Material Handling Equipment

Robotics/Automated Material Handling Equipment

Robotics/Automated Material Handling Equipment

Protection, Sustainment, and Warfighter Performance

Medical Chem-Bio Defense

Military Infectious Diseases

Propulsion and Extreme Environments

Fixed Wing Vehicles (includes UAS)

Survivability

Maintainability/Sustainability

Unmanned Ground and Sea Vehicles

Corrosion

Advanced Computing/Software Development

Networks and Communications

Modular/Open/Reconfigurable Architectures

RF Components for sensing, transmission and communication

Electronics Integration

Broadband/Multispectral Components and Systems

Sensors, Electronics and Photonics

Radio Frequency (RF) (non-EW)

Survivability

Broadband/Multispectral Components and Systems

RF Components for sensing, transmission and communication

Radio Frequency (RF) (non-EW)

Networks and Communications

Guidance, Navigation & Control (GN&C) and Data Links

RF Components for sensing, transmission and communication
Networks and Communications
Cognitive/Adaptive Capabilities
Preemptive/Proactive Effects
Broadband/Multispectral Components and Systems
Advanced Computing/Software Development
Networks and Communications
Personalized Assessment, Education, and Training
System Interfaces & Cognitive Processes
Aircraft Propulsion, Power and Thermal
Modeling, Simulation & Test Infrastructure
Rotary Wing Vehicles
Fixed Wing Vehicles (includes UAS)
Fixed Wing Vehicles (includes UAS)
Acoustic, Seismic and Magnetic
Rotary Wing Vehicles
Structures and Protection
Energy storage
Unmanned Ground and Sea Vehicles
Mobility
Power and Energy
Synthesis/Analytics/Decision Tools
Information Collection/Management
Advanced Computing/Software Development
Survivability
Unmanned Ground and Sea Vehicles
Radio Frequency (RF) (non-EW)
Power Generation/Energy Conversion
Energy storage
Power and Energy
Sensors, Electronics and Photonics
Maintainability/Sustainability
Advanced Computing/Software Development
EO/IR Components for sensing, transmission and communication
Microelectronics and Nanoelectronics
Networks and Communications
Mobility
Broadband/Multispectral Components and Systems
Sensors, Electronics and Photonics
Structures and Protection
Electro-Optical/Infrared (EO/IR)
Human/Autonomous System Interaction and Collaboration
Maintainability/Sustainability
System Interfaces & Cognitive Processes
Aircraft Propulsion, Power and Thermal
Power Generation/Energy Conversion
High Energy Lasers (HEL)

Propulsion
Biomedical Informatics / Health Information Systems & Technology
Protection, Sustainment, and Warfighter Performance
Modeling, Simulation & Test Infrastructure
Maintainability/Sustainability
Mobility
Personalized Assessment, Education, and Training
RF Components for sensing, transmission and communication
Broadband/Multispectral Components and Systems
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Radio Frequency (RF) (non-EW)
Radio Frequency Weapons (RFW)
Energy storage
Power Generation/Energy Conversion
Thermal Transport and Control
Unmanned Ground and Sea Vehicles
Acoustic, Seismic and Magnetic
RF Components for sensing, transmission and communication
Guidance, Navigation & Control (GN&C) and Data Links
Survivability
High-Speed/Hypersonics
Power Generation/Energy Conversion
Acoustic, Seismic and Magnetic
Radio Frequency Weapons (RFW)
Electronic Materials
Electronics Integration
RF Components for sensing, transmission and communication
Electromechanical conversion
Energy storage
Power Control and Distribution
Power Generation/Energy Conversion
Thermal Transport and Control
EO/IR Components for sensing, transmission and communication
RF Components for sensing, transmission and communication
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Fixed Wing Vehicles (includes UAS)
Distributed/Coordinated/Net-Enabled Systems
High-Speed/Hypersonics
Propulsion and Extreme Environments
Energy storage
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Information Collection/Management
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EO/IR Components for sensing, transmission and communication
Rotary Wing Vehicles
Protection, Sustainment, and Warfighter Performance

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Modeling, Simulation & Test Infrastructure
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Machine Perception, Reasoning and Intelligence
Assuring Effective Missions
Modular/Open/Reconfigurable Architectures
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Machine Perception, Reasoning and Intelligence
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RF Components for sensing, transmission and communication
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Military Infectious Diseases
Military Operational Medicine
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Propulsion
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Biomedical Informatics / Health Information Systems & Technology
Electro-Optical/Infrared (EO/IR)
High Energy Lasers (HEL)
EO/IR Components for sensing, transmission and communication

Networks and Communications
Sensors, Electronics and Photonics
Electro-Optical/Infrared (EO/IR)
Human Computer Interfaces (HCI) for Decision Making
Information Collection/Management
Synthesis/Analytics/Decision Tools
Human Aspects of Operations in Military Environments
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Military Operational Medicine
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Acoustic, Seismic and Magnetic

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Networks and Communications
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Microelectronics and Nanoelectronics
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Manufacturing Technology for Affordability
Propulsion
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Biomedical Informatics / Health Information Systems & Technology
Military Operational Medicine
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RF Components for sensing, transmission and communication
Electronics Integration
Propulsion and Extreme Environments
Readiness
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Fixed Wing Vehicles (includes UAS)
Machine Perception, Reasoning and Intelligence
Resilient Infrastructure
Trust Foundations
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Thermal Transport and Control
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Scalable Teaming of Autonomous Systems
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Power Control and Distribution
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Fixed Wing Vehicles (includes UAS)
Aircraft Propulsion, Power and Thermal
Rotary Wing Vehicles
EO/IR Components for sensing, transmission and communication
Satellite Communications (SATCOM)
Networks and Communications
Trust Foundations
Electro-Optical/Infrared (EO/IR)
Unmanned Ground and Sea Vehicles
Maintainability/Sustainability
Modularity
Survivability
Electro-Optical/Infrared (EO/IR)
Sensors, Electronics and Photonics
EO/IR Components for sensing, transmission and communication
RF Components for sensing, transmission and communication
Networks and Communications
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Electronics Integration
Protection, Sustainment, and Warfighter Performance
Clinical & Rehabilitative Medicine
Combat Casualty Care
Medical Chem-Bio Defense
Energy storage
Protection, Sustainment, and Warfighter Performance
Human Computer Interfaces (HCI) for Decision Making
Synthesis/Analytics/Decision Tools
Undersea Weapons
Human Computer Interfaces (HCI) for Decision Making
Information Collection/Management

Synthesis/Analytics/Decision Tools
Power and Energy
Propulsion and Extreme Environments
RF Components for sensing, transmission and communication
Fixed Wing Vehicles (includes UAS)
Broadband/Multispectral Components and Systems
Preemptive/Proactive Effects
Radio Frequency (RF) (non-EW)
Energy storage
Manufacturing Technology for Affordability
Power and Energy
Structures and Protection
Synthesis/Analytics/Decision Tools
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Trust Foundations
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Rotary Wing Vehicles
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Propulsion
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RF Components for sensing, transmission and communication
Fixed Wing Vehicles (includes UAS)
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Electronics Integration
Energy storage
Power Control and Distribution
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Synthesis/Analytics/Decision Tools
Synthesis/Analytics/Decision Tools
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Combat Casualty Care
Military Operational Medicine
Personalized Assessment, Education, and Training
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Electronic Materials
EO/IR Components for sensing, transmission and communication
Microelectronics and Nanoelectronics
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Test, Evaluation, Validation, and Verification
EO/IR Components for sensing, transmission and communication
Microelectronics and Nanoelectronics
Networks and Communications
Networks and Communications
Aircraft Propulsion, Power and Thermal
Electro-Optical/Infrared (EO/IR)
EO/IR Components for sensing, transmission and communication
Fixed Wing Vehicles (includes UAS)
Unmanned Ground and Sea Vehicles
Electro-Optical/Infrared (EO/IR)
Sensors, Electronics and Photonics
Broadband/Multispectral Components and Systems
Cognitive/Adaptive Capabilities

Electro-Optical/Infrared (EO/IR)
Biomedical Informatics / Health Information Systems & Technology
Advanced Computing/Software Development
Synthesis/Analytics/Decision Tools
Biomedical Informatics / Health Information Systems & Technology
Personalized Assessment, Education, and Training
Protection, Sustainment, and Warfighter Performance
Modeling, Simulation & Test Infrastructure
Fixed Wing Vehicles (includes UAS)
Rotary Wing Vehicles
Human Computer Interfaces (HCI) for Decision Making
System Interfaces & Cognitive Processes
Human Computer Interfaces (HCI) for Decision Making
Information Collection/Management
Synthesis/Analytics/Decision Tools
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Rotary Wing Vehicles
Machine Perception, Reasoning and Intelligence
Synthesis/Analytics/Decision Tools
Unmanned Ground and Sea Vehicles
Fixed Wing Vehicles (includes UAS)
Machine Perception, Reasoning and Intelligence
Scalable Teaming of Autonomous Systems
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Fixed Wing Vehicles (includes UAS)
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Design and Integration
Modularity
Unmanned Ground and Sea Vehicles
System Interfaces & Cognitive Processes
Fixed Wing Vehicles (includes UAS)
Information Collection/Management
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Radio Frequency Weapons (RFW)
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System Interfaces & Cognitive Processes
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Networks and Communications
Electronic Materials
RF Components for sensing, transmission and communication
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RF Components for sensing, transmission and communication
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Unmanned Ground and Sea Vehicles
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Corrosion
Propulsion and Extreme Environments

Department of the Navy SBIR/STTR Transition Program

STATEMENT A. Approved for public release; distribution is unlimited.

ONR Approval # 43-2203-16

Topic # N13A-T028

Hybrid, Ultra-High-Speed, High Efficiency, Power Dense, Electronically Controlled Energy Conversion Unit for Ship Systems, Unmanned Vehicles, and Robotics Applications
Electric Drivetrain Technologies, LLC

WHO

SYSCOM: ONR

Sponsoring Program: Navy's power and energy management program and a next generation integrated power system architecture (NGIPS) for application on shore based facilities, future surface ships, and underwater vehicles.

Transition Target: Applications within PMS 320; potential fit for PMS 405 with a focus on railguns and directed energy weapons

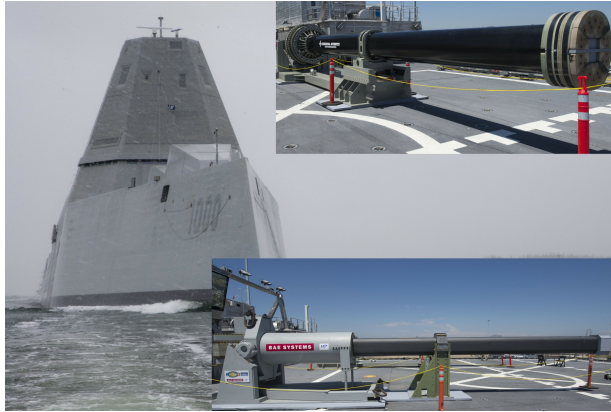
TPOC:

Captain Lynn Petersen
lynn.j.petersen@navy.mil

Other transition opportunities:

The DoD has engaged in the High Speed Mechanical Energy Storage Initiative (HMES) throughout the various system components and this technology may enhance the results from this initiative.

Notes: Opportunities in commercial grid power applications and high density energy storage (mechanical battery). The passive magnetic bearing system has significant other opportunities both for military and commercial applications.



Images courtesy of the U.S. Navy, 140708-N-ZK869-003 SAN (July 2014), 140708-N-ZK869-010 (July 2014), 160324-N-DM751-003 (March 2016)

WHEN Contract Number: N00014-15-C-0150 Ending on: November 30, 2016

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Bearing Test Model	Low	stable bearing operation	TRL 3	August 2016
Medium Speed Test Model (300 KRPM capable, 50 KW peak)	Med	successful pulse power operation at > 20 KW	TRL 4	November 2016
Design high speed/full size evaluation unit	High	complete design documentation	TRL 4	July 2017
Build high speed/full size evaluation unit	High	unit running at 500 KW pulse load	TRL 5	March 2018
Complete full testing of high speed/full size evaluation unit	High	complete all testing at full power (thermal etc.)	TRL 6	July 2018

WHAT

Operational Need and Improvement: The Navy requires compact power sources for pulsed power applications. The very high speed energy storage can reduce the space and weight required for these power conditioning system. This is an important factor as the Navy's need for pulse power sources will continue to increase in the foreseeable future. A smaller, lighter energy storage and power conditioning system saves cargo space and fuel while enhancing system portability. This motor/generator will have a wide range of applications, i.e. it can be used as the core building block of a very lightweight electrical energy storage system for unmanned aerial vehicles (UAV) or to maintain power quality in micro-grids that experience high pulse loads such as airframes and Navy ships.

Specifications Required: The Navy seeks to develop new, innovative motor/generator technologies that can effectively operate at speeds up to 1,000 kRPM at power densities of 40 kW/kg (excluding heat exchanger) with an overall system efficiency of 95 percent or better. Based on our initial design we will be able to achieve a power density of 60 KW/Kg well above the Navy's targets.

Technology Developed: We have developed new and novel motor technologies that allow us to manufacture efficient motors for very high speed operation. Two of the main features of this motor are a passive magnetic bearing technology that is a key component to achieve these extremely high speeds, and a pulse width modulated inverter that switches at 1 MHz and greater PWM carrier frequency. The dynamic bandwidth of the current loop system is > 100 KHz to minimize motor losses, control the bearing stabilization and improve the system's dynamic performance and the power quality of the output voltage.

Warfighter Value: The system addresses the Navy's need for its power and energy management program and a next generation integrated power system architecture (NGIPS). The combined system is a very power dense, lightweight mechanical energy storage system that is competitive with current battery technology and which can be rapidly discharged and recharged. This system is virtually maintenance free and has no cycle limitations which yield a near unlimited (greater 10 years) life.

HOW

Projected Business Model: We will team with a partner (TBD) to transition the technology for DoD applications. We have had very preliminary discussions with Honeywell and UTC.

Our sister company will develop industrial power products for manufacture and sale to the industrial market. We plan to also work with a suitable partner and we are having initial discussions with potential industrial partners.

Company Objectives: We will continue to develop different aspects of the technology:

- high speed motors: new technologies are needed for machine tool spindles, high performance energy efficient compressors
- magnetic bearing: are sought for many industrial and HVAC applications to increase operating speed, reduce maintenance costs and quite, more reliable, more energy efficient operation
- high bandwidth inverter: we are already implementing this technology for use in TELECOM power systems and we plan to expand on these developments
- high speed flywheel system: we plan to continue the development of mechanical batteries for utility power management, solar power plants and we have discussed a 100 MWh modular storage system with a potential customer

Potential Commercial Applications: Bearing: low cost, high RPM machines, i.e. turbo/superchargers. No contact - no wear bearings for machine tools and aerospace applications
Motor technology: very low cost motor system made from solid materials (non-laminated) or soft magnetic composites (SMC) for appliances and automotive
High speed motor: turbo/superchargers, efficient generators, spindle drives
Mechanical energy storage: alternative to batteries with no memory and maintenance free unlimited life (charge/discharge) cycles

Contact: George Holling, Technical Director
George.Holling@ElectricDrivetrainTechnologies.com 435-259-5500