NASA STTR-2024-Phase 1 Solicitation

Proposal Details

Proposal Number: T1.15-1017
Subtopic Title: Alternative Design Approaches for High Heat Flux Detonation Engines
Proposal Title: Innovative Design Solutions Enabling Refractory Materials for Detonation Engines

Small Business Concern

Firm: Plus Designs, Inc.
Address: 1220 Valley Forge Rd, Phoenixville, PA, 19460-2676
Phone: 610-513-6845

Principal Investigator

Name: Joseph Pluscauskis
E-mail: joseph.pluscauskis@plusdesignsinc.com
Address: 1220 Valley Forge Rd, Phoenixville, PA, 19460-2676
Phone: 610-513-6845

Business Official

Name: Joseph + Pluscauskis
E-mail: joseph.pluscauskis@plusdesignsinc.com
Address: 1220 Valley Forge Rd, Phoenixville, PA, 19460-2676
Phone: 610-513-6845

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 6 - 7
Technical Abstract (Limit 2000 characters):

Rotating Detonation Rocket Engines (RDREs) are of interest in aerospace and defense applications because they rely on detonation, as opposed to deflagration. In detonation, or pressure gain combustion, the flame is supersonic, and heat is released through a pressure gain and release cycle that is characteristically time varying in both temperature and pressure. An often unappreciated system benefit arises from how compact the hot flow-path can become due to the localization of combustion and its relative robustness for a range of inlet conditions. This compressed flowpath becomes a SWAP benefit that can be taken advantage of in several ways, such as increased space for fuel to enhance system range. This proposal addresses the design, analysis, and fabrication demonstration of innovative design solutions enabling non-eroding refractory materials for detonation engines, which is considered a step towards developing a reusable high heat flux rotating detonation rocket engine. This technology will offer significantly higher maximum use temperature and improved thermal-chemical resistance when compared to the current copper-based materials. This advanced concept will be demonstrated during the Phase I work plan by completing tasks related to: define design requirements; selection of materials and property database development; design and analysis; fabrication of simple demonstration hardware; and reporting and deliverables. The importance of this proposed effort is offering more robust RDRE components that allow for longer lifetimes, less testing down time, and more aggressive testing conditions. Furthermore, relative to the current state-of-the-art, the concepts determined in this effort will offer a non-eroding hot-walled materials solution that will not require any active cooling; thereby, eliminating the complexity and additional weight penalties associated with the use of ancillary pumps, manifolds, and tubing needed to provide the cooling fluid.

Duration: 13

Proposal Details

Proposal Number: T1.15-1028
Subtopic Title: Alternative Design Approaches for High Heat Flux Detonation Engines
Proposal Title: Next-generation Enabling, eXtreme Temperature RDRE

Small Business Concern

Firm: Quadrus Corporation
Address: 200 Clinton Ave W, Huntsville, AL, 35801-4933
Phone: 256-327-3410

Principal Investigator

Name: Stephen Cooke
E-mail: scooke@quadruscorp.com
Address: 200 Clinton Ave W, Huntsville, AL, 35801-4933
Phone: 256-801-3125

Business Official

Name: Claire + D'az
E-mail: cdaz@quadruscorp.com
Address: 5014 Pulaski Pike, Huntsville, AL, 35810-1716
Phone: 256-327-3410

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 4
Technical Abstract (Limit 2000 characters):

Quadrus Corporation’s Advanced Manufacturing Division (AMD) and our STTR partner University of Alabama in Huntsville (UAH) is pleased to present this proposal for demonstrating feasibility in an advanced rotating detonation rocket engine (RDRE) we call the Next-generation Enabling, eXtreme Temperature RDRE (NEXT-RDRE). NEXT-RDRE uses a clever combination of rhenium, C103, and Ti-6Al-4V to enable a lightweight chamber design that can operate with exceedingly high local wall temperatures. Rhenium is used in the hottest portions of the centerbody, outer body, and cowl/nozzle, because its melting point is 3,182°C (5,759°F). Even though rhenium is extremely strong at elevated temperatures, it is also extremely dense; being just over 21 g/cm3, it is more than 2-1/2 times denser than Inconel 718. Thus, NEXT-RDRE uses rhenium only where necessary, transitioning first to C103 niobium alloy and then to Ti-6Al-4V, as wall temperatures and heat fluxes allow. The design takes advantage of our experience with bimetallic laser powder bed fusion (L-PBF), diffusion bonding of refractory metals, and lightweight lattice structures in a manner that makes it weight competitive with ceramic matrix composite (CMC) designs. Our Phase I focuses on enabling high temperature, multi-material manufacturing techniques, so that multiple material combinations can be used at various strategic locations in the RDRE geometry. Sensitivity to hot oxidizing species is nearly universal for materials, but especially for nearly all refractory materials, so NEXT-RDRE includes a proven next-generation environmental barrier coating (EBC) to protect the underlying substrate materials. Our EBC consists of a thin layer of ruthenium between the substrate and the outer layer of hafnia, HfO2. Since hafnia, which is nearly as refractory as rhenium itself (m.p. 2,758°C), is already in an oxidized state, it naturally protects the substrate from oxidizing combustion products like O2, O, CO, OH-, and H2O.

Duration: 13

Proposal Details

Proposal Number: T1.15-1030
Subtopic Title: Alternative Design Approaches for High Heat Flux Detonation Engines
Proposal Title: Refractory Metals and Advanced Coatings for Radiatively Cooled RDREs

Small Business Concern

Firm: Agile Space Industries, Inc
Address: 1514 Main Ave, Durango, CO, 81301-5143
Phone: 303-587-7467

Principal Investigator

Name: Benjamin Graybill
E-mail: benjamin.graybill@agilespaceindustries.com
Address: 1514 Main Ave, Durango, Colorado, 81301-5143
Phone: 303-587-7467

Business Official

Name: Will + Francis
E-mail: will.francis@agilespaceindustries.com
Address: 1514 Main Ave, Durango, CO, 81301-5143
Phone: 303-587-7467

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 3
Technical Abstract (Limit 2000 characters):

The development of combustion chambers and nozzles for a Rotating Detonation Rocket Engine (RDRE) is currently a difficult endeavor. Some factors contributing to this difficulty are the analytical determination of heat fluxes, limited survivability of existing materials in the environment of an RDRE, and the design complexity of regenerative cooling necessitated by the materials limits. The team of Agile Space

Industries and MIT plan to holistically address these challenges during the Phase I effort, where RDRE thermal analysis codes developed at MIT will be adopted by the Agile Space Industries team. These codes will inform the design of a combustion chamber and nozzle for an RDRE injector already designed by UCLA with assistance from The Aerospace Corporation who will be subcontractors to the effort. To eliminate the need for regenerative cooling, the Agile Space Industries team will demonstrate the suitability of higher temperature refractory metal alloy for the metal laser powder bed fusion (LB-PBF) additive manufacturing process. This effort will yield the design of an RDRE manufactured using Niobium C129Y, establishing the basis for continued full-scale product development during a Phase II.

Duration: 13

Proposal Details

Proposal Number: T1.15-1037
Subtopic Title: Alternative Design Approaches for High Heat Flux Detonation Engines
Proposal Title: Multi-parameter measurements for thermal shock and thermo-mechanical loading in RDREs

Small Business Concern

Firm: Spectral Energies, LLC
Address: 4065 Executive Dr, Beavercreek, OH, 45430-1062
Phone: 937-266-9570

Principal Investigator

Name: Christopher Fugger
E-mail: chris.fugger@spectralenergies.com
Address: 4065 Executive Dr, Beavercreek, OH, 45430-1062
Phone: 937-256-7733

Business Official

Name: Sukesh + Roy

E-mail: admin1@spectralenergies.com
Address: 4065 Executive Dr, Beavercreek, OH, 45430-1062
Phone: 937-902-6546

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 3 - 4
Technical Abstract (Limit 2000 characters):

Traditional thermal management methods used in rocket combustion systems are not readily applicable in the RDRE framework due to the higher cooling load demands from the same propellant feed system. Therefore, significant research and development efforts are essential for RDRE thermal management. Specifically, heat-flux loads, as obtained through traditional calorimeter data, face challenges in the RDRE framework due to axial variations in reactant stratification, detonation wave riding near the outer wall, and high periodic heat-fluxes. The high heat-flux density also presents challenges in providing optical access for diagnostic evaluations of various unsteady interactions in RDREs, essential for a physics-based understanding through the use of optical diagnostics. The proposed work here aims to understand these complicated questions with a suite of temporally and spatially resolved diagnostics and the experience to make these detailed measurements in such harsh environments.

Duration: 13

Proposal Details

Proposal Number: T3.04-1005
Subtopic Title: Advanced Low-Temperature Secondary Batteries
Proposal Title: Rechargeable batteries for improved low-temperature performance based on alloy anodes

Small Business Concern

Firm: Wecoso, Inc.
Address: 17682 Gothard Street, Huntington Beach, CA, 92647-6251
Phone: 714-587-4628

Principal Investigator

Name: Carl Kirkconnell
E-mail: carlk@wecoso.com
Address: 17682 Gothard Street, Huntington Beach, CA, 92647-6251
Phone: 714-587-4628

Business Official

Name: Carl + Kirkconnell
E-mail: carlk@wecoso.com
Address: 17682 Gothard Street, Huntington Beach, CA, 92647-6251
Phone: 714-587-4628

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 3
Technical Abstract (Limit 2000 characters):

West Coast Solutions (WCS) and the Georgia Institute of Technology (GT) have teamed to propose the Rechargeable Batteries for Improved Low-Temperature Performance based on Alloy Anodes Program. The proposed approach to achieving the required energy and temperature metrics in this program involves combining high energy lithium and sodium-ion battery components into full cells that to date have been used in isolation from each other at low temperatures. These materials and electrolytes have higher specific capacities than those used in commercial lithium-ion chemistries and/or have demonstrated impressive electrochemical performance at and below -40 ºC. Together, they show great promise for meeting metrics of high energy density at room temperature (> 300 Wh/kg) with the ability to cycle at extreme low temperatures (-80 ºC). The secondary thrust of the proposed effort is battery packaging, with a particular Phase I focus on thermal management given the inherent challenge of achieving a functioning cell at -80 ºC. Even with the projected improvements at low temperature obtained through the proposed lithium and sodium-ion combination, it will still be advantageous to limit operation at extremely cold temperatures to improve cycle life and to implement techniques to leverage self-heating to increase the core temperature off the lower limits. WCS has identified several promising technologies including variable conductance heat pipes (VCHP), thermal switches, and freeze-tolerant radiators. These and other thermal management technologies will be explored in a system context, along with the development of a notional BMS feature set, to identify the optimum battery system implementation approach for the developed cell technology.

Duration: 9

Proposal Details

Proposal Number: T3.04-1009
Subtopic Title: Advanced Low-Temperature Secondary Batteries
Proposal Title: High-Frequency AC Heating of Batteries in Extreme Cold Environments

Small Business Concern

Firm: Omnitek Partners LLC
Address: 85 AIR PARK DR, RONKONKOMA, New York, 11779-9207
Phone: 570-236-7479

Principal Investigator

Name: Jahangir Rastegar
E-mail: j.rastegar@omnitekpartners.com
Address: 85 Air Park Drive, Ronkonkoma, NY, 11779-9207
Phone: 631-665-4008

Business Official

Name: Jahangir + Rastegar
E-mail: j.rastegar@omnitekpartners.com
Address: 85 Air Park Drive, Ronkonkoma, NY, 11779-9207
Phone: 631-665-4008

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 3 - 5
Technical Abstract (Limit 2000 characters):

The low temperature environment of the lunar surface and the long duration of the lunar nights (~14 days) require batteries to integrate ancillary thermal management systems to maintain an optimum operational temperature range. Current battery heating methods are heavy, bulky, and thermally inefficient. Here we present an innovative technology that uses high-frequency AC current to heat-up the battery's liquid electrolyte directly and uniformly with the least amount of electrical energy, as

compared to the currently available technologies (e.g. external convection heating, internal resistive elements, battery self-heating, etc). The implementation of the system does not require modification or replacement of any internal components of the existing batteries since the external high AC frequency circuitry can be integrated into the battery management system (BMS) electronics. Our technology has been experimentally demonstrated by enabling commercial off-the-shelf Li-ion batteries operate at their optimum operating range in extremely cold environments (< -60C), delivering 100% of their nominal storage capacity and cycling life expectancy. The objective of the proposed project is to develop a robust electrical energy storage technology that can be readily integrated into the battery systems powering NASA's space missions for operation in extreme cold environments. The main goal of the Phase I work is to further develop and experimentally validate Omnitek's proprietary high-frequency AC heating technology to enable the use of lithium-ion battery cells in ultra-low temperature environments. Omnitek's thermal management technology is applicable to any existing electrochemical energy storage device containing an electrolyte. These include primary or rechargeable batteries and supercapacitors. This innovation can quickly and safely condition batteries to their optimum temperature operating range enabling top charge/discharge performance and long cycling life.

Duration: 13

Proposal Details

Proposal Number: T3.04-1015
Subtopic Title: Advanced Low-Temperature Secondary Batteries
Proposal Title: Advanced Low-Temperature Capable Polymer Composite Electrolyte, Semi Solid-State Battery

Small Business Concern

Firm: SOLID ENERGIES INC
Address: 985 E. ORANGEFAIR LANE, ANAHEIM, California, 92801-1104
Phone: 714-770-0064

Principal Investigator

Name: ZHIGANG LIN
E-mail: contact@solidenergies.com
Address: 985 E. ORANGEFAIR LANE, ANAHEIM, CA, 92801-1104

Phone: 714-770-0064

Business Official

Name: ZHIGANG + LIN
E-mail: contact@solidenergies.com
Address: 985 E. ORANGEFAIR LANE, ANAHEIM, CA, 92801-1104
Phone: 714-770-0064

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 3 - 7
Technical Abstract (Limit 2000 characters):

Solid Energies Inc. (SEI) (www.solidenergies.com) in team with the University of South Dakota proposes to provide reliable, high-performing secondary battery technologies for sustained operation and survivability in low-temperature lunar conditions. The harsh, low-temperature environment of the lunar surface presents unique challenges for providing reliable surface power. Advanced cells with lower temperature capability reduce the need for ancillary thermal management, which would reduce system mass /volume, enable longer mission durations, and enhance our capabilities throughout a sustained human presence. The goal is to create highly versatile, stretchable, and shape changing batteries that benefit both NASA's Moon to Mars initiative and planetary science missions to the outer solar system. These batteries possess unique qualities, such as the ability to withstand extreme temperatures and fit securely into tight or irregular spaces without compromising safety. It is built upon a high-voltage capable, multifunctional, polymer composite solid-state electrolyte (SSE), which offers high ionic conductivity to facilitates charge transfer and excellent electrochemical/ chemical stability over an extreme range of temperatures (-80℃ to 90℃). This class of SSE enable the use of (1) Li-ion anodes through a resilient interface control, and (2) 5V class high-voltage cathode materials, for instance, Co-free, low-cost LiNi0.5Mn1.5O2 (LNMO) with high operating potential (~4.7 V vs. Li/Li+) that is normally outside the window of liquid electrolytes used in current Li-ion batteries (LiBs). In addition, the proposed ASSB cells will employ the patented designs of electrolyte-infiltrated composite cathode and co-curable multilayer cell structure that (1) enables the formation of a 3-dimension networking electrolyte to minimize the interface resistance and (2) allows the ASSB to be manufactured with a low-cost, roll-to-roll process compatible with the current production of LiBs.

Duration: 12

Proposal Details

Proposal Number: T3.04-1019
Subtopic Title: Advanced Low-Temperature Secondary Batteries
Proposal Title: Development of High-Voltage Cryogenic Secondary Li-Metal Batteries Suitable for Temperatures Below -80°C

Small Business Concern

Firm: ATSP Innovations, Inc.
Address: 6762 Shadyvilla Lane, Houston, TX, 77055-5237
Phone: 832-808-1176

Principal Investigator

Name: Ahmad Amiri
E-mail: ahmad-amiri@utulsa.edu
Address: 800 South Tucker Drive, Tulsa, OK, 74104-3189
Phone: 979-204-2146

Business Official

Name: Jacob + Meyer
E-mail: jacob.l.meyer@atspinnovations.com
Address: 6762 Shadyvilla Lane, Houston, TX, 77055-5237
Phone: 832-808-1176

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 4
Technical Abstract (Limit 2000 characters):

This proposal addresses the development of advanced low-temperature secondary batteries capable of operating below -80°C with high specific energy density, targeting subtopic S13.06. Despite recent progress in extending the operational temperatures of Li metal battery systems to very low ranges, the mechanisms behind their poor cold-weather performance remain poorly understood. This project aims to fill this gap by developing secondary battery technologies that can reliably function in the extreme cold conditions of the lunar surface, essential for supporting long-term lunar missions. The proposed approach involves the development of a new Li-metal battery with a novel anti-freezing electrolyte and capable of high voltage operation (~4.8 V), an engineered cathode, and Li foil anode materials. The electrolyte strategy focuses on dissolving fluorinated carbonate electrolytes in stable, non-polar solvents to reduce

solvent-Li-ion affinity. Preliminary results show promising characteristics across a broad temperature range from -80 to +50°C, including high ionic conductivity and electrochemical stability. Proposed deliverables include synthesized electrolytes with tailored properties, comprehensive material characterization reports, fabricated prototype batteries, and electrochemical measurement data under simulated lunar conditions.

Duration: 13

Proposal Details

Proposal Number: T6.09-1001
Subtopic Title: Human-Autonomous System Integration for Deep Space Tactical Anomaly Response in Smart Habitats
Proposal Title: SOSHA – Sensor Optimization for Space Habitat Awareness

Small Business Concern

Firm: Space Lab Technologies, LLC
Address: 5455 Spine Rd, Boulder, CO, 80301-0000
Phone: 720-309-8475

Principal Investigator

Name: Christine Escobar
E-mail: chris@spacelabtech.com
Address: 5455 Spine Rd, Boulder, , 80301-0000
Phone: 720-309-8475

Business Official

Name: Christine + Escobar
E-mail: chris@spacelabtech.com
Address: 5455 Spine Rd, Boulder, , 80301-0000
Phone: 720-309-8475

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 4
Technical Abstract (Limit 2000 characters):

Deep space habitats must provide a functional, hospitable, and safe environment with and without crew onboard. This will require Earth independent operation during periods of intermittent crew occupancy and reduced mission control support due to communication delays and data bandwidth limits. NASA needs advanced systems engineering tools to develop and operate integrated autonomous fault management (FM) capabilities. Sensor network (SN) design and tools for FM systems verification and validation (V&V) are critical gaps. The optimal combination, density, and placement of sensors for fault detection and diagnosis and communicating spacecraft state in complex, dynamic, integrated subsystems may be difficult to ascertain from a large SN design space. Model-based systems engineering (MBSE) tools can help to reduce design space complexity, facilitate sensor suite optimization (SSO), and evaluate FM system performance, thus improving the safety, effectiveness, and cost of autonomous FM system development. Space Lab, in collaboration with the University of Colorado at Boulder, proposes the Sensor Optimization for Space Habitat Awareness (SOSHA™), an MBSE tool to support the design, verification, and validation of sensor networks and algorithms employed by smart habitat FM systems. SOSHA will be a major step towards autonomous systems development for Earth-independent spacecraft operation. The design is also readily transferable to terrestrial applications, including the management of industrial internets of things (IIoT) for industrial process monitoring. The Phase I project goal is to demonstrate SOSHA proof of concept. Objectives are to 1) Demonstrate critical functions in an autonomous SSO process; 2) Investigate feasibility of non-critical, low TRL SOSHA functions; and 3) Plan for V&V of high-fidelity SOSHA prototype. Through conceptual design, breadboard prototype demonstration, and high-fidelity V&V planning, the proposed project will raise SOSHA TRL from 2 to 4.

Duration: 13

Proposal Details

Proposal Number: T6.09-1003
Subtopic Title: Human-Autonomous System Integration for Deep Space Tactical Anomaly Response in Smart Habitats
Proposal Title: Cognitive Systems Engineering (CSE) Methods to Support Adaptive, Integrated Anomaly Response

Small Business Concern

Firm: Applied Decision Science, LLC
Address: 1776 Mentor Avenue, Cincinnati, OH, 45212-3596
Phone: 513-607-8268

Principal Investigator

Name: Laura Militello
E-mail: l.militello@applieddecisionscience.com
Address: 1776 Mentor Avenue, Cincinnati, Ohio, 45212-3596
Phone: 937-602-7844

Business Official

Name: Heather + Kinsman
E-mail: h.kinsman@applieddecisionscience.com
Address: 1776 Mentor Avenue, Cincinnati, OH, 45212-3596
Phone: 513-833-6626

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 1 - 2
Technical Abstract (Limit 2000 characters):

The proposed project aims to tailor cognitive systems engineering methods to support the design of Fault Detection, Isolation, and Recovery (FDIR) capabilities intended for remote smart habitats and NASA's Moon to Mars initiative. We will adapt the Integrated Cognitive Analysis for Human-Machine Teaming (ICA-HMT) strategy, developed and exercised previously as part of the Army's Future Vertical Lift program to understand the envisioned world for future rotorcraft that leverages advanced automation and operates in dynamic, time-critical and high-risk contexts. For this project, we will conduct an in-depth Cognitive Task Analysis (CTA) to understand and document the envisioned world of remote smart habitats and identify cognitive requirements associated with deep space operational challenges such as intermittently occupied smart habitats, limited communications bandwidth, and significant communication latencies. CTA findings will be used to generate design recommendations for integrated human-autonomy system configurations that can then be evaluated using Work Models that Compute (WMC), a modeling and simulation framework. WMC is designed to model elements of collective work such as workload, interdependencies, and tradeoffs, incorporating macrocognitive aspects of the work that are not easily observed (e.g., sensemaking, decision making). We further propose the design of visualizations that enable developers to "what-if" and explore tradeoffs between different teaming configurations. Phase I objectives include identifying high-consequence FDIR use cases, extending WMC to include the cognitive aspects of the work that enable modeling of various integrated human-autonomy teaming

configurations, and assessing feasibility of the proposed approach. This team includes Applied Decision Science, experts in cognitive task analysis; Dr. Martijn Ijtmsa of the Ohio State University, expert in WMC; and former astronaut James ‘Mash’ Dutton.

Duration: 13

Proposal Details

Proposal Number: T6.09-1008
Subtopic Title: Human-Autonomous System Integration for Deep Space Tactical Anomaly Response in Smart Habitats
Proposal Title: Model-Driven Deep Graph Learning for Risk-Aware Anomaly Response

Small Business Concern

Firm: Elder Research, Inc.
Address: 701 E Water St Ste 103, CHARLOTTESVILLE, Virginia, 22902-5499
Phone: 434-973-7673

Principal Investigator

Name: Michael Fowler
E-mail: michael.fowler@elderresearch.com
Address: 701 E Water St Ste 103, CHARLOTTESVILLE, Virginia, 22902-5499
Phone: 434-973-7673

Business Official

Name: Debbie + Owen
E-mail: debbie.owen@elderresearch.com
Address: 701 E Water St Ste 103, CHARLOTTESVILLE, VA, 22902-5499
Phone: 434-973-7673

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 3
Technical Abstract (Limit 2000 characters):

Future deep space habits will require resilient and autonomous operations that have a holistic understanding of the systems contained within. The HOME team stated that a fundamentally disruptive approach is required to safely perform human-exploration driven by a holistic perspective on systems across a wide range of domains. Our approach addresses the critical area of balancing human and autonomous system intervention by leveraging the capabilities inherent in model-based systems engineering (MBSE) to understand the complexity of a fault or anomaly to the mission and the safety of the astronauts. By having a systems perspective on the FDIR, a more cohesive story can be presented to astronauts, including potentiality of cascading failures, recommended courses of action, time to failure predictions, and other human factors in risk analysis. To address the need for holistic understanding, we leverage an ensemble approach that combines MBSE, graphical models, probabilistic graphical models, semantic learning, and decision theory to provide anomaly response and fault action impacts. Our innovative approach disaggregates the problem into three components: 1. Model-based systems engineering and semantic understanding that gathers all the design information, model parameters, interrelations from the systems' models and expands their context with semantic understanding of the taxonomies and classifications of components. 2. Online Guided Deep Structure Learning provides the fault propagation modeling of the entire system that is guided by a priori information about the system from the system model but learns the real characteristics of the sensors and their interdependencies through physics-informed online learning. 3. Risk-aware Anomaly Response is the final module that makes decisions based upon actual relationships and an understanding of the impact a decision will have across the entire system, the mission, and any safety concerns.

Duration: 12

Proposal Details

Proposal Number: T7.04-1005
Subtopic Title: Lunar Surface Site Preparation
Proposal Title: Foundation Design and Seismic Protection of Lunar Infrastructure Utilizing Bulk Regolith

Small Business Concern

Firm: Slate Geotechnical Consultants, Inc.
Address: 5727 Claremont Ave, Oakland, California, 94618-1279

Phone: 510-277-3325

Principal Investigator

Name: Christopher Dreyer
E-mail: cdreyer@mines.edu
Address: 1310 Maple Street, Golden, CO, 80401
Phone: 303-273-3890

Business Official

Name: Debra + Murphy
E-mail: dmurphy@slategeotech.com
Address: 5727 Claremont Ave, Oakland, CA, 94618-1279
Phone: 510-277-3325

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 1 - 4
Technical Abstract (Limit 2000 characters):

As a part of NASA's Artemis program to establish a long-term human presence on the Moon, NASA will need to design and construct surface infrastructure to enable lunar exploration and science. Our proposed project will use the limited lunar seismicity data to develop a prediction model for seismic loading. The seismic model will be used in conjunction with analysis, testing, and engineering design to establish preliminary design criteria, procedures, and ConOps for seismic protection systems leveraging bulk regolith. This proposed work will target the civil, geotechnical, and structural engineering markets and further the state-of-the-art of lunar foundation engineering and seismic resilience of infrastructure and structures. This includes testing of geotechnical properties, an evaluation of surface preparation efficiency, determination of lateral loading conditions of bulk regolith infrastructure, designing and assessing infrastructure for the anticipated loading conditions to understand the structural response, and testing of scaled prototype protection systems using a shake table in TRL 4 environments. Protection of lunar surface infrastructure elements from seismic activity (moonquakes) is paramount to ensure system survival, resilience, mission objectives, and life safety. While terrestrial civil engineering design will provide a baseline for lunar building and construction, new models need to be developed and tested to ensure appropriate resilience of lunar infrastructure, structures, and other mission assets. Potential applications of the innovations addressed through this proposal include the planned Artemis basecamp, other private endeavors to the lunar surface, and assistance in the drafting of the American Society of Civil Engineers Lunar Infrastructure Engineering, Design, Analysis, and Construction guidelines.

Duration: 13

Proposal Details

Proposal Number: T7.04-1006
Subtopic Title: Lunar Surface Site Preparation
Proposal Title: Shear Strength Enhancement for Autonomous Regolith Preparation (SHEARPREP)

Small Business Concern

Firm: Cislune Inc.
Address: 301 N Almansor St, Alhambra, CA, 91801-2644
Phone: 661-390-1060

Principal Investigator

Name: Erik Franks
E-mail: erik@cislune.com
Address: 301 N Almansor St, Alhambra, CA, 91801-2644
Phone: 661-390-1060

Business Official

Name: Erik + Franks
E-mail: erik@cislune.com
Address: 301 N Almansor St, Alhambra, CA, 91801-2644
Phone: 661-390-1060

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 3
Technical Abstract (Limit 2000 characters):

Cislune Inc., in collaboration with the University of Central Florida (UCF), proposes the SHEARPREP project aimed at enhancing lunar surface preparation for infrastructure development through the innovation of electrostatic concrete technology. This technology leverages in-situ lunar regolith to create structures with improved shear strength, utilizing a unique process that requires no imported materials and minimal energy. The Phase I STTR funding will be dedicated to testing the shear strength of various electrostatic concrete mixtures in a vacuum environment, optimizing the mix for maximum compacted strength. The project focuses on applications critical to lunar exploration, including launch/landing zones, blast protection structures, and pathways, thereby directly supporting NASA's vision for sustainable lunar infrastructure. SHEARPREP's approach combines geotechnical investigation, advanced material science, and robotic construction concepts, intending to minimize lunar surface disturbance and maximize utilization of lunar resources. The project's target market encompasses NASA's lunar exploration initiatives, commercial lunar payload services, and international lunar exploration missions, positioning it as a pivotal technology for the establishment of a sustainable human presence on the Moon. Through this endeavor, Cislune Inc. aims to address critical gaps in lunar construction technology, transitioning from low TRL concepts to practical, deployable solutions for lunar surface operations and infrastructure development.

Duration: 13

Proposal Details

Proposal Number: T7.04-1010
Subtopic Title: Lunar Surface Site Preparation
Proposal Title: Deployable Surface Cover for Lunar Surface Operations During Launch and Landing

Small Business Concern

Firm: Astroport Space Technologies, Inc
Address: 110 E. Houston Street 3FL, San Antonio, TX, 78205-2990
Phone: 210-404-2981

Principal Investigator

Name: Sam Ximenes
E-mail: sam@astroportspace.com
Address: 110 E. Houston Street 3FL, San Antonio, TX, 78205-2990

Phone: 210-404-2981

Business Official

Name: Sam + Ximenes
E-mail: sam@astroportspace.com
Address: 110 E. Houston Street 3FL, San Antonio, TX, 78205-2990
Phone: 210-404-2981

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 3 - 4
Technical Abstract (Limit 2000 characters):

Our proposed effort focuses on a solution for dust plume blast mitigation during landing that can be deployed in the near term temporarily for early lunar missions. Specifically, we leverage a fabric-based ultralight matting system being developed by Astroport and its team of subcontract partners for U.S. military expeditionary landing surfaces in terrestrial Point-to-Point rocket cargo remote environments landings. For this NASA Phase 1 STTR, we research modifications needed for applying our novel thermal shielding coating technique to a textile substrate material to increase thermal tolerance and strength for the lunar environment. We then assess packaging and installation options for autonomous robotic deployment on the lunar surface. The project will conclude in Phase 2 with ground tests of a prototype matting system to demonstrate key operational characteristics in a simulated lunar environment. Although the fabric can be employed in a variety of applications for mitigating lunar surface dust control and containment, our research will focus on viability of two specific use cases relevant to NASA investments in our concept of operations (ConOps) for LLP infrastructure construction: (1) rocket plume blast mitigation during the return launch of a lunar lander from the unimproved surface at the initial landing spot where excavation and construction machinery were delivered and offloaded; and (2) use as a covering to stabilize and mitigate surface ablation of our LLP brick material pavement

Duration: 9

Proposal Details

Proposal Number: T7.04-1011
Subtopic Title: Lunar Surface Site Preparation

Proposal Title: Optimization of Lunar Materials for Launch and Landing Pads

Small Business Concern

Firm: Blueshift, LLC
Address: 155 Commerce St, Broomfield, CO, 80020-2243
Phone: 850-445-3431

Principal Investigator

Name: Nima Goudarzi
E-mail: ngoudarzi@outward.tech
Address: 155 Commerce St, Broomfield, CO, 80020-2243
Phone: 850-445-3431

Business Official

Name: Ryan + Garvey
E-mail: rgarvey@outward.tech
Address: 155 Commerce St, Broomfield, CO, 80020-2243
Phone: 850-445-3431

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 4
Technical Abstract (Limit 2000 characters):

Blueshift, LLC doing business as Outward Technologies in partnership with the Colorado School of Mines propose to develop a launch and landing pad design tool for identifying optimal geometries, materials, and configurations of landing pads, landing pad aprons, and berms constructed from bulk regolith while minimizing the amount of robotic hardware and materials that are required to be launched from Earth. Preliminary design criteria have been established which capture traditional civil engineering design concepts applied to the lunar environment. This approach has yielded a promising berm design which may be used to mitigate high-speed ejecta while eliminating complex collisions and deflected ejecta particles. While these concepts have been developed from a strong theoretical basis, additional numerical and experimental results are required to further validate the use of these bulk regolith structures in minimizing the risk posed to critical infrastructure and equipment by high-speed ejecta during lunar launches and landings. In support of these goals, high-fidelity plume surface interaction models previously developed by Outward Technologies through a NASA SBIR Phase I and pending Phase II project will be integrated into a

streamlined Launch and Landing Pad Design Tool (LLPDT) capable of simulating various pad, pad apron, and berm geometries, materials, and configurations. These proposed Phase I efforts will lead to a comprehensive design and evaluation tool for assessing various configurations of bulk regolith structures composing launch/landing pads, pad aprons, and berms. Colorado School of Mines will be relied upon in these efforts to help guide the assessment of various berm geometries and construction methods to identify candidate LLP and berm configurations which score favorably using the LLPDT in Phase I.

Duration: 13

Proposal Details

Proposal Number: T7.05-1006
Subtopic Title: Climate Enhancing Resource Utilization
Proposal Title: Efficient, High Performance Solid Oxide Electrolysis Cell for Hydrogen Production

Small Business Concern

Firm: OxEon Energy, LLC
Address: 257 River Bend Way, North Salt Lake, UT, 84054-2986
Phone: 801-677-3002

Principal Investigator

Name: Jenna Pike
E-mail: jenna@oxeonenergy.com
Address: 257 River Bend Way, North Salt Lake, UT, 84054-2986
Phone: 801-677-3423

Business Official

Name: S (Elango) + Elangovan
E-mail: elango@OxEonEnergy.com
Address: 257 River Bend Way, STE 300, North Salt Lake, UT, 84054-2986

Phone: 801-677-3002

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 3 - 4
Technical Abstract (Limit 2000 characters):

The objectives of the proposed work are to increase efficiency, specific power, and specific volume of solid oxide electrolysis cells (SOEC) via performance improvements. Two approaches are proposed: (1) reducing the electrolyte thickness, and (2) using a rapid prototyping technology to create and validate optimal microstructures and compositional grading previously identified, via modeling and experimental work, to show a reduction in electrode resistance. The project goal is to improve SOEC current density at a given voltage by over 60%, which enables technological advances in electrolysis that enhance ISRU capabilities to produce power and propulsion consumables from lunar and martian carbon- or hydrogen-containing resources. For terrestrial applications, the project addresses climate concerns by enabling commercial deployment of hydrogen and synthesis gas generation using renewable energy and CO2. The OxEon team designed, constructed, and delivered a SOEC stack for the Mars In-Situ Resource Utilization Experiment (MOXIE) project for NASA's Mars 2020 mission that produced propellant grade oxygen by electrolyzing Mars atmosphere CO2. Two paths will be evaluated to decrease electrolyte thickness while retaining the robustness of the electrolyte-supported cell structure proven on MOXIE and further developed to meet redox and thermal cycle tolerance requirements in a NASA SBIR Phase II program. Air electrode supported design development will continue, and > 60% thinner electrolytes will be evaluated for electrolyte supported cells. The proposed effort uses aerosol jet printing (AJ) as a rapid prototyping approach to precisely control electrode deposition to achieve functionally and microstructurally graded compositions. Optimal electrode microstructures produced via AJ printing will be evaluated in Phase I and transferred to a screen-printing manufacturing process in Phase II.

Duration: 13

Proposal Details

Proposal Number: T7.05-1008
Subtopic Title: Climate Enhancing Resource Utilization
Proposal Title: Electrochemical Production of Polyethylene from Atmospheric Carbon Dioxide

Small Business Concern

Firm: Faraday Technology, Inc.
Address: 315 Huls Drive, Englewood, OH, 45315-8983
Phone: 937-836-7749

Principal Investigator

Name: Alex Fertig
E-mail: alexfertig@faradaytechnology.com
Address: 315 Huls Drive, Englewood, OH, 45315-8983
Phone: 937-836-7749

Business Official

Name: Maria + Inman
E-mail: mariainman@faradaytechnology.com
Address: 315 Huls Drive, Englewood, OH, 45315-8983
Phone: 937-836-7749

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 4
Technical Abstract (Limit 2000 characters):

Supporting human life on long-tern space exploration missions, such as manned missions to the surface of Mars, require sustainable resource utilization with minimal support from Earth. In response to this need, NASA's in-situ resource utilization (ISRU) mission was put in place to provide a sustainable infrastructure for long-tern missions, such as exploration of extraterrestrial planets. One particular resource available on Mars is atmospheric carbon dioxide (CO2). CO2 makes up 95% of the atmosphere, providing an abundant resource for human explorers to take advantage of. For instance, CO2 can be electrochemically reduced into a variety of compounds, including polyethylene. Polyethylene is a widely used plastic, for manufacturing containers, tubing, sealants, and more. In Phase I, Faraday and UTEP will develop an electrochemical reactor capable of converting atmospheric carbon dioxide into polyethylene at conditions commonly experienced on the Martian surface, such as low temperatures (-65°C average on Martian surface) and low pressures (0.0065 bar). Optimization of polyethylene production will be performed through modifying the reactor design and the electrodes, with the goal of producing polyethylene with high selectivity (>50%) with a low energy requirement for production of polyethylene (0.034 g polyethylene per watt-hour). Phase I will include a critical risk assessment for using naturally occurring perchlorate salts, which are found in water on Mars, as the electrolyte in the electrochemical reactor. Alignment of this technology with future NASA and commercial missions to Mars is critical for successful integration, and with the help of our team, we will assess safety and system robustness metrics required for

Phase II and beyond. In Phase II, we will work to scale up the production of polyethylene, while establishing the ability to process CO2 from atmospheric conditions similar to Mars.

Duration: 13

Proposal Details

Proposal Number: T7.05-1012
Subtopic Title: Climate Enhancing Resource Utilization
Proposal Title: Plasma Reactor Techniques for Carbon Product Generation from the Martian Environment

Small Business Concern

Firm: CU Aerospace
Address: 3001 Newmark Dr, Champaign, Illinois, 61822-1474
Phone: 217-239-1701

Principal Investigator

Name: Joseph Zimmerman
E-mail: jwzimmer@cuaerospace.com
Address: 3001 Newmark Dr, Champaign, Illinois, 61822-1474
Phone: 217-239-1701

Business Official

Name: David + Carroll
E-mail: carroll@cuaerospace.com
Address: 3001 Newmark Dr, Champaign, IL, 61822-1474
Phone: 217-239-1703

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 3
Technical Abstract (Limit 2000 characters):

CU Aerospace (CUA) and the Massachusetts Institute of Technology (MIT) propose to develop novel plasma reactors for the generation of useful carbon products, to meet the objectives of in-situ resource utilization (ISRU) in future NASA missions. Plasma techniques offer the possibility of adaptation to various environments containing carbon dioxide, including both Martian planetary and habitable atmospheres. Moreover, the planned approach can be adapted for utilization of carbon dioxide generated by industrial processes, enabling pathways to recycle waste carbon dioxide streams into useful products. The team will focus its research on generating ethylene, considering it to be a high-value target, as it is a feedstock for making various useful industrial products. The planned technological studies will combine the efficacy of various plasma approaches for splitting carbon dioxide along with novel methods for introducing hydrogen co-reactants, and determine the ethylene selectivity of the plasma reactor approaches. Successful demonstrations would have the benefit of supplanting existing industrial methods for generating ethylene (e.g., steam cracking), which use significant power resources and contribute significantly to the global carbon emissions. With the goal of realizing benefits of ISRU in future NASA missions, and in response to the strong need for addressing carbon-cycle issues in terrestrial industrial applications, the CUA-MIT team proposes to advance CO2 plasma reactors by: (1) developing an end-to-end extraction and transformation concept, (2) studying size, weight, power, and lifecycle of system components, (3) conducting experimental and computational studies to evaluate the feasibility of critical subsystems for operation in a Martian environment, (4) developing models of system scaling, throughput, and efficiency for carbon product generation, and (5) conducting a preliminary design for a prototype testbed to be revised and built in a Phase II effort

Duration: 13

Proposal Details

Proposal Number: T8.06-1000
Subtopic Title: Quantum Sensing/Measurement and Communication
Proposal Title: III/V Nonlinear Sources for Entanglement and Squeezing

Small Business Concern

Firm: Nexus Photonics
Address: 6500 Hollister Ave Ste 140, Goleta, California, 93117-3011
Phone: 805-895-4733

Principal Investigator

Name: Minh Tran
E-mail: tran@nexusphotonics.com
Address: 6500 Hollister Ave Ste 140, Goleta, California, 93117-3011
Phone: 805-837-9079

Business Official

Name: Tin + Komljenovic
E-mail: komljenovic@nexusphotonics.com
Address: 6500 Hollister Ave Ste 140, Goleta, CA, 93117-3011
Phone: 805-895-4733

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 4
Technical Abstract (Limit 2000 characters):

We propose to develop chip-scale squeezer and chip-scale pump laser that can be co-packaged in a typical butterfly like package for significant size, weight and power (SWaP) improvement to enable squeezed light source quantum sensing applications. Squeezed-light injection into the LIGO interferometer is now regularly implemented to achieve quantum-enhanced sensitivity. Likewise, by injecting squeezed light into a classical sensor, the sensitivity can be improved beyond the classical limit.

Duration: 13

Proposal Details

Proposal Number: T8.06-1005
Subtopic Title: Quantum Sensing/Measurement and Communication
Proposal Title: Quantum Light Sources from vdW Ultrathin Niobium Oxyhalide Crystals

Small Business Concern

Firm: Nanohmics, Inc.
Address: 6201 E. Oltorf St., Austin, Texas, 78741-0000
Phone: 512-389-9990

Principal Investigator

Name: Steve Savoy
E-mail: ssavoy@nanohmics.com
Address: 6201 E. Oltorf St., Austin, Texas, 78741-0000
Phone: 512-389-9990

Business Official

Name: Michael + Mayo
E-mail: mmayo@nanohmics.com
Address: 6201 E. Oltorf St., Austin, Texas, 78741-0000
Phone: 512-389-9990

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 3 - 4
Technical Abstract (Limit 2000 characters):

The future of ultrasensitive detection and measurement capabilities vital to NASA's aerospace applications relies on the development of advanced Quantum Sensing and Measurement (QSM) techniques. QSM encompasses a diverse array of technologies and instruments that harness the quantum nature of light, such as schemes involving squeezed light, discrete photon sources, and weak value principles, to name a few. QSM holds promise in achieving measurement precision unattainable via classical physics methodologies; notably, the utilization of quantum principles can significantly augment photon-based interferometric measurement, imaging, and sensing functionalities. One key QSM enabling technology is the integration of quantum light sources capable of generating entangled photon pairs and indistinguishable photons. Within the present technological landscape, there is a preference for ultracompact solid-state photon sources that can be fabricated directly onto chip-scale devices using microfabrication methods. These embodiments offer scalability and seamless integration with existing semiconductor technologies. However, the absence of a singular, ideal, commercially available platform meeting all single photon source criteria underscores the imperative for ongoing exploration and development of novel materials conducive to the production and control of quantum light in future QSM applications. To address the needs of next-generation QSM, Nanohmics, Inc. (Austin, TX), a sensing technologies and measurement instrumentation development company, working in collaboration with Professor Anton Malko at the University of Texas at Dallas (UT Dallas) proposes to develop a novel near-infrared, room-temperature-

operational, entangled photon pair source based ultrathin structures that are designed for ready-integration with state-of-the-art, microfabricated photonic integrated circuits (PICs).

Duration: 13

Proposal Details

Proposal Number: T8.06-1007
Subtopic Title: Quantum Sensing/Measurement and Communication
Proposal Title: Quantum-entangled SPectrometer using Infra-Red Interference Technology: Q-SPIRIT

Small Business Concern

Firm: Physical Sciences Inc.
Address: 20 New England Business Center, Andover, MA, 01810-1077
Phone: 978-738-8112

Principal Investigator

Name: Maggie Tse
E-mail: mtse@psicorp.com
Address: 20 New England Business Center, Andover, MA, 01810-1077
Phone: 978-738-8177

Business Official

Name: Michael + Tieman
E-mail: mtieman@psicorp.com
Address: 20 New England Business Center, Andover, MA, 01810-1077
Phone: 978-738-8112

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 4
Technical Abstract (Limit 2000 characters):

Physical Science Inc. and the University of Illinois Urbana Champaign will develop the Quantum-entangled SPectrometer using Infra-Red Interference Technology (Q SPIRIT) platform, which aims to realize a low size, weight, and power (SWaP) spectroscopy unit for detecting infrared-wavelength gas-absorption spectra by leveraging novel quantum entanglement and interference techniques without the need for high-power lasers or cool infrared detectors. Infrared (IR) spectroscopy is a critical technique for many NASA missions that require the detection and analysis of chemical compounds and molecules, in addition to many applications in astronomy, medicine, and other fields. However, gas spectroscopy in the IR requires detectors that currently suffer from high background noise and low sensitivity. To increase the signal-to-noise ratio, these detectors are either cryogenically cooled (increasing the system SWaP and cost) or paired with high-power light sources (which suffer from narrow bandwidths, in addition to being high SWaP). Such high-SWaP solutions cannot be easily added to space-based assets (such as landers) without consuming significant supporting resources. In contrast, high-sensitivity visible-wavelength detectors are cost-effective, widely available, and do not require cryogenic cooling; yet, they are insensitive to IR light. To address this challenge, PSI and UIUC are leveraging a quantum-enhanced spectroscopic technique, known as “ghost spectroscopy”, which combines highly non-degenerate entangled-pairs configured to probe a gas sample using the IR photons while only detecting visible photons. This unique approach avoids cryogenically-cooled IR detectors or high-power IR sources to realize a reduced SWaP spectrometer for portable sensors compatible with deployment in NASA missions.

Duration: 13

Proposal Details

Proposal Number: T8.06-1018
Subtopic Title: Quantum Sensing/Measurement and Communication
Proposal Title: Ultra-narrow Bandpass Filter

Small Business Concern

Firm: Opto-Atomics Corp.
Address: 1891 N Gaffey St, San Pedro, CA, 90731-1270
Phone: 424-477-5132

Principal Investigator

Name: Jae Choi
E-mail: jchoi@opto-atomics.com
Address: 1891 N Gaffey St, San Pedro, CA, 90731-1270
Phone: 424-477-5132

Business Official

Name: Jae + Choi
E-mail: jchoi@opto-atomics.com
Address: 1891 N Gaffey St, San Pedro, CA, 90731-1270
Phone: 424-477-5132

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 4
Technical Abstract (Limit 2000 characters):

Free-space quantum communication (FSQC) has many advantages over conventional long-distance communication based on the microwave or radiofrequency (RF) bands, including enhanced security and narrow beam divergence, and. Optical filters are one of the many system components essential in implementing FSQC for ground-to-satellite or satellite-to-satellite links. Optical filters will allow getting “more signal, with less background,” thereby enabling high-fidelity FSQC in the presence of the background noise (e.g., daytime sun light). For example, in FSQC between Mars and the Earth, the Sun might be in or near the line of sight, and FSQC without an ultra-narrowband filter (transmission bandwidth < 100 MHz) will suffer from background noise issues. The ability to tune the filter passband in the NIR spectral range would also enable operation flexibility. To summarize, the optical fiber should have a narrow passband (~ 100 MHz), offer frequency tuning, and provide minimal insertion loss (< 0.5 dB) and high rejection (>50 dB) of out-of-band light with a wide operational range (780 ~ 2500 nm). To address this need, Opto-Atomics Corp. (OAC) proposes to develop an Ultra-narrow Bandpass Filter (UBF), which will provide a transmission bandwidth of 100 MHz around a tunable center wavelength in the NIR range. UBF will also have optical insertion loss < 0.5 dB, and an out-of-band rejection over 50 dB.

Duration: 12

Proposal Details

Proposal Number: T8.07-1002
Subtopic Title: Photonic Integrated Circuits
Proposal Title: Waveguide Integrated SNSPDs on Foundry Silicon PICs

Small Business Concern

Firm: memQ Inc
Address: 5235 S Harper Ct. 9th Floor, Chicago, Illinois, 60615-4241
Phone: 505-795-4382

Principal Investigator

Name: Sean Sullivan
E-mail: sean@memq.tech
Address: 5235 S. Harper Ct, Chicago , IL, 60615-4241
Phone: 513-373-6645

Business Official

Name: Manish Kumar + Singh
E-mail: manish@memq.tech
Address: 5235 S Harper Ct. 9th Floor, Chicago, IL, 60615-4241
Phone: 312-536-1855

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 4 - 6
Technical Abstract (Limit 2000 characters):

To address the NASA need for integrated photonic single photon detectors, memQ proposes to create superconducting nanowire single photon detectors (SNSPDs) through back-end-of-line fabrication on the 300mm silicon photonics platform at AIM photonics. Waveguide integrated SNSPDs offer un-matched performance in terms of efficiency and timing precision, and would benefit PIC based technologies such as LiDAR, optical communications, quantum systems, and sensing. In phase I, the feasibility of the approach will be investigated through fabrication and characterization of SNSPDs onto foundry PICs. In phase II, SNSPDs would be fabricated on 300mm wafer-scale and optimized for yield. At the end of phase II, this technology is expected to be ready (TRL-6) for development as a component on AIM's platform - which will be the focus of a Phase III type effort.

Duration: 13

Proposal Details

Proposal Number: T8.07-1007
Subtopic Title: Photonic Integrated Circuits
Proposal Title: Thin-Film Lithium Niobate Modulator for Inertial Navigation

Small Business Concern

Firm: Lynntech Inc.
Address: 2501 Earl Rudder Fwy S, College Station, TX, 77845-6023
Phone: 979-764-2200

Principal Investigator

Name: Dwayne Macik
E-mail: dwayne.macik@lynntech.com
Address: 2501 Earl Rudder Fwy S, College Station, TX, 77845-6023
Phone: 979-764-2200

Business Official

Name: Jaclyn + McCord
E-mail: jaclyn.mccord@lynntech.com
Address: 2501 Earl Rudder Fwy S, College Station, TX, 77845-6023
Phone: 979-764-2200

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 1 - 3
Technical Abstract (Limit 2000 characters):

According to the NASA Strategic Plan there are four goals: discover, explore, innovate, and advance. These strategic goals focus on certain technologies that will strengthen the ability of NASA to complete specific missions. Namely, NASA is interested in the development and maturation of photonic integrated circuit (PIC) technology for infusion into existing and upcoming instruments which will lend well to the Space Technology Mission Directorate (STMD), Science Mission Directorate (SMD), and Exploration Systems Mission Directorate (ESDMD). Lynntech proposes to develop a thin-film lithium niobate modulator for inertial navigation.

Duration: 13

Proposal Details

Proposal Number: T8.07-1025
Subtopic Title: Photonic Integrated Circuits
Proposal Title: A Low SWAP-C, Narrow-Bandwidth, and High-Channel-Density RF Photonic Integrated Channelizer Based on Serial Arrayed Waveguide Gratings and Liquid Crystal Phase Modulators

Small Business Concern

Firm: Light Integration Technologies LLC
Address: 9407 NE VANCOUVER MALL DR STE 104 # 934, VANCOUVER,, WA, 98662-6191
Phone: 714-225-1524

Principal Investigator

Name: Stewart Fryslie
E-mail: thomas.fryslie@L-I-T.co
Address: 4000 Mason Road Fluke Hall, Seattle, WA, 98195-0001
Phone: 714-225-1524

Business Official

Name: Stewart + Fryslie
E-mail: thomas.fryslie@L-I-T.co

Address: 4000 Mason Road Fluke Hall, Seattle, WA, 98195-0001
Phone: 714-225-1524

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 4
Technical Abstract (Limit 2000 characters):

Light Integration Technologies (LIT) and the University of Washington (UW) propose to develop a novel Liquid-Crystal integrated Serial Arrayed Waveguide Grating (LC-SAWG) photonic integrated channelizer for NASA's hyperspectral microwave sensing applications. The LC-SAWG builds upon the innovative SAWG architecture, enabling arbitrary filter shape synthesis, high channel density, and narrow bandwidths, and integrates liquid-crystal-based phase tuning for compact, low-power, and fast reconfigurability. The technology addresses the limitations of existing RF and photonic solutions in meeting the demanding requirements of NASA's Hyperspectral Microwave Photonic Instrument (HyMPI) program, which requires ultra-wide bandwidth, high spectral resolution (<1 GHz channels), and stringent size, weight, power, and cost (SWaP-C) constraints. The LC-SAWG's unique capabilities, including multi-GHz instantaneous bandwidth channelization, sub-3 GHz channel bandwidths, high channel density, and superior filter characteristics, enable a disruptive solution for advanced hyperspectral microwave atmospheric sounding and remote sensing from space-based platforms. The funding will be used to develop system requirements, design and simulate the multi-level silicon nitride (SiN) photonic integrated circuit (PIC) platform and key components, optimize the fabrication process, and characterize the liquid-crystal-based phase tuners. Phase I will culminate in demonstrating a liquid-crystal-based phase modulator on a low-loss, multi-level SiN PIC platform, validating the feasibility and paving the way for full LC-SAWG prototype development in Phase II. The LC-SAWG technology has significant market potential beyond NASA, including telecommunications (advanced WDM systems), spectroscopy (compact, high-resolution spectrometers), optical sensing, astronomy (high-resolution spectrographs), quantum optics (high-density quantum state multiplexing), and defense applications (mmwave sensing, secure comms)

Duration: 13

Proposal Details

Proposal Number: T8.07-1034
Subtopic Title: Photonic Integrated Circuits
Proposal Title: QPICS: Quantum Dot Photonic Integrated Circuits on Silicon

Small Business Concern

Firm: Aeluma, Inc.
Address: 27 CASTILIAN DR., SANTA BARBARA, CA, 93117-3026
Phone: 805-351-2707

Principal Investigator

Name: Bei Shi
E-mail: research@aeluma.com
Address: 27 CASTILIAN DR., SANTA BARBARA, California, 93117-3026
Phone: 805-351-2707

Business Official

Name: James + Seo
E-mail: research@aeluma.com
Address: 27 CASTILIAN DR., SANTA BARBARA, California, 93117-3026
Phone: 805-351-2707

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 3
Technical Abstract (Limit 2000 characters):

The focus of this proposed effort is to provide a path to add high-performance quantum dot (QD) gain to SiPh by leveraging Aeluma's large-diameter wafer technology and its relationships with SiPh foundry partners, with an emphasis on the performance requirements for space communications and sensing applications. Hybrid integration using flip-chip bonding or solder-based assembly of processed group III-V compound semiconductor lasers onto SiPh circuits has been commercialized but faces issues associated with scalability, robustness and SWaP reduction. Heterogeneous integration such as wafer- or die-to-wafer bonding, and emerging micro-transfer printing (MTP), have attracted interest more recently. These approaches address several critical challenges by bonding III-V gain chiplets into SiPh to form gain elements and lasers. III-V substrate costs and complex process integration, however, have limited the broad adoption of these technologies. The direct heteroepitaxy of III-V QD lasers on silicon, as proposed here, is considered the ultimate solution for scaling SiPh for broad market adoption, for SWaP reduction, and for increased performance, robustness, and reliability.

Duration: 12

Proposal Details

Proposal Number: T9.03-1003
Subtopic Title: Low SWaP-C Terrain Mapping Sensor for Onboard Hazard Detection
Proposal Title: Adaptive Sampling LIDAR for High Speed, High Resolution Hazard Detection

Small Business Concern

Firm: Physical Sciences Inc.
Address: 20 New England Business Center, Andover, MA, 01810-1077
Phone: 978-738-8112

Principal Investigator

Name: Austin Jantzi
E-mail: ajantzi@psicorp.com
Address: 20 New England Business Center, Andover, MA, 01810-1077
Phone: 978-738-8186

Business Official

Name: Michael + Tieman
E-mail: mtieman@psicorp.com
Address: 20 New England Business Center, Andover, MA, 01810-1077
Phone: 978-738-8112

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 4
Technical Abstract (Limit 2000 characters):

PSI is proposing an Adaptive Sampling (AdS) LiDAR for high-speed, high-resolution hazard detection capable of generating digital elevation maps (DEMs) for entry/deorbit, descent, and landing. This system will function as a standalone 3D terrain mapping sensor, mapping from altitudes over 250 m, that can be generalized to various missions and platforms regardless of illumination condition. The AdS-LiDAR uses a highly flexible receiver architecture that allows it to generate DEMs at high speeds (< 4 seconds) with high resolution (1000 x 1000 pixels) without scanning. This is achieved by using a large-format (1080p) DMD that superimposes Walsh-Hadamard (WH) masks on an image of the scene for 3D imaging, exploiting computational imaging (CI) concepts with a single pixel camera architecture. AdS further reduces DEM acquisition time by sampling only the spatial frequencies which are salient. In the Phase I program, we will build and functionally test an AdS-LiDAR breadboard, demonstrating ranging and mapping capabilities.

Duration: 13

Proposal Details

Proposal Number: T9.03-1004
Subtopic Title: Low SWaP-C Terrain Mapping Sensor for Onboard Hazard Detection
Proposal Title: RASTR – Ultra-Fast Smart LiDAR Sensor for Terrain Mapping

Small Business Concern

Firm: Astrobotic Technology Inc
Address: 1016 N Lincoln Ave, Pittsburgh, PA, 15233-2132
Phone: 412-682-3282

Principal Investigator

Name: Andrew Horchler
E-mail: andrew.horchler@astrobotic.com
Address: , , PA,
Phone:

Business Official

Name: Jesse + Kuhn
E-mail: jesse.kuhn@astrobotic.com
Address: 1016 N Lincoln Avenue, Pittsburgh, PA, 15233-2132
Phone: 570-847-8714

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 3 - 4
Technical Abstract (Limit 2000 characters):

Planetary landing systems are constrained by performance, size, weight, and power (SWaP), and cost of active hazard detection (HD) sensor systems that enable real-time terrain mapping and safe site selection. The time it takes an HD sensor system to scan, produce an elevation map that corrects for spacecraft motion, and compute safe landing sites is a critical bottleneck that requires trading fuel mass (delta-V) with scan resolution and accuracy in order to achieve a desired level of mission assurance. A low-SWaP sensor capable of accurately scanning a target landing region to a resolution of 10 cm or better in just two seconds would enable lower cost planetary landers while providing hazard detection capabilities that enhance landing safety and mission assurance, including payload deployment onto the surface. Astrobotic's RApid Scanning Terrain Resolver (RASTR) sensor solution addresses this lander mission assurance bottleneck by increasing the responsiveness and adaptability of the LiDAR sensor. RASTR will reduce the amount of time and power needed generate accurate terrain maps in real time. Astrobotic will combine its heritage high performance space-grade computing, flight-ready LiDAR processing algorithms, and validated physics-based simulation and terrain modeling tools with a state-of-the-art on-chip ultra-long-range frequency modulated continuous wave (FMCW) LiDAR commercial product and novel single-shot depth estimation machine learning algorithms. Building a system to better optimize around an increased scanning speed and lower SWaP and cost is critical to reducing the barriers to entry of integrating this sensor type into NASA's Commercial Lunar Payload Services (CLPS) landers. Existing space-grade HD sensor system components do not take advantage of economies of scale (e.g., the autonomous vehicle and drone markets), resulting in cost and lead times being a limiting factor to commercial capabilities.

Duration: 13

Proposal Details

Proposal Number: T9.03-1011
Subtopic Title: Low SWaP-C Terrain Mapping Sensor for Onboard Hazard Detection

Proposal Title: LITPHAM: Low Illumination Planetary Hazard Avoidance and Mapping

Small Business Concern

Firm: Rhea Space Activity, Inc.
Address: 1455 Pennsylvania Ave NW, Washington, DC, 20004-1029
Phone: 702-862-6407

Principal Investigator

Name: Jake Singh
E-mail: jake.singh@rheaspaceactivity.com
Address: 1455 Pennsylvania Ave NW, Washington, DC, 20004-1029
Phone: 540-878-7578

Business Official

Name: Samuel + Lee
E-mail: samuel.lee@rheaspaceactivity.com
Address: 1455 Pennsylvania Ave NW, Washington, DC, 20004-1029
Phone: 702-862-6407

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 4
Technical Abstract (Limit 2000 characters):

NASA and the National Research Council (NRC) have maintained precision landing and hazard detection/avoidance (PL&HA) as a critical space technology required for robotic science and human exploration operations to locations with unknown or hazardous terrain. Current sensing and navigation systems are not mature enough to consistently enable reliable operations in hazardous environments, and SWaP-C gaps in state-of-art PL&HA preclude advancement of the technology by new commercial lander companies. LITPHAM will bridge the SWaP-C gap and will be a standalone 3D terrain mapping sensor capable of operating in any illumination condition. Furthermore, LITPHAM can be generalized to any mission, vehicle configuration, and concept of operations.

Duration: 13

Proposal Details

Proposal Number: T10.01-1001
Subtopic Title: Autonomous Target Identification and Sensor Optimization
Proposal Title: Autonomous Storm Detection and Tracking Using Random Finite Sets

Small Business Concern

Firm: ASTER Labs, Inc.
Address: 155 East Owasso Lane, Shoreview, MN, 55126-3034
Phone: 651-484-2084

Principal Investigator

Name: Suneel Sheikh
E-mail: sheikh@asterlabs.com
Address: 155 East Owasso Lane, Shoreview, MN, 55126-3034
Phone: 651-484-2084

Business Official

Name: Suneel + Sheikh
E-mail: sheikh@asterlabs.com
Address: 155 East Owasso Lane, Shoreview, MN, 55126-3034
Phone: 651-484-2084

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 3
Technical Abstract (Limit 2000 characters):

Lightning storm observations are used in advanced weather models to predict and provide warning of severe weather. Current lightning observations gathered from geostationary orbit are static and not well resolved. Observations made from Low Earth Orbit (LEO) offer improved resolution and could take advantage of decreasing LEO construction and launch costs, however challenges are introduced by rapidly changing observing location and smaller sensor field of view. Therefore, to achieve autonomous extended storm target tracking from LEO, ASTER Labs will develop innovative Random Finite Set (RFS)-theory-based software using measurement filtering methods that include the Gamma-Gaussian-Inverse Wishart (GGIW) with Cardinalized Probability Hypothesis Density (CPHD) and GGIW with Joint Generalized Labeled Multi-Bernoulli (JGLMB) filters. Using sequential measurements, these methods enable identification and tracking of extended targets, such as thunderstorms producing lightning flashes. ASTER Labs' team will develop RFS-based algorithms that identify a storm, quantify and narrow a region of interest (ROI), and output the global location of that ROI. The newly developed STORM Module software tool will provide storm tracking on-orbit with RFS filtering for CMOS sensors. Predictive estimation of the storm dynamics will be provided via a near-constant velocity and unknown turning rate model, inferred by a Reinforcement Learning (RL) agent. Archival data from current lightning mappers, e.g. GOES-16 and GOES-17, will be processed for RL agent training and simulation, as well as evaluation of the STORM algorithms' ability to properly identify, track, and report a thunderstorm ROI. Phase I will focus on developing the STORM Module and associated algorithms, along with executing storm tracking simulations to assess the algorithms' performance in select scenarios. The target market for the STORM Module is weather satellites operated by government or private entities.

Duration: 13

Proposal Details

Proposal Number: T10.01-1008
Subtopic Title: Autonomous Target Identification and Sensor Optimization
Proposal Title: Autonomous Storm Tracking and Control for Space Based Lightning Sensors

Small Business Concern

Firm: RNET Technologies
Address: 5335 Far Hills Avenue, Dayton, Ohio, 45429-2317
Phone: 650-248-3371

Principal Investigator

Name: Gerald Sabin
E-mail: gsabin@RNET-Tech.com
Address: 5335 Far Hills Avenue, Dayton, Ohio, 45429-2317
Phone: 937-433-2886

Business Official

Name: Vaidyanathan + Nagarajan
E-mail: VNagarajan@RNET-Tech.com
Address: 5335 Far Hills Avenue, Dayton, OH, 45429-2317
Phone: 650-248-3371

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 1 - 3
Technical Abstract (Limit 2000 characters):

NeuraLightning is a Neural Network based framework to generate regions of interest for lightning storm clusters from the lightning event stream (i.e., L1b data generated by the real time event processor) that can be used to adjust the sensor/satellite attitude and as input to the CIS. NeuraLightning will use nowcasting to predict future lighting event frames from recent aggregated LIS/GLM/LXM data output using a Convolutional LSTM (C-LSTM). Lightning storms in each predicted frame will then be detected using a "one shot" CNN based object detection model (e.g., YOLO). The chosen NN architectures will also be optimized to execute efficiently on a space qualified hardware. A fundamental constraint is that the autonomous processing of lightning event data must be performed on the processing hardware available on a space-borne satellite, which must satisfy multiple constraints such as weight, power, radiation hardness etc. Since the achievable throughput for the various algorithmic components/options on appropriate space-borne hardware are not known a priori, our approach will be to develop a family of algorithmic variants that represent a trade-off between achievable throughput and model accuracy. Once hardware platform choices are identified, the achieved throughput for the various variants can be evaluated and the version with highest accuracy and sufficient throughput can be selected.

Duration: 13

Proposal Details

Proposal Number: T10.01-1009
Subtopic Title: Autonomous Target Identification and Sensor Optimization
Proposal Title: Adaptive Imaging Software for Optimized Detection and Tracking of Thunderstorms from LEO

Small Business Concern

Firm: TRL11 Inc
Address: 5270 California Avenue, Irvine, CA, 92617-3231
Phone: 949-559-1040

Principal Investigator

Name: Douglas Michael Mach
E-mail: dmach@usra.edu
Address: 320 Sparkman Drive Rm 4022, Huntsville, AL, 35805-4022
Phone: 256-961-7830

Business Official

Name: Aneesh + Goel
E-mail: aneesh@trl11.com
Address: 5270 California Avenue, Irvine, CA, 92617-3231
Phone: 408-329-3116

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 4
Technical Abstract (Limit 2000 characters):

This Phase I effort proposes the development of ThunderTrack™, a lightning detection and tracking software suite that uses autonomous adaptive imaging strategies to optimally detect events from space during any time of the day, cluster them into flashes, and direct the platform navigation and attitude and CIS sampling approach for consistent tracking. ThunderTrack™ is a significant improvement from the current state-of-the-art, which employs fixed event detection and sampling strategies, since it optimizes lightning measurements based on the image scenes of interest. The effort will be accomplished through a strategic partnership between USRA, a space research institution and TRL11, a privately-funded, revenue-generating early stage company with expertise in developing low-latency full motion video solutions for space in limited SWaP and bandwidth constraints. Key personnel for this effort include USRA's

renowned Lightning Scientist Dr. Douglas Mach, TRL11's Founder/CEO Nicolaas Verheem (with entrepreneurial experience building and commercializing video technology), TRL11's Space Imaging Guru Rodney Grubbs (who has 35+ years of experience at NASA's MSFC building imagers), and TRL11's Stephen Long (a seasoned Intelligence, Surveillance, and Reconnaissance expert who knows how to leverage images for data/science). The funding for this effort will be spent on developing this software to advance it from TRL 2 to TRL 4. This will position the technology well to be tested on the Processing Unit developed within the other project in this subtopic in Phase II. The technology developed in this Phase I has applications to better track thunderstorms from LEO, but also for a wide range of other earth and space-based observations. Beachhead commercial target markets include Satellite-based Earth Observation and In-Space Logistics. TRL11 foresees up to $2B in revenue potential from these two markets alone and plans to identify and evaluate other markets as well.

Duration: 13

Proposal Details

Proposal Number: T10.05-1003
Subtopic Title: Integrated Data Uncertainty Management and Representation for Trustworthy and Trusted Autonomy in Space
Proposal Title: DPUQC: Data Pipeline Uncertainty and Quality Control for Trustworthy Space Autonomy

Small Business Concern

Firm: Kryptowire LLC
Address: 8200 Greensboro Drive, McLean, VA, 22102-3892
Phone: 571-282-6724

Principal Investigator

Name: Shridatt "James" Sugrim
E-mail: ssugrim@kryptowire.com
Address: 8200 Greensboro Drive, McLean, VA, 22102-3892
Phone: 571-282-6724

Business Official

Name: Susan + Kloss
E-mail: skloss@kryptowire.com
Address: 8200 Greensboro Drive, McLean, VA, 22102-3892
Phone: 703-755-0036

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 1 - 2
Technical Abstract (Limit 2000 characters):

The DPUQC: Data Pipeline Uncertainty and Quality Control for Trustworthy Space Autonomy creates an updated pipeline that will treat Uncertainty Quantification (UQ) and Sensitivity analysis of models as primary objectives of the pipeline. This will be achieved by augmenting traditional pipelines, which currently handle problems of dynamic scaling, inhomogeneous data formats and data enrichment quite well. While these cloud native solutions have their merits, they do not consider the need to dynamically adjust operations in the presence of significant resource reduction. These pipelines assume that error analysis only the job of the terminal model. DPUQC will address this with a pipeline that pushes annotated data which carries quantifiers of uncertainty along with the data. This will provide data provenance for down stream decisions enabling explainability. The UQ that is transported can be adjust to accommodate changes in resources available to run the pipeline. Model analysis at the terminal edge of the pipeline will test model sensitivity to the variability of the data captured in the UQ, while also providing additional evidence to accept or reject the decision in the form of corroborating decisions from independently trained diagnostic models. The addition of provenance chains with UQ, diagnostic models and UQ model based testing will increase decision trustworthiness as each decision can be cross checked both via the model sensitivity and by comparing to additional evidence the diagnostic models provide. Any decision can be traced to the source that lead to it for diagnostic and quality control purposes.

Duration: 6

Proposal Details

Proposal Number: T10.05-1006
Subtopic Title: Integrated Data Uncertainty Management and Representation for Trustworthy and Trusted Autonomy in Space
Proposal Title: Quantification and Modulation of Trust in a Crew Health Integrated Medical Response Agent (CHIMERA)

Small Business Concern

Firm: Nahlia Inc
Address: 95 1st Street, Los Altos, California, 94022-2756
Phone: 310-936-6237

Principal Investigator

Name: Jeremy Parra
E-mail: jeremy@nahlia.com
Address: 95 1st Street, Los Altos, California, 94022-2756
Phone: 971-708-3986

Business Official

Name: Jayant + Menon
E-mail: jayant@nahlia.com
Address: 95 1st Street, Los Altos, CA, 94022-2756
Phone: 310-936-6237

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 1 - 2
Technical Abstract (Limit 2000 characters):

In long duration space medicine, trustworthy decision-making is crucial for delivering effective patient care. It involves integrating complex data, such as diagnostic information, patient history, and treatment outcomes, with clinical expertise and patient values. Bayesian decision support systems, leveraging their ability to handle uncertainty and provide interpretable results, are particularly suited for enhancing this process1. By quantifying uncertainties and fusing data from various sources, these systems support clinicians in making informed, evidence-based decisions that are crucial for patient outcomes and healthcare efficiency. Active inference is a theoretical framework (AIF) for understanding behavior as a single imperative to minimize free energy. The free energy principle suggests that all living organisms, including humans, strive to minimize their free energy—a measure of the system's uncertainty or surprise about its sensory inputs given its model of the world. This minimization is achieved through perception, where the agent updates its internal model to better predict sensory inputs, and action, where the agent acts upon the environment to make its sensory inputs more predictable In this Phase I proposal, we will leverage our work on cyber-physical-human autonomous systems for astronaut health and performance to demonstrate how an active inference framework allows for the quantification and

modulation of trust in a critical space flight system called the Crew Health Integrated Medical Response Agent (CHIMERA)

Duration: 6

Proposal Details

Proposal Number: T10.05-1007
Subtopic Title: Integrated Data Uncertainty Management and Representation for Trustworthy and Trusted Autonomy in Space
Proposal Title: Real-Time Trust Dynamics in Space Cyber-Human Teaming

Small Business Concern

Firm: Cislune Inc.
Address: 301 N Almansor St, Alhambra, CA, 91801-2644
Phone: 661-390-1060

Principal Investigator

Name: Erik Franks
E-mail: erik@cislune.com
Address: 301 N Almansor St, Alhambra, CA, 91801-2644
Phone: 661-390-1060

Business Official

Name: Erik + Franks
E-mail: erik@cislune.com
Address: 301 N Almansor St, Alhambra, CA, 91801-2644
Phone: 661-390-1060

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 4
Technical Abstract (Limit 2000 characters):

Cislune Inc., in collaboration with the University of Central Florida (UCF), proposes the development of an analytical framework designed to enhance the safety and efficacy of lunar missions by optimizing the interaction dynamics between astronauts and Autonomous Systems (AS). This initiative aims to refine decision-making processes through the advanced integration of state-of-the-art machine learning algorithms, data analytics, and uncertainty quantification (UQ) techniques, specifically focusing on improving trust dynamics in Cyber-Physical-Human (CPH) teams. The intended use of funding is to prototype and validate this framework, aiming for a 10% reduction in crew cognitive workload by enhancing the quality and representation of mission-critical data, such as breathable oxygen levels, propellant stores, and rover range. Utilizing immersive technologies like OpenMCT for data visualization and Cislune's SimMoon for scenario simulations, the project targets the development of a proof of concept documented in a comprehensive Phase I final report. This framework is not only pivotal for the Artemis 3 mission, aiming to ensure astronaut safety and mission success through reliable and efficient decision-making but also sets the groundwork for broader applications in future lunar and deep space exploration missions. The target markets encompass NASA's lunar exploration initiatives and commercial space entities focused on establishing a sustained human presence on the Moon, offering a significant leap in the operational capabilities of CPH teams in space exploration contexts.

Duration: 13

Proposal Details

Proposal Number: T11.06-1016
Subtopic Title: Extended Reality (Augmented Reality, Virtual Reality, Mixed Reality, and Hybrid Reality)
Proposal Title: Operationally Modulating Neurophysiological Interface for Extended Reality (OMNI Cog XR)

Small Business Concern

Firm: Tietronix Software, Inc.
Address: 1331 Gemini Avenue, Suite 300, Houston, TX, 77058-2794
Phone: 281-461-9300

Principal Investigator

Name: William Buras
E-mail: wburas@tietronix.com
Address: 1331 Gemini Avenue, Suite 300, Houston, TX, 77058-2794
Phone: 281-658-6467

Business Official

Name: Sicilia + Liranzo
E-mail: sliranzo@tietronix.com
Address: 1331 Gemini Avenue, Houston, TX, 77058-2794
Phone: 281-404-7226

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 3 - 4
Technical Abstract (Limit 2000 characters):

Astronauts encounter numerous cognitive and physiological challenges from the unique environment encountered during spaceflight. These challenges can significantly impact their health and performance throughout the duration of their missions. Cognitive challenges include altered sensory perceptions, disrupted circadian rhythms, and increased cognitive workload due to the demands of managing complex mission tasks confined spacecraft environment. Additionally, microgravity can lead to physiological alterations affecting astronauts' physical health and functioning. Artificial Intelligent Agents, monitoring these crewmember conditions and tailoring human computer interfaces, including XR platforms, might be utilized to better manage crewmember health an increase mission performance where operator decrements are detected. We propose the development of a portable, lightweight platform that can integrate cognitive/physiological monitoring sensors, and/or application-based measures of the same into an efficient data management and processing system (AI/ML) with dynamic two-way integration with XR systems (capturing camera or other data from HMD as well as sending real-time data to one or more HMDs). The innovative aspects of this system will be true multimodal data fusion (cognitive, physiological, and visual along with environmental telemetry) and analysis resulting in concise informational display and/or modulation of information presented to respective crewmembers based upon their KSA or operational state during task execution. Additionally, we propose the first “team” based XR applications, providing unique content and function depending on a specific crewmember’s role in tasks. To achieve this functional goal, we are partnering with medical and neurophysiological experts at UT Austin Dell Medical School to utilize their clinical expertise and existing, non-invasive cognitive/physiological monitoring platform funded by NIH and currently deployed in clinical trials.

Duration: 12

Proposal Details

Proposal Number: T11.06-1028
Subtopic Title: Extended Reality (Augmented Reality, Virtual Reality, Mixed Reality, and Hybrid Reality)
Proposal Title: OpenUSD + Interactivity for XR Experience Description (USDI-XRED)

Small Business Concern

Firm: DigitalFish, Inc.
Address: 20 San Mateo, San Mateo, CA, 94401-2814
Phone: 415-669-2734

Principal Investigator

Name: Daniel Herman
E-mail: dh@digitalfish.com
Address: 20 San Mateo, San Mateo, CA, 94401-2814
Phone: 213-910-5371

Business Official

Name: Camille + Cellucci
E-mail: c.cellucci@icloud.com
Address: 20 San Mateo, San Mateo, CA, 94401-2814
Phone: 213-910-5371

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 4
Technical Abstract (Limit 2000 characters):

Current and near-future NASA missions are facing significant challenges that Extended Reality (XR) systems may help address. DigitalFish proposes a novel approach to fulfilling the content-infrastructure demands of current and future XR systems - OpenUSD and Interactivity for XR Experience Description (USDI-XRED). Our solution offers a common representation for vendor-agnostic, high-fidelity XR

experiences supporting distribution and consumption of and collaboration with peta-scale datasets. It builds on proven crossover technology from Media & Entertainment, with industry standard underpinnings backed by a broad industry working group, expanded and adapted for NASA's unique needs within XR and interactivity across diverse devices. USDI-XRED innovations include: • Extending USD with new schemas supporting XR, interactivity and interchange • Providing a reference implementation and dataset exercising these extensions • Introducing a validation layer for targeting the restricted functionality on any given deployment platform • Demonstrating the suitability and sufficiency of the extensions through user testing • Documenting a best-practices approach to scalable, vendor-agnostic XR content built on top of USD, the new schemas, and the new validation layer. We will use the funding to: • Develop a system design and implementation extending core OpenUSD to support key elements for XR, interactivity and interchange. • Provide an example scene dataset, relevant to one or more NASA mission objectives, demonstrating novel capabilities and supporting user testing. • Validate the sufficiency, flexibility, and device independence of USDI-XRED's interactivity model and validation layer through qualitative user testing. Target markets include: media & entertainment, manufacturing, aerospace & defense, architecture / engineering / construction, oil and gas, education, health and medicine, public safety, defense, aviation, maritime and shipping, and industrial safety.

Duration: 13

Proposal Details

Proposal Number: T11.06-1029
Subtopic Title: Extended Reality (Augmented Reality, Virtual Reality, Mixed Reality, and Hybrid Reality)
Proposal Title: AI-Powered XR Health Application for Diagnostics and Health Management

Small Business Concern

Firm: Buendea
Address: 24 SW 22nd Road, Miami, Florida, 33129-1507
Phone: 305-510-7868

Principal Investigator

Name: Julian Reyes

E-mail: julian@buendea.com
Address: 24 SW 22nd Road, Miami, FL, 33129-1507
Phone: 305-510-7868

Business Official

Name: Julian + Reyes
E-mail: julian@buendea.com
Address: 24 SW 22nd Road, Miami, FL, 33129-1507
Phone: 305-510-7868

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 3
Technical Abstract (Limit 2000 characters):

This proposal from Buendea and University of Central Florida leverages XR to address known physical and mental health risks associated with long-distance and long-duration human missions to the Moon, Mars, and beyond. For these missions, communications delays or disruption could have a devastating effect in treatments for crew members who encounter traumatic injuries, chronic pains, infections, or mental health crises. Even if a physician is selected for a mission, it is unlikely that they will have the breadth of training to address every possible condition that could afflict their crewmates. For Phase I, this proposal will demonstrate the technical feasibility for in-flight usage of XR technologies to address physical, mental, and nutritional health concerns for long duration and long distance human space travel. This proposal will focus on developing a spatial health application using real-time rendering solutions to enable its use in both XR virtual environments and support for passthrough integration to demonstrate its use in the real-world. Use case number 1 includes a comprehensive imaging, diagnostic, and treatment interface using assumed onboard equipment, materials, and medications to treat injuries, dental emergencies, and other physical ailments. Use case number 2 employs emerging AI applications for continuous in-flight mental health treatment. Use case number 3 identifies an innovative onboard XR platform to improve nutrition and relieve menu fatigue, which is a known contributor to mental health among astronauts. Use case number 4 will address using resistance devices with augmented displays that help improve physical training performance. Each use case will demonstrate integrated spatial application for use in multi-user Lunar and Mars environments and will be based off of real life procedures developed in collaboration with medical professionals in their respective fields.

Duration: 13

Proposal Details

Proposal Number: T11.06-1031
Subtopic Title: Extended Reality (Augmented Reality, Virtual Reality, Mixed Reality, and Hybrid Reality)
Proposal Title: Holodeck The Next Generation using Anaglyph Extended Reality Technologies

Small Business Concern

Firm: Integrated Solutions for Systems, Inc.
Address: 2995 Wall Triana Hwy, Huntsville, AL, 35824-1531
Phone: 334-332-9659

Principal Investigator

Name: Joshua Soper
E-mail: josh.soper@is4s.com
Address: 2995 Wall Triana Hwy, Huntsville, AL, 35824-1531
Phone: 407-616-2763

Business Official

Name: Jason + Genorotti
E-mail: jason.generotti@IS4S.com
Address: 6450 University Blvd, Suite 1, WINTER PARK, FL, 32792-7434
Phone: 954-646-9100

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 3 - 4
Technical Abstract (Limit 2000 characters):

Holodeck The Next Generation using Ultimate Extended Reality Technologies will create new interactive training tools for supporting future NASA missions. This will enable a fully immersive space with touch through a new technology concept called SUIT (Strings Uniform with Increased Tactile) and the ultimate in visuals through

Integrated Solutions for Systems AXR technology. This will be coupled with scent and wind effects.

Duration: 13

Proposal Details

Proposal Number: T12.01-1005
Subtopic Title: Additively Manufactured Electronics for Severe Volume Constrained Applications
Proposal Title: Volume-constrained Additive Manufactured Polymers for Integrated Robust Electronics (VAMPIRE)

Small Business Concern

Firm: Nanohmics, Inc.
Address: 6201 E. Oltorf St., Austin, Texas, 78741-0000
Phone: 512-389-9990

Principal Investigator

Name: Mohammad Abdul-Moqueet
E-mail: mabdulmoqueet@nanohmics.com
Address: 6201 E. Oltorf St., Austin, Texas, 78741-0000
Phone: 512-389-9990

Business Official

Name: Michael + Mayo
E-mail: mmayo@nanohmics.com
Address: 6201 E. Oltorf St., Austin, Texas, 78741-0000
Phone: 512-389-9990

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 4
Technical Abstract (Limit 2000 characters):

Traditional manufacturing methods struggle to meet NASA's strict volume constraints for electronics. Additive manufacturing electronics (AME) offer potential for compact, conformable, and cost-effective structures, but designing space-qualified systems is challenging. Materials suitable for 2D and 3D additive manufacturing haven't been proven rugged enough for space. Nanohmics, Inc. and Dr. Maggie Chen, from Texas State University, propose Volume-constrained Additive Manufactured Polymers for Integrated Robust Electronics (VAMPIRE) to use aerosol printing, materials synthesis, and PVDF polymer inks to demonstrate Volume-constrained Additive Manufactured Polymers for Integrated Robust Electronics. Piezoelectric materials, useful in transducers, sensors, and energy harvesting, include ceramic lead zirconium titanate (PZT) and polymer polyvinylidene fluoride (PVDF). While PZT is strong and durable, it's dense and contains lead. PVDF is less strong but offers benefits like low density, flexibility, and environmental safety. PVDF can be enhanced by combining it with other polymers, increasing its mechanical properties and low-temperature survivability. PVDF is commonly used in sensing applications but 3D aerosol printing of PVDF is not well-studied. Aerosol jet technology can print PVDF on various substrates, but its application in PVDF 3D printing is limited. Phase I effort will focus on formulating PVDF copolymer inks for 3D aerosol printing and conducting environmental testing to evaluate survivability in extreme temperatures. Phase II will prototype sensors or actuators using engineered material.

Duration: 13

Proposal Details

Proposal Number: T12.01-1006
Subtopic Title: Additively Manufactured Electronics for Severe Volume Constrained Applications
Proposal Title: Hybrid Additive Manufacturing of Complex Functional Structures

Small Business Concern

Firm: EngeniusMicro
Address: 1300 Meridian Street North, Huntsville, AL, 35801-4605
Phone: 256-261-1260

Principal Investigator

Name: Brian English
E-mail: brian.english@engeniusmicro.com
Address: 1300 Meridian Street North, Huntsville, AL, 35801-4605
Phone: 256-261-1260

Business Official

Name: Amy + Boller
E-mail: amy.boller@engeniusmicro.com
Address: 1300 Meridian Street North, Huntsville, AL, 35801-4605
Phone: 256-261-1260

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 4
Technical Abstract (Limit 2000 characters):

Reliability in extreme environments is a critical challenge to realizing part consolidation and rapid manufacturing electronics and multi-material components in space vehicles. Meeting this challenge will greatly increase the performance, lifetime, and reliability of NASA exploration vehicles. Reducing existing tooling costs will ensure systems are commercially viable and thereby available for future NASA and government needs. Engeniusmicro (EGM) and Alabama A&M University (AAMU) propose to develop additive manufacturing materials, tooling, and DFAM for multi-material electronics and sensor structures. The team will down-select commercially available additive materials based known past performance in similar environments and based on new simulations of expected performance. The team will develop additive manufacturing processes specific for down-selected materials in single- and multi-material test coupons. Coupons will be tested for relevant mechanical, thermal, and electrical properties. Results of the material study will define process and design rules for future prototypes. The STTR will further develop EngeniusMicro's hybrid additive manufacturing tooling and software for the new material characteristics. The hybrid tooling includes multi-material and multi-process additive manufacturing heads, milling spindle, surface treatment tools. The control software will integrate process and design rules into DFAM procedure to output unified machine codes and process flows. The system will be a compact, affordable system with 50 μm resolution.

Duration: 13

Proposal Details

Proposal Number: T12.01-1010
Subtopic Title: Additively Manufactured Electronics for Severe Volume Constrained Applications
Proposal Title: 3D Printed Electronics with Material Properties Engineered for Cold Survivability

Small Business Concern

Firm: Enova Concepts LLC
Address: 118 Painted Post Ln, Shavano Park, TX, 78231-1414
Phone: 210-748-0957

Principal Investigator

Name: William (Paul) Flynn
E-mail: pflynn@enovaconcepts.com
Address: 118 Painted Post Ln, Shavano Park, TX, 78231-1414
Phone: 210-862-8064

Business Official

Name: Matthew + Trippy
E-mail: matrippy@enovaconcepts.com
Address: 118 Painted Post Ln, Shavano Park, TX, 78231-1414
Phone: 210-748-0957

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 4
Technical Abstract (Limit 2000 characters):

A Survivability and Volume Constraint Challenge: Scalable Additive Manufactured Electronics (AME) and Explorations of Strain Management Solutions. The innovation we propose is a high throughput AME process using Materials Jetting (MJ) and Reactive Inkjet Printing of Electronics by Chemical Solution Deposition (RIPE-CSD) technologies to additively fabricate flexible, non-planar, and multimaterial advanced electronic circuits and devices engineered to survive extreme cold temperatures and meet Size, Weight and Power-Cost (SWaP-C) demands of space missions. This innovation leverages the layer-by-layer nature of 3D printing to pattern composite electronic materials with tailored thermal and mechanical properties allowing for robust and reliable performance in the extreme cold of space missions and

temperatures potentially found on interplanetary or lunar missions (-180 °C). These tailored properties will mitigate the mechanical stresses at the interface of different materials making up electronic materials. Market Opportunity. The technologies being proposed will demonstrate the benefits of the Enova team leveraging high expertise in deep research into compatible materials for these specialized environments, multiple techniques for combining materials to support complex additive manufacturing, and advanced acceptance and qualification testing techniques developed by the UTSA researchers being leveraged for this effort.

Duration: 13

Proposal Details

Proposal Number: T12.09-1000
Subtopic Title: Thermoplastic Composites for Repurposable Aerospace Applications
Proposal Title: In-Space Disassembly and Assembly of Thermoplastic Composite Structures with Embedded Carbon Nano-Heaters

Small Business Concern

Firm: AnalySwift, LLC
Address: 444 Jennings Street, West Lafayette, IN, 47906-1146
Phone: 801-599-5879

Principal Investigator

Name: Kawai Kwok
E-mail: kawaik@purdue.edu
Address: 2550 Northwestern Ave., West Lafayette, IN, 47906-1332
Phone: 407-607-1099

Business Official

Name: Allan + Wood
E-mail: allanwood@analyswift.com
Address: 6523 S Eventide Way, West Valley City, UT, 84081-1951

Phone: 801-599-5879

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 1 - 3
Technical Abstract (Limit 2000 characters):

This Phase I project aims to assess the feasibility of disassembling and reassembling thermoplastic composite joints in space by thermo-mechanically debonding and bonding the joint interface. By harnessing this fundamental operation, space structures can be reconfigured into vastly different geometries depending on mission needs using the same set of structural elements. Repurposing thermoplastic composite structures has the potential to significantly reduce the amount of materials to be delivered to space as payloads. In our proposed concept, the original and the repurposed structures are trusses consisting of composite joints and struts. The joint-strut interfaces are pre-inserted with a conductive composite adhesive layer made of the same thermoplastic matrix as the adherend composite parts and embedded with nanostructured carbon fillers. By forming an electrically and thermally conductive network, the carbon fillers act as an in-situ resistance heater to bring the thermoplastic matrix to the processing temperature for interface debonding by mechanical forces. The disassembled struts and joints are reassembled to the repurposed configuration via resistance welding using the same or additional conductive adhesive layers. The proposed in-situ heating and reassembly method enables spacecraft components to be reutilized, which greatly reduces the logistical footprint to deliver technologies to space. Current spacecraft components are still largely designed for single-use missions, which are costly and not scalable. The ability to repurpose spacecraft components maximizes their useful service life and lowers the cost of building new infrastructure on planetary surfaces. In Phase I, the power and tooling requirements to make the proposed technology viable will be established using multiphysics simulations and analyses of the full reassembly operation.

Duration: 13

Proposal Details

Proposal Number: T12.09-1006
Subtopic Title: Thermoplastic Composites for Repurposable Aerospace Applications
Proposal Title: Repurposable Thermoplastic Composites for Lunar Use (RTCLU)

Small Business Concern

Firm: Lynntech Inc.
Address: 2501 Earl Rudder Fwy S, College Station, TX, 77845-6023
Phone: 979-764-2200

Principal Investigator

Name: Clint Bergeron
E-mail: clint.bergeron@lynntech.com
Address: 2501 Earl Rudder Fwy S, College Station, TX, 77845-6023
Phone: 979-764-2200

Business Official

Name: Jaclyn + McCord
E-mail: jaclyn.mccord@lynntech.com
Address: 2501 Earl Rudder Fwy S, College Station, TX, 77845-6023
Phone: 979-764-2200

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 3 - 4
Technical Abstract (Limit 2000 characters):

Thermoplastic composites can be reformed, repaired, and welded utilizing thermal processes, providing lunar missions a means of repurposing lander components into equipment that can be used for in-situ resource utilization (ISRU) activities. By reforming spacecraft components after arriving on the Moon, equivalent system mass (ESM) is minimized, allowing for additional equipment to be transported. Lynntech and the University of Washington propose an innovative means of reforming, repairing, and welding thermoplastic composites using an automated process capable of producing repeatable results, allowing for the process to be certified and employed across various industries, such as aerospace and automotive. The team will: 1) identify lander components suitable for thermoplastic composite construction, and 2) create designs for a handcart that can be constructed from the lander's thermoplastic composites after arriving on the Moon. The handcart will enhance lunar activities by providing the astronauts with a means of increasing their carrying capacity on missions. The cart can be used to carry additional oxygen, power systems, tools, and lunar regolith. Solar panels can be equipped to the cart, allowing for continuous energy harvesting during lunar extravehicular activities. The research team will utilize finite element analysis, multiphysics modeling, and empirical methods to develop the thermoplastic composite process and designs for the lander components and handcart. The process developed can be adapted for other thermoplastic components if NASA desires an alternative to the handcart.

Duration: 13

Proposal Details

Proposal Number: T12.09-1015
Subtopic Title: Thermoplastic Composites for Repurposable Aerospace Applications
Proposal Title: Thermoplastic based carbon fiber structural batteries for space technologies

Small Business Concern

Firm: Energized Composite Technologies
Address: 1209 West Gore Street, Orlando, Florida, 32805-3809
Phone: 407-697-1550

Principal Investigator

Name: Lyle Sampson
E-mail: webman712@gmail.com
Address: 552 West 66th Street , Loveland, CO, 80538-4669
Phone: 407-697-1550

Business Official

Name: Lynta + Thomas
E-mail: energizedcomposite@gmail.com
Address: 1209 West Gore Street, Orlando, FL, 32805-3809
Phone: 407-697-1550

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 3
Technical Abstract (Limit 2000 characters):

Space missions, particularly those targeted towards the Moon and Mars, require innovative solutions to address the challenges of limited resources, weight restrictions, and extended mission durations. Among these challenges, energy storage stands out as a critical factor, as conventional battery systems add significant mass and volume to spacecraft. This proposal aims to explore the utilization of carbon fiber reinforced thermoplastic (CFRT) composite structural batteries for repurposable space applications, offering a multifunctional solution that integrates structural integrity with energy storage capabilities. The proposed structural battery panels integrate energy storage functionality into the structural components of the spacecraft, thereby minimizing the additional space required for electrical storage while maximizing the available volume for payload. The structural battery panels used for the space vehicle can be repurposed after landing since the thermoplastic-based structural panels can be reshaped to build habitat frames without affecting the battery structure. If necessary, flexible solar cells can be integrated into the composite for energy harvesting. Small heating elements can also be integrated into the composite so that the stored battery power can be used to heat and repurpose the composite to the required shape.

Duration: 13

Proposal Details

Proposal Number: T13.01-1005
Subtopic Title: Intelligent Sensor Systems
Proposal Title: Multimodal Wireless Piezoelectric Microsensors For Harsh Environments

Small Business Concern

Firm: INTEGSENSE INC
Address: 1421 S CULPEPPER DR, STILLWATER, OK, 74074-1856
Phone: 404-429-4780

Principal Investigator

Name: Hakhamanesh Mansoorzare
E-mail: hakha@integsense.com
Address: 4328, Scorpius St., ORLANDO, FL, 32816-2362
Phone: 352-346-4400

Business Official

Name: Hakhamanesh + Mansoorzare
E-mail: hakha@integsense.com
Address: 4328, Scorpius St., ORLANDO, FL, 32816-2362
Phone: 352-346-4400

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 3 - 5
Technical Abstract (Limit 2000 characters):

A passive wireless miniaturized sensor patch will be developed using piezoelectric MEMS for operation in harsh environment. The proposed system provides temperature and pressure readings from hard to access locations via wirelessly communicating with a nearby (>20 ft. away) transceiver module at ISM 2.4 GHz band. The combination of the stress-free low-loss substrate and excellent energy confinement in the MEMS device enables reliable and accurate readings in cryogenic to high temperatures. Technology Purpose: This technology enables competitively long-distance measurement of physical parameters (temperature and pressure in this effort) in sub-GHz to few GHz range, which represents an optimal balance between antenna size and communication distance. The change in the frequency of the MEMS resonator responsive to the physical parameter provides a simple, battery-less digital readout. Intended Use of Funding: Experimental evaluation of lifetime and robustness of the proposed sensor in extreme conditions is the main objective of the proposed effort. This funding would allow for design and fabrication of testbeds and the sensor system (chip containing resonant sensors coupled with a small antenna) for comprehensive performance characterization in temperature, pressure, vibration, … extremes that mimic real world application scenarios. Target Markets: Battery-less and wireless sensor solutions enjoy a vast market opportunity and are needed across many industries. While the compact, resilient, and modular nature of the proposed sensor technology makes it application range broad, the proposed effort aim to support NASA's rocket propulsion testing applications.

Duration: 13

Proposal Details

Proposal Number: T13.01-1007
Subtopic Title: Intelligent Sensor Systems

Proposal Title: A Wireless, Embedded Sensor System for Rocket Propulsion Test Applications environment

Small Business Concern

Firm: X-wave Innovations, Inc.
Address: 555 Quince Orchard Rd, Gaithersburg, MD, 20878-1464
Phone: 301-200-8368

Principal Investigator

Name: Dan Xiang
E-mail: dxiang@x-waveinnovations.com
Address: 555 Quince Orchard Rd, Gaithersburg, MD, 20878-1464
Phone: 301-200-8128

Business Official

Name: Jennifer + Duan
E-mail: jduan@x-waveinnovations.com
Address: 555 Quince Orchard Rd, Gaithersburg, MD, 20878-1464
Phone: 240-686-9512

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 4
Technical Abstract (Limit 2000 characters):

NASA is looking for advanced sensor technologies, especially wireless embedded sensor systems, to support rocket propulsion development. The enabling technology should provide a highly flexible instrumentation solution capable of monitoring remote or inaccessible measurement locations. This sensor system should substantially reduce operational costs and evolutionary improvements in ground, launch and flight system operational robustness. It should provide an advanced diagnostics capability to monitor test facility parameters including temperature, pressure, strain and near-field acoustics. To address this critical need, X-wave Innovations, Inc. (XII) and New York Institute of Technology (NYIT) propose to develop a novel wireless dual-frequency sensor system for simultaneous measurements of fuel temperature and pressure inside rocket propulsion supply lines. For the Phase I program, XII will prototype a SAW sensor system and demonstrate the feasibility of the proposed technique for simultaneous temperature and pressure measurements and wireless data transmission. For the Phase II program, XII will focus on refining the prototype system design and development

with improved hardware and software. For the Phase III program, XII will focus on optimizing the prototype performance and collaborating with our commercial partners to package the sensor technology into a commercially-available system.

Duration: 13

Proposal Details

Proposal Number: T13.01-1010
Subtopic Title: Intelligent Sensor Systems
Proposal Title: IoT-Inspired Wireless Sensor Networks for Ground and Flight Test Instrumentation

Small Business Concern

Firm: Spectral Energies, LLC
Address: 4065 Executive Dr, Beavercreek, OH, 45430-1062
Phone: 937-266-9570

Principal Investigator

Name: Sivaram Gogineni
E-mail: goginesp@gmail.com
Address: 4065 Executive Dr, Beavercreek, OH, 45430-1062
Phone: 937-266-9570

Business Official

Name: Sukesh + Roy
E-mail: admin1@spectralenergies.com
Address: 4065 Executive Dr, Beavercreek, OH, 45430-1062
Phone: 937-902-6546

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 3
Technical Abstract (Limit 2000 characters):

The development of rocket propulsion systems requires rigorous full-scale testing. These full-scale tests usually require numerous non-homogenous sensors and instrumentation meticulously placed over large distances. To address this need, Spectral Energies (SE) in collaboration with its academic partners propose to transform current sensor collections into intelligent sensor networks through the addition of wireless protocols, edge processing, adaptable firmware, and novel sensor diagnostics and optimization algorithms. The envisioned system is a plug-and-play sensor network in which sensor modules have in-built processing and wireless communications capabilities. Each sensor module will incorporate edge processing for sensor health monitoring, conversion to physical units, filtering, and anomaly detection. Sensor modules will form a mesh network with multi-hop communications capability, relaying their data (and that of other modules) to a central base station. A user interface on the central base station will allow users to easily add sensors, monitor outputs, reconfigure or recalibrate sensors, and optimize sensor placement given models of sensor output and/or prior test data. The proposed project will leverage recent developments in the Internet-of-Things (IoT) community to greatly improve the quality of data obtained from ground- and flight-test instrumentation systems while also reducing cost and time involved in sensor setup, calibration, and configuration. During Phase I, the team will develop initial hardware/software. A literature review will be performed and down selection will occur to ensure that the best practices are being incorporated into the wire sensor network. During Phase II, the full network will be designed, built, and tested. Eventually the network will be delivered to the NASA program manager.

Duration: 13

Proposal Details

Proposal Number: T15.04-1009
Subtopic Title: Full-Scale (Passenger/Cargo) Electric Vertical Takeoff and Landing (eVTOL) Scaling, Propulsion, Aerodynamics, and Acoustics Investigations
Proposal Title: eVTOL Aircraft Subscale Disturbance Response Testing for Full-sized Vehicle Qualification

Small Business Concern

Firm: Continuum Dynamics, Inc.
Address: 34 Lexington Avenue, Ewing, NJ, 08618-2302
Phone: 609-538-0444

Principal Investigator

Name: Jeffrey Keller
E-mail: jeff@continuum-dynamics.com
Address: 34 Lexington Avenue, Ewing, NJ, 08618-2302
Phone: 609-538-0444

Business Official

Name: Melissa + Kinney
E-mail: melissa@continuum-dynamics.com
Address: 34 Lexington Avenue , Ewing, , 08618-2302
Phone: 609-538-0444

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 1 - 3
Technical Abstract (Limit 2000 characters):

Advanced air mobility (AAM) seeks to develop a large-scale transportation system to revolutionize how people live and work in this century. Electric vertical take-off and landing (eVTOL) aircraft will form a central part of the AAM infrastructure due to reduced emissions and noise impact. An important aspect for eVTOL aircraft certification is safe urban operations, which requires understanding of the response due to aerodynamic disturbances. Experimental data are required to support eVTOL aircraft development with respect to flight dynamics and controllability, as well as design specification development. To this end, Continuum Dynamics, Inc. with teaming partners Pennsylvania State University and Alaka'i Technologies proposes to develop a subscale testing methodology for assessing eVTOL aircraft disturbance response / rejection characteristics including validation with similar data obtained for full-sized aircraft flight tests. In Phase I, scaling relationships for flight dynamics/control, aerodynamic interactions, and propulsion-airframe integration will be identified from comprehensive analytical models. A subscale dynamic model will be fabricated and tested in an indoor facility to quantitatively measure response characteristics in aerodynamic disturbances. Subscale data will be compared with model predictions and available full-sized vehicle data, which will be used to form experimental test plans for execution during follow-on work.

Duration: 13

Proposal Details

Proposal Number: T15.04-1012
Subtopic Title: Full-Scale (Passenger/Cargo) Electric Vertical Takeoff and Landing (eVTOL) Scaling, Propulsion, Aerodynamics, and Acoustics Investigations
Proposal Title: Full-Scale eVTOL Cabin Noise Measurements and Analysis

Small Business Concern

Firm: Blue Ridge Research and Consulting, LLC
Address: 29 N Market St, Asheville, NC, 28801-2983
Phone: 828-252-2209

Principal Investigator

Name: Shane Lympany
E-mail: Shane.Lympany@BlueRidgeResearch.com
Address: 29 N Market St, Asheville, North Carolina, 28801-2983
Phone: 828-252-2209

Business Official

Name: Josh + Mellon
E-mail: josh.mellon@BlueRidgeResearch.com
Address: 29 N Market St, Asheville, NC, 28801-2983
Phone: 828-252-2209

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 2 - 4
Technical Abstract (Limit 2000 characters):

To create a viable market for full-scale electric Vertical Takeoff and Landing (eVTOL) aircraft, the Urban Air Mobility (UAM) industry must design a comfortable cabin noise environment for passengers. Although the cabin noise environment in eVTOL aircraft may share some similarities with conventional aircraft, helicopters, and automobiles, multirotor eVTOL aircraft have unique design features and operating states that differentiate them from existing vehicles. Cabin noise is a multidisciplinary acoustics,

aerodynamics, propulsion, and structures problem, with noise sources generated by interactions between the airframe, rotors, and turbulence. NASA has identified a need for flight test data to validate multidisciplinary models of full-scale, multirotor eVTOL aircraft. Blue Ridge Research and Consulting (BRRC) and The Pennsylvania State University propose to deliver full-scale eVTOL cabin noise measurements and analysis to NASA. With our industry partner, Archer Aviation, our team will acquire full-scale flight test measurements during Phase I of interior and exterior noise and vibration onboard Midnight, Archer's four-passenger, multirotor eVTOL aircraft. We will develop analytical methods to quantify the vibroacoustic excitation and identify the dominant sources of cabin noise generated by the rotors, electric engines, and fluid-structure interactions onboard Midnight. Based on the results of our initial Phase I measurements, our team will develop a flight test plan to acquire more extensive cabin noise measurements during Phase II. At the end of Phase I, we will deliver the initial flight test data archive, the Phase II flight test plan, and a final technical report to NASA documenting the initial cabin noise measurements and the dominant sources of cabin noise onboard Midnight. The proposed full-scale eVTOL cabin noise measurements and analysis meet NASA's need for validation data to accelerate the development timeline of full-scale eVTOL aircraft.

Duration: 13

Proposal Details

Proposal Number: T15.04-1021
Subtopic Title: Full-Scale (Passenger/Cargo) Electric Vertical Takeoff and Landing (eVTOL) Scaling, Propulsion, Aerodynamics, and Acoustics Investigations
Proposal Title: Subscale EVTOL Testbed for safeTy critical softwarE development and scalability Research (SETTER)

Small Business Concern

Firm: optoXense, Inc.
Address: 3343 Chartwell St, San Ramon, CA, 94583-3519
Phone: 925-577-0980

Principal Investigator

Name: Joel Dunham
E-mail: jd@optoxense.com
Address: 1780 W Wesley Rd NW, Atlanta, GA, 30327-1910

Phone: 817-228-4391

Business Official

Name: George + Lu
E-mail: lu@optoxense.com
Address: 3343 Chartwell St, San Ramon, CA, 94583-3519
Phone: 925-577-0980

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): 3 - 4
Technical Abstract (Limit 2000 characters):

The electric vertical takeoff and landing (eVTOL) market for Urban Air Mobility (UAM) and Advanced Air Mobility (AAM) applications is still in its fledgling stages in early 2024, despite several players in the market (notably Joby Aviation, CityAirbus, Archer, and Volocopter). However, there is a distinct lack of openly available data on how safety critical software algorithms are deployed in practice and how well they perform. Furthermore, whereas there are a great number of small-scale eVTOL unmanned aerial systems (UAS), there are very few that are specifically set up as representative subscale UAM aircraft. This is especially the case for motor tilt and rotor blade pitch collective subsystems which are rarely found as commercial off-the-shelf (COTS) items. This proposal seeks directly to bridge these gaps through the development of "SETTER": a Subscale EVTOL Testbed for safeTy critical softwarE development and scalability Research. SETTER is planned to be a Phase 1 and 2 STTR proposal, wherein a subscale eVTOL aircraft will be built and flown extensively during Phase 2. These tests will primarily serve to explore the following items: 1. A wide array of failure mode mitigation strategies in the presence of failures to any major DEP subsystem. 2. Aerodynamic and flight dynamics performance optimization through control allocation strategies. 3. The ability to predict full-scale flight dynamics using sub-scale prototypes. SETTER will be designed to have low enough cost, size, and ease of manufacture to be considered a highly attritable testbed with low overhead to enable fast and frequent flight testing. SETTER will be designed with a high degree of modularity in mind, so that testing of different configurations can be accommodated without full re-designs. All designs will be open sourced with accompanying documentation. This Phase 1 STTR proposal is comprised of all preparatory activities required to physically realize SETTER in Phase 2.

Duration: 13