

U.S. DOT's Small Business Innovation Research (SBIR) Program



SBIR Phase II Awards
Based on Fiscal Year 2023 Solicitation

Project Title	Company
23-FH2: Edge Computing and Sensor Fusion System for Comprehensive Monitoring of Traffic and Road Conditions	Aiwaysion, Inc
23-PH4: Wearable Altering Tactile Cues for Hazard Response	Triton Systems, Inc.
23-PH3: In-Field Magnetometry for Determination of Lithium Battery SOC	TDA Research, Inc.
23-PH2: E-HazID - Integrated RFID, Sensing and Communication System for Safe Transportation of HAZMAT	Newport Sensors, Inc.
23-PH1: Encapsulated Microbes for Bioremediation of Hazardous Material Spills	Aries Science & Technology, LLC
23-NH1: Development of a CO2 Breathing Anthropomorphic Test Device	X-Biomedical Inc
23-FR2: Novel Design for Passenger Railcar Retention Systems Submission	Protection Engineering Consultants, LLC
23-FH2: An Energy-efficient and Self-diagnostic Portable Edge-Computing Platform for Traffic Monitoring and Safety	CLR Analytics Inc.
23-FH1: A Low-Cost High-Capacity Portable Stormwater Treatment System for Emerging Contaminants	TDA Research, Inc.
23-FH1: Development of a Self-Contained Electro-Flocculation Device to Achieve Stormwater and Water Quality Goals	Fagan Consulting

Aiwaysion, Inc. (Seattle, WA)

Edge Computing and Sensor Fusion System for Comprehensive Monitoring of Traffic and Road Conditions

PI Name: Wei Sun

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Abstract: In Phase I, Aiwaysion successfully developed a working scaled prototype named the Mobile Unit for Sensing Traffic (MUST). MUST is an Edge Computing and Sensor Fusion System for comprehensive traffic and road conditions monitoring. This innovative roadside edge computing device seamlessly integrates a low-power edge computing chip with advanced traffic and environment sensors and other essential components. The prototype system was designed, developed, and tested at three locations, covering both rural and urban environments. Building upon the prototype system developed in Phase I, Phase II will develop the system into a fully functional and commercial-ready product by improving its design and functionality and ensuring compliance with DOT standards. Phase II will expand collaboration efforts with a wider range of agencies and conduct field testing in both urban and rural areas covering a variety of environmental conditions to ensure the product's versatility and effectiveness. By conducting more field tests, the system will be able to adapt to different scenarios, circumstances, and customer needs, which will make it more robust. Additionally, the data collected during the field test will be used to improve the system's performance by fine-tuning the AI-algorithms and models.

Company Website: <https://www.aiwaysion.com/>



Triton Systems, Inc. (Chelmsford, MA)

Wearable Altering Tactile Cues for Hazard Response

PI Name: Jason Lassar

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Abstract: First responders to hazardous material (HAZMAT) incidents face many safety risks daily, such as exposure to hazardous chemicals and toxic gases, which can be difficult to detect. Despite significant recent developments in sensing and wearable technology, no currently available product combines the user need for reliable, sensitive, multichemical detection with an affordable and easy-to-use alerting and communication system. Triton Systems will design, fabricate, and demonstrate an integrated sensing and alerting system focused on providing critical alerts to first responders. Triton's body worn product is reliable, easily interpreted, low profile, and ruggedized for dynamic emergency environments. Launderable components encourage affordable daily use, lowering barriers to adoption. Triton's solution will empower first responders with advanced sensor and wearable electronics integration technologies to inform rapid decision-making and increase safety.

Company Website: <https://tritonsystems.com/>



TDA Research, Inc. (Wheat Ridge, CO)

In-Field Magnetometry for Determination of Lithium Battery SOC

PI Name: Ambalavanan Jayaraman

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Abstract: LiB are used in personal electronic devices, e-bikes, tools, green-power storage and electric vehicles. Individual cells are commonly collected into packs or modules to provide the power required for automotive operation. The operational capability of the entire module can be heavily influenced by defects or poor performance of individual cells and is assessed through knowledge of the state-of-charge (SOC) at the cell and module levels. The SOC is also related to the batteries' state-of-health, and also determines the severity of thermal run-away events. Current methods of battery health and SOC are proprietary battery management systems (BMS), require destruction of the battery or are difficult to implement. To minimize damage caused by battery fires, or to prevent battery fires, a non-destructive sensor that can monitor LiB SOC during use and shipment is needed. In Phase I work, TDA Research has demonstrated such a sensor, based on readout of the magnetic field amplitude of battery cells using a field portable magnetometer. In Phase II, TDA will create a commercially available tool, SafeLi+on, so this new approach can be made widely available to battery transporters, warehouseers, and first responders.

Company Website: <https://tda.com/>



Newport Sensors, Inc. (New York, NY)

E-HazID - Integrated RFID, Sensing and Communication System for Safe Transportation of HAZMAT

PI Name: Masato Mizuta **PI Email:** info@newportsensors.com

Abstract: E-HazID represents a cutting-edge solution designed to address critical challenges of HAZMAT transportation: the insufficiency of physical labeling and the lack of timely incident alerts. Leveraging a network of compact, low-power, wireless RFID/sensor tags attached to HAZMAT packages, E-HazID enables authorized users to quickly access crucial HAZMAT information, track package location, monitor safety conditions in real time, and receive prompt notifications in the event of package compromise. This technology is applicable across all types of packaging and modes of transport. In Phase I, we successfully demonstrated technology feasibility by designing, constructing, and evaluating a prototype E-HazID system, featuring wireless tags equipped with novel microsensors capable of detecting gas and liquid leaks, temperature spikes, and package overturns. It also developed a reader device for connecting the sensors to the internet and a cloud server to enable remote monitoring, along with mobile applications. For Phase II, we aim to advance the E-HazID system by developing a beta version that offers enhanced versatility and durability under harsh operational conditions.

We will undertake comprehensive field testing, including nationwide shipping trials and user-led beta testing. Additionally, we will leverage the substantial data gathered by E-HazID sensors to create an AI-powered algorithm capable of analyzing incident patterns to issue accurate incident alerts and early warnings, thus promoting proactive risk management strategies. By validating E-HazID in real-world scenarios and showcasing its value to potential users, Phase II aims to lay a solid groundwork for the rapid commercialization of this pivotal safety technology.

Company Website: <https://www.newportsensors.com>



Aries Science & Technology, LLC (Westerville, OH)

Encapsulated Microbes for Bioremediation of Hazardous Material Spills

PI Name: Ramanathan Lalgudi

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Abstract: The current protocols for responding to HAZMAT spills have historically focused on containing and cleaning up the spill. While these methods have been effective in the short term, they do not provide a sustainable solution for treating or remediating the spill in the long term. Therefore, adopting sustainable bioremediation methods that align with DOT safety, climate change, and sustainability goals is crucial. In Phase I, we validated the feasibility of containing and bioremediating HAZMATs by encapsulating bacillus microbes in an absorbent material. Our Phase I project yielded a superior and differentiated product compared to what is currently available. As a result, there is immense potential for commercializing the Phase I product, which will benefit environmental remediation companies catering to DOT and other Federal, State, and local governments seeking eco-friendly bioremediation.

During Phase II, we will demonstrate scalability, assess product safety, conduct field tests by mimicking HAZMAT spill scenarios in land and water, and collect field data. By carrying out these activities, we can provide a more detailed assessment of the product's viability and effectiveness. This will enable us to develop a comprehensive and sustainable solution that meets the DOT goals.

Company Website: <https://ariesst.com/>



X-Biomedical Inc (Newtown Square, PA)

Development of a CO2 Breathing Anthropomorphic Test Device

PI Name: Matthew Maltese **PI Email:** maltese@x-biomedical.com

Abstract: Tragically, 936 children have died in hot cars since 1998. Wisely, the National Highway Traffic Safety Administration (NHTSA) has prioritized evaluation of sensor systems in vehicles for “the ability to detect unattended children and prevent heat stroke occurrence.” Recently, innovators have developed systems that detect children present in the vehicle by measuring carbon dioxide (CO₂) in the vehicle cabin, but there is no test method to assess whether or not these CO₂ sensor systems are working properly. Thus, the purpose of this project is to develop the CO₂ATD—a mannequin that exhales CO₂ in a manner similar to a 12 month old, or 3 or 6 year old child. The CO₂ATD itself, which is a humanoid structure of dimension and mass distribution of a human 12 month old, has an upper airway including nostrils and mouth similar to that of a human. The CO₂ATD inhales air from the cabin and exhales CO₂-enriched air to the cabin, at a breathing rate, tidal volume, and CO₂ concentration similar to the 12 month old or 3 or 6 year old child, as specified by the test technician. Breathing is accomplished in a “lung” that is connected to the CO₂ATD via a “trachea” that terminates at the nostrils/mouth.

Company Website: <https://goscopemicroscopes.com/>



Protection Engineering Consultants, LLC (Dripping Springs, TX)

Novel Design for Passenger Railcar Retention Systems Submission

PI Name: Eric Sammarco **PI Email:** esammarco@protection-consultants.com

Abstract: Additional passenger fatalities and injuries can occur in rollover-type derailment accidents due to failures of glazing retention mechanisms on passenger railcars. A key failure mode is shearing off the external rubber gasket that secures the glazing panes as the side of the railcar drags along the ground. Once the gasket fails, the glazing pane is pushed inside, leaving an opening from which passengers can be ejected, often fatally, out of the railcar.

During Phase I, the project team identified several design solutions for emergency and non-emergency railcar window applications. A “best” concept for each application was down-selected with the DOT for further investigation. High-fidelity finite element models of the two concepts were developed and it was demonstrated that the proposed designs perform better than the baseline window design used today.

Phase II research and development will establish proof-of-concept of the two novel window securement methods. This will be achieved through an experimental program involving tests on specimens replicating the railcar body in the vicinity of a window opening to determine the load to dislocate the glazing out of the railcar body frame. Testing will be complemented with high-fidelity analysis. Also, a roadmap for market delivery will be developed to guide commercialization activities.

Company Website: <https://www.protection-consultants.com/contact/>



CLR Analytics Inc. (Irvine, CA)

An Energy-efficient and Self-diagnostic Portable Edge-Computing Platform for Traffic Monitoring and Safety

PI Name: Lianyu Chu

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Abstract: This project aims to develop an energy-efficient and self-diagnostic portable traffic monitoring system utilizing AI-based edge computing technologies. The system, named ThermoVision Edge, addresses specific technical challenges encountered in Intelligent Transportation System (ITS) applications, including comprehensive sensor integration, efficient data processing and information extraction, sustainability in remote areas, customizability, retrofitting existing infrastructure, and accommodating varying environmental and weather conditions. Designed for low power consumption, it can be supplemented with solar energy and features a self-diagnostic function to ensure reliability. This system is engineered to provide in-depth traffic insights with minimal human oversight, aiming to enhance transportation infrastructure management. In Phase I, the evaluation of prototype edge-computing devices and the creation of an energy-efficient hybrid camera prototype for vehicle and micromobility classification using both visible and thermal video data showcased promising results. Phase II will focus on fully developing, deploying, and commercializing the ThermoVision Edge system, which utilizes deep-learning models to classify vehicles, detect Vulnerable Road Users (VRU), identify stopped vehicles, recognize conflict events, and identify pavement and environmental conditions. This will be achieved by successfully demonstrating its operation and evaluating its performance in three States.

Company Website: <http://www.clr-analytics.com/about/>



TDA Research, Inc. (Wheat Ridge, CO)

A Low-Cost High-Capacity Portable Stormwater Treatment System for Emerging Contaminants

PI Name: Ambalavanan Jayaraman

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Abstract: Innovative self-contained portable stormwater treatment systems are needed to reduce the impact of highways on streams and other waters; recreation facilities; and habitat by capturing contaminants of emerging concern (CECs). The primary pollutant of concern is the 6PPD-quinone (6PPD-q), which is an automobile tire by-product that finds its way into storm water and has been reported to be killing Coho salmon in the Pacific Northwest. Research suggests that it is among the most toxic chemicals known for aquatic organisms with Coho mortality occurring at ~0.1 ppb.

Phase I TDA Research, in partnership with Fabco Industries, demonstrated the feasibility of a portable stormwater treatment system based on TDA's novel composite sorbent that removes 6PPD-q and PFAS (per and polyfluoroalkyl substances) from stormwater down to less than 0.1 ppb (100 ppt). In Phase II we will continue working with Fabco Industries to further develop, fabricate, and test a prototype based on their StormSafe multifilter cartridge-based filtration technology that incorporates TDA's sorbents to remove 6PPD-q and other contaminants from stormwater. We will then complete independent, third-party evaluations of the full-scale device using simulated runoff events and then test it in actual stormwater management applications.

Company Website: <https://tda.com/>



Fagan Consulting (Prattville, AL)

Development of a Self-Contained Electro-Flocculation Device to Achieve Stormwater and Water Quality Goals

PI Name: Barry Fagan **PI Email:** barry@faganllc.com

Abstract: Goals of the Clean Water Act (CWA) included the protection and restoration of U.S. waters with deadlines that passed over 40 years ago. Today, over half of assessed U.S. waters remain too polluted to support their designated uses. Stormwater runoff carrying sediment and other pollutants is identified as a leading contributor to these impairments. Removal of sediment from stormwater by chemical flocculation has become an accepted best management practice in many areas. However, many State DOTs, regulators, and other environmental advocates are reluctant to allow the use of chemicals for stormwater treatment due to the known and unknown potential for associated negative environmental impacts.

Chemical-free electrical flocculation for stormwater treatment was explored by Fagan Consulting LLC and Auburn University under a U.S. DOT SBIR Phase I contract and with supplemental funding provided by Innovate Alabama. The work resulted in the development of a full-scale electric floc generator and a significant advancement in stormwater management technology.

Phase II efforts build on the work of Phase I to evaluate, verify, refine, and establish the CleanCurrent Floc Generator as a commercially available, chemical-free, portable, scalable, and cost-effective solution to effectively remove pollutants commonly found in stormwater runoff from construction sites and urban environments.

Company Website: <https://faganllc.com/about>

