NASA Ignite 2025-I Solicitation

Proposal Details

Proposal Number: I01.01-1007
Subtopic Title: Advanced real-time monitoring and control technologies for additive manufacturing
Proposal Title: Additive Manufacturing Real-Time Density Monitor

Small Business Concern

Firm: Albireo Technologies LLC
Address: 18870 Kilfinan St, Northridge, CA - 91326

Summary Details

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

To address the NASA need for real-time monitoring of additive manufacturing (AM) process, Albireo Technologies LLC (ATC) proposes to develop a new Additive Manufacturing Real-Time Density Monitor (AMRIDM) system. The AMRIDM, intended as a feedback sensor for providing real-time quality control for metal AM technologies, is based on probing the part's melt pool region with an X-ray beam and monitoring the intensity of the Compton-scattered signal. The AMRIDM will be able to characterize the real-time deposited density of the AM part, with the defects being immediately identified via irregular changes in the measured signal. When used as a fully integrated feedback sensor, the AMRIDM will enable the AM system to adjust the process parameters in real time to improve the part quality and reduce the need for post-processing. In Phase I, ATC will demonstrate the feasibility of the AMRIDM technology by fabricating and testing a prototype system , with a projected technology readiness level (TRL)-4. In Phase II, ATC plans to develop a modular TRL-6 AMRIDM system prototype capable of integration with commercial AM systems. In Phase III, ATC will team up with AM system manufacturers to develop a fully-functional AMRIDM system for high-fidelity, real-time AM process control.

Duration: 6

Proposal Details

Proposal Number: I01.01-1037
Subtopic Title: Advanced real-time monitoring and control technologies for additive manufacturing
Proposal Title: Born Qualified Additive Manufacturing for Space Using In-Situ Inspection

Small Business Concern

Firm: Phase3D
Address: 2415 W 19TH ST STE 2B-1, CHICAGO, Illinois - 60608-3054

Summary Details

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

Phase3D proposes to develop and deploy Fringe Inspection and Fringe Qualification real-time, in-situ inspection and qualification systems for metal additive manufacturing (AM) to address NASAs urgent need for deployable quality assurance tools that meet the stringent requirements of spaceflight hardware. These technologies directly respond to NASA Civil Space Shortfalls 1490 through 1494, including in-situ process monitoring, process qualification, part qualification, and qualification of complex geometries. The proposed system uses structured light scanning to generate calibrated, repeatable heightmaps of each printed layer, enabling early detection of defects such as powder anomalies, recoater collisions, and melt pool irregularities. This data supports traceable, standards-aligned qualification workflows compatible with NASA-STD-6030, NASA-STD-6033, and SAE AMS7032. Unlike legacy inspection methods, Fringe Inspection enables a born qualified paradigm where parts are validated during the build process rather than through post-process CT scanning and destructive testing. Funding from this Phase I effort will be used to adapt Fringe Inspection for a quad-laser EOS M300-4 printer at Northrop Grumman Corporation Space, collect and correlate over 50,000 layers of in- situ data with post-build CT scans, and define quantitative go/no-go thresholds for part acceptance. Expected outcomes include up to 60% reduction in qualification costs and 23Ã— acceleration in qualification timelines . Target markets include NASA, aerospace primes, defense contractors, and AM service bureaus seeking scalable, standards-compliant solutions for qualifying mission-critical components. By enabling real-time, machine-agnostic inspection and qualification, this technology will transform AM from a prototyping tool into a production-ready solution for spaceflight and other regulated applications.

Duration: 6

Proposal Details

Proposal Number: I01.01-1040
Subtopic Title: Advanced real-time monitoring and control technologies for additive manufacturing
Proposal Title: Intelligent Real-Time Additive Manufacturing (IRAM) Hybrid Digital Twin Platform

Small Business Concern

Firm: Rallypoint One LLC
Address: 3481 Ranger Rd, Davidsonville, Maryland - 21035-1316

Summary Details

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

This proposal introduces the Intelligent Real-Time Additive Manufacturing (IRAM) platform a novel hybrid digital twin system that transforms quality assurance in metal additive manufacturing from reactive inspection to predictive control. Targeting NASAs need for zero-defect production of space-grade components, IRAM integrates physics-informed neural networks with high-fidelity thermal-metallurgical models to anticipate and prevent defects in real time. Using Julias SciML ecosystem, the platform achieves sub-millisecond closed-loop response by embedding Universal Differential Equations (UDEs) within multi-physics models of melt pool dynamics and solidification processes. Multi-modal sensor data including thermal, optical, and acoustic inputs feeds directly into the hybrid model, enabling adaptive control of key parameters like laser power and scan speed. The Phase I effort will demonstrate feasibility through model development, space-grade alloy simulation, and integration with advanced control algorithms. The IRAM platform directly supports NASAs strategic goals for advanced manufacturing and in-space fabrication by enabling defect-free production of critical propulsion and structural hardware.

Duration: 6

Proposal Details

Proposal Number: I01.02-1008
Subtopic Title: Computational design of new materials, processes, and products leveraging the microgravity environment of space
Proposal Title: Alloy Simulation Toolkit for Robust Optimization in low Gravity (ASTRO-Grav)

Small Business Concern

Firm: QuesTek Innovations LLC
Address: 1820 RIDGE AVE, EVANSTON, IL - 60201-3621

Summary Details

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

To enable NASAs goals for in-space and on-surface manufacturing of parts/products and computational-materials-informed qualification and certification for in-space manufacturing, QuesTek (QT) will develop and demonstrate an Alloy Simulation Toolkit for Robust Optimization in low Gravity (ASTRO-Grav). The framework will incorporate four main technical thrusts: (1) Multi-fidelity PSP modeling, (2) High-throughput experiments, (3) Bayesian uncertainty quantification (UQ), and (4) Robust optimization. ASTRO-Grav will enable the use of modeling and experimental data to optimize materials and processes to reduce the variability in properties of interest resulting from irreducible uncertainties in inputs, like gravity during welding in space. In-space manufacturing is critical to space missions, both in low earth orbit, and for future lunar and Mars missions where astronauts need to be able to fix or replace parts in a reliable manner. Welding is a key manufacturing path for these repairs. To reliably weld parts in space, with low or no gravity (low-G) and often time in variable gravity due to acceleration, docking, and astronaut movements (so-called G-jitter) it is critical to understand the impact of gravity on processing of materials. Without gravity, hot air doesn’t rise, resulting in little or no convective cooling which leads to very slow cooling and solidification. These slow cooling and solidification conditions influence the microstructure evolution and in turn mechanical properties of materials. Moreover, it is impractical to machine tensile coupons and carry out full scale mechanical testing to qualify material properties in space. Thus, ASTRO-Grav will utilize a Bayesian UQ approach to combine multi- fidelity modeling and simulation to predict the evolution of microstructure and properties in these environments with high throughput experiments to validate these predictions in a feasible manner in space.

Duration: 6

Proposal Details

Proposal Number: I01.02-1009
Subtopic Title: Computational design of new materials, processes, and products leveraging the microgravity environment of space
Proposal Title: OrbitGRO: AI-Guided Growth of Space-Grade Semiconductors

Small Business Concern

Firm: Syrnatec Inc
Address: 549 CEDAR ST STE 400, NEWINGTON, Connecticut - 06111-1814

Summary Details

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

Syrnatec Inc. proposes the development and orbital integration of Î²--based wide-bandgap semiconductor wafers, grown in microgravity environments aboard the International Space Station (ISS). These wafers are engineered to deliver superior electrical performance, radiation hardness, and thermal resilience for next-generation spaceborne power electronics. The technology builds upon Syrnatecs flight- qualified MOSFETs and DCDC converters, developed under NASA programs, and leverages previous DARPA-funded work on perovskite-based hard X- ray detection. The requested funding will be used to scale Syrnatecs orbital wafer manufacturing capability, integrate ISS-grown substrates into industrial additive systems (specifically, Breton S.p.A.s Genesi printer), and validate their performance in real-world aerospace and defense applications. These wafers will offer 99.9% purity, >8 MV/cm breakdown strength, and >40% dopant uniformity improvement enabling compact, high-voltage systems that reduce power losses by up to 40% and operate reliably above 250Â°C. Target markets include space-qualified electronics, directed energy weapon systems, CubeSats, electric propulsion platforms, and high-efficiency terrestrial power infrastructure. Syrnatecs solution addresses critical gaps in U.S. semiconductor supply chains and directly supports national mandates under Executive Orders 13817 and 14017, aligning with over $900B in FY2025 NDAA funding for microelectronics and aerospace technologies.

Duration: 6

Proposal Details

Proposal Number: I02.01-1011
Subtopic Title: Multidisciplinary Space Hardware design automation leveraging AI techniques
Proposal Title: Momentum, AI-Driven Multidisciplinary Hardware Design Automation

Small Business Concern

Firm: Dan Mueller Consulting LLC
Address: 3931 E 5th St, Long Beach, CA - 90814

Summary Details

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

Momentum is a multidisciplinary AI-driven design automation tool designed to significantly enhance engineering efficiency and creativity by automating repetitive tasks, streamlining workflows, and enabling rapid exploration of expansive design possibilities. Momentum integrates three main components: a structured Framework, a dynamic Process, and a robust Tool Orchestrator. The Framework provides clear, stage-gated maturity milestones from mission definition through concept and preliminary design, ensuring traceability via an auditable verification chain. The Process features a human-centric agentic workflow that users control through an intuitive chat interface, managing actions, generating engineering artifacts, and providing critical knowledge reviews. The Tool Orchestrator seamlessly integrates existing engineering tools (CAD, FEA, analysis, manufacturing), using an open, extensible framework to ensure compatibility and flexibility with diverse user requirements. Phase I specifically targets TRL-4 maturity by demonstrating a payload adapter and dispenser system within disciplines including systems engineering, structures, mechanisms, materials and processes, thermal, and manufacturing. Momentum enables engineers to explore up to 10 times more design alternatives and reduces time to manufacturable solutions by at least 5 times. The initial market focus is on 35,400 U.S. aerospace engineers, with planned future expansion to other engineering disciplines.

Duration: 6

Proposal Details

Proposal Number: I02.01-1029
Subtopic Title: Multidisciplinary Space Hardware design automation leveraging AI techniques
Proposal Title: NXGen Multidisciplinary Space Hardware design Tool

Small Business Concern

Firm: Neoskye Inc
Address: 549 Cedar Street, NEWINGTON, Connecticut - 06111-1812

Summary Details

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

NXGen is an AI-driven text-to-hardware platform that compresses a weeks- long spacecraft design cycle into a single, automated day. By reading mission requirements written in plain English or SysML, a fine-tuned language model turns them into structured inputs. An encoder-decoder engine then generates fully parameterised 3-D CAD for avionics enclosures, while an image-based surrogate simulator instantly checks thermal, vibration, and structural performance. A built-in manufacturability module flags thin walls, overhangs, and other shop-floor issues in real time. The system outputs STEP files, along with traceable pass/fail reports, slashing iteration time by more than five times and aligning with NASAs Text-to-Spaceship digital engineering vision. Purpose of the Technology The goal is to space-hardware design: Engineers or mission planners without advanced CAD skills describe functional requirements for an enclosure, and the platform produces a verified model prepared for manufacturing. This reduces late-stage failures, frees scarce engineering labor, and creates a reusable framework that will be expanded to propulsion, cryogenics, or even terrestrial industries. Funding & Market Outlook Automated design and simulation for aerospace and industrial housings is a $1316 billion annual market. Capturing just 0.1 % by year 5 translates to $18 million in revenue, with early sales focused on high-value spacecraft suppliers and OEMs before widening to power-generation and industrial-turbine sectors.

Duration: 6

Proposal Details

Proposal Number: I02.01-1035
Subtopic Title: Multidisciplinary Space Hardware design automation leveraging AI techniques
Proposal Title: Flight-Ready Generative Design for Rocket Engine Cooling Systems

Small Business Concern

Firm: PhiNyx Technologies, Inc.
Address: 221 Fritz Way, Cibolo, Texas - 78108

Summary Details

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

PhiNyx proposes a next-generation generative design platform that automates the creation of mission-ready, physics-driven space hardware. The system integrates AI-informed geometry generation, GPU-accelerated physics simulation, and design-for-manufacturing constraints to produce hardware optimized for thermal, fluid, and structural performance. Phase I will focus on regeneratively-cooled rocket engines: among the most demanding environments in aerospace. The platforms core capabilities also apply to adjacent domains such as fusion energy, hypersonics, and advanced electronics cooling; each offers strong commercial potential beyond spaceflight. This dual-use solution aims to dramatically reduce design-build-test cycles from months to days, accelerating the development of safer, more efficient, more reliable high-performance hardware for the advancement of humanity, both in space and on our home planet.

Duration: 6

Proposal Details

Proposal Number: I02.01-1049
Subtopic Title: Multidisciplinary Space Hardware design automation leveraging AI techniques
Proposal Title: Mixed Initiative Collaborative Agents for Robot Design

Small Business Concern

Firm: TRAC Labs
Address: 100 NE LOOP 410 STE 520, SAN ANTONIO, Texas - 78216-4727

Summary Details

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

Robots will play an increasingly important role in future space missions. Robots will be exploring distant planets, moving Lunar regolith, assembling structures on the lunar surface, constructing space telescopes, and assisting crew members in their tasks. Designing a space robot is a complex task with multiple trade-offs in shape, size, strength, and flexibility. Current space robots are one-of-a-kind, custom-designed for their particular set of tasks. Design factors and requirements unique to space robot systems include the need to fit within launch vehicle fairings, minimizing weight to reduce launch cost, while still guaranteeing payload capacity and task capabilities. Optimizing over these many objectives can take years. Emerging artificial intelligence tools such as Large Language Models (LLMs) and Reinforcement Learning (RL) can assist engineers in both the iterative design of and the simulated testing of space robots. In this proposal, we introduce Mixed Initiative Collaborative Agents for Robot Design (MICARD), which will assist NASA robotics engineers in designing robots for space mission tasks. Starting with a natural language description of the task and the task requirements along with an input database of robot components such as motors, gears, shafts, etc. MICARD will iteratively and collaboratively design a robot and then test that robot in a 3D, physics-based simulation to evaluate its performance. The integration of new technologies such as LLMs with dynamic simulations to drive design optimization is a novel concept that promises a large payoff.

Duration: 6

Proposal Details

Proposal Number: I02.01-1050
Subtopic Title: Multidisciplinary Space Hardware design automation leveraging AI techniques
Proposal Title: AI-Coupled Design Agents for Real-Time Adaptive Spacecraft Architecture

Small Business Concern

Firm: UHV3D Inc. dba. CAMINNO
Address: 2778 AGUA FRIA ST, SANTA FE, NM - 87507-5491

Summary Details

Estimated Technology Readiness Level(TRL Begin - TRL End): TRL 3 - TRL 6
Technical Abstract (Limit 2000 characters):

Designing atmospheric reentry capsules remains a multidisciplinary challenge, requiring precise trade-offs between aerodynamic stability, thermal protection, structural integrity, and manufacturability. Traditional tools, such as ANSYS and Siemens Simcenter, rely on siloed workflows with computationally intensive simulations and manual design iteration, limiting scalability and speed. This project proposes an AI-powered design automation framework that integrates large language models (LLMs) and scientific machine learning (SciML) to enable end-to-end, human-in-the-loop reentry capsule design. The system ingests natural language mission requirements and engineering data to automatically generate optimized capsule geometries, evaluate aerodynamic and thermal protection performance using fast, physics-informed surrogate models, and provide real-time manufacturability feedback via open standards like STEP-NC and IPC-2581. An agent-based optimization loop employs reinforcement learning and Bayesian methods to explore design configurations across variables such as nose angle, TPS layout, and center of gravity location coupled to trajectory-based constraints. The final Phase I deliverable will be a containerized, API-accessible platform validated against traditional high-fidelity tools, demonstrating at least a 5Ã— reduction in design cycle time for a reentry-critical subsystem. This capability aligns with NASA's Text-to-Spaceship vision and lays the groundwork for autonomous, adaptive spacecraft hardware generation.

Duration: 6

Proposal Details

Proposal Number: I03.01-1018
Subtopic Title: Low-cost mm-wave and cm-wave radar for planetary exploration vehicles
Proposal Title: Versatile Imaging System for Terrain & Anomaly Detection (VISTA)

Small Business Concern

Firm: Vulcan Ventura Inc
Address: 2412 Wimbledon St, Concord, North Carolina - 28025

Summary Details

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

Our proposed innovation is a ground-based, low-cost millimeter-wave (mm-wave) and centimeter-wave (cm-wave) radar system specifically designed for planetary exploration vehicles. At its core, the system leverages commercially available automotive radar SoC components, enhanced with custom RF front-end modules and advanced digital signal processing tailored for extraterrestrial environments. The radar operates in the 7781 GHz and 2428 GHz bands, offering dual-band capability to optimize both fine-scale surface resolution and deeper subsurface probing. Key innovations include a novel antenna array design that balances a narrow beamwidth for high-resolution 3D mapping with a wide field of view for hazard detection, and an onboard AI-driven inference engine that performs real-time object classification and segmentation of radar returns. The AI engine, trained on vast synthetic datasets generated via our ultra-low-latency Electromagnetic (EM) simulations, delivers sub-decimeter accuracy in terrain reconstruction, as well as robust identification of static obstacles (e.g., rocks, cliffs) and dynamic entities (e.g., rover wheels, astronaut suits) in the presence of planetary dust and complex surface geometries. The radars modular SWaP architecture enables seamless integration onto rovers, crew transport vehicles, and surface drones. Quantum Ventura (JV partner)'s existing partnership with Lockheed Martin will be leveraged to exploit their deep ties to the defense industry can provide a direct path into military UGV programs of record. We will explore mining industry as its operational environment is the closest terrestrial analog to planetary exploration, maximizing the direct reuse of the technology developed for NASA. Furthermore, its exceptionally high CAGR of over 22% indicates a strong market pull and willingness to invest in technologies that provide a clear return on investment through increased safety and productivity.

Duration: 6

Proposal Details

Proposal Number: I03.01-1019
Subtopic Title: Low-cost mm-wave and cm-wave radar for planetary exploration vehicles
Proposal Title: Real-Time 3D Mapping and Navigation Using Low-Cost Millimeter-Wave Radar for Autonomous Vehicles

Small Business Concern

Firm: Wearless Device, LLC
Address: 905 Bannockburn Dr, Lexington, South Carolina - 29073-6112

Summary Details

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

This Phase I project proposes the development of a compact, low-cost millimeter-wave (mmWave) radar system to enable real-time 3D terrain mapping, hazard detection, and navigation support for planetary exploration vehicles operating in harsh and visually degraded environments such as the lunar or Martian surface. The proposed system leverages automotive-grade mmWave radar chips, combined with advanced signal processing and machine learning algorithms to generate high-resolution 3D point clouds, detect both static and dynamic hazards, and self-localize within the mapped environment. To ensure mapping fidelity despite rover movement, the system incorporates motion compensation techniques by fusing inertial measurement unit (IMU) data with radar reflections with non-linear synthetic aperture radar (SAR) processing. The point cloud is further refined using learning-based noise filtering methods. For obstacle identification, the system integrates a machine learning-based hazard detection module trained to recognize terrain features such as rocks, cliffs, and slopes from radar intensity and Doppler signatures. In addition, the platform demonstrates radar-based self-localization using radar odometry by matching successive radar point clouds to estimate vehicle motion and drift. Together, these innovations deliver a compact, rugged, and intelligent sensing solution tailored for planetary exploration. Funding will be used to design and prototype the radar hardware, develop onboard software for real-time mapping and object detection, and validate the system in simulated planetary conditions. The technology offers a robust,

cost-effective alternative to conventional lidar and optical systems, particularly in dust, darkness, or extreme lighting conditions. Beyond NASA missions, the system holds strong dual-use potential in commercial markets, including underground mining, autonomous robotics, smart agriculture, and disaster response.

Duration: 6

Proposal Details

Proposal Number: I04.01-1017
Subtopic Title: Modular, scalable robotic subcomponents to unlock scalable robotic manufacturing & assembly in remote, challenging environments
Proposal Title: Miniaturized High Torque Density Modular Actuators for SmallSats and Challenging Environments

Small Business Concern

Firm: HEBI
Address: 3577 BIGELOW BLVD FL 3, PITTSBURGH, Pennsylvania - 15213-1074

Summary Details

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

HEBI Robotics proposes to develop miniaturized, high torque density modular robotic actuators ruggedized for challenging environments. This project aims to bridge the gap between inexpensive, low-performance hobby servos and costly, custom-designed space robotics systems. Phase I will involve a feasibility study to determine optimal design parameters, including form factor, motor and gearbox combination types, and BOM costs at various production scales (100, 1,000, and 10,000 units per year). The results of which will lead to an initial proof-of-concept design and prototyping of the miniaturized actuator assembly. The ultimate goal is to enable affordable, versatile, and scalable mass-production of robotic actuation for manufacturing and assembly tasks in challenging environments, both terrestrially and in space. This will significantly benefit both NASA's in-space servicing missions and diverse commercial applications in industries such as agriculture, confined space inspection, and academia.

Duration: 6

Proposal Details

Proposal Number: I04.01-1021
Subtopic Title: Modular, scalable robotic subcomponents to unlock scalable robotic manufacturing & assembly in remote, challenging environments
Proposal Title: Mass-Optimized Rotary Actuators for Scalable Space Robotics: A COTS-Based Approach

Small Business Concern

Firm: Interlune Corporation
Address: 5601 6th Ave S STE 270, SEATTLE, WA - 98108

Summary Details

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

Future space exploration and industrial operations require standardized, scalable, and cost-effective robotic components capable of enduring extreme orbital, lunar, and Martian environments. Current solutions are often custom, expensive, and lack reconfigurability. Interlune proposes to develop a reconfigurable, scalable, and mass-producible rotary actuator architecture using commercially available (COTS) parts to address this gap. This innovation focuses on engineering an environmentally robust packaging and interface system around selected COTS motors and gear component sets. This design will ensure survivability and operability across wide temperature and pressure ranges, protect against space radiation, mitigate dust intrusion, and enable mass optimization. A non-proprietary electrical interface will facilitate modularity and interoperability across diverse robotic platforms. The goal is to create a lightweight COTS actuator family, specifically designed for space applications, by eliminating the customization barrier typically associated with these components. Phase I funding will be used to design and build a prototype of a representative small-scale actuator. This effort includes assessing the full scalable range of the technology, evaluating critical COTS components (including lubricants, bearings, and seals), and establishing a roadmap for Technology Readiness Level (TRL) advancement. The technology's primary target markets include NASA's exploration and infrastructure programs, as well as commercial lunar and Martian missions (e.g., landers, rovers, in-space servicing, assembly, and manufacturing). This actuator will provide a more affordable,

adaptable, and dependable component solution, with an initial flight demonstration planned on a robotic arm during a future Interlune lunar prospecting mission.

Duration: 6

Proposal Details

Proposal Number: I04.01-1027
Subtopic Title: Modular, scalable robotic subcomponents to unlock scalable robotic manufacturing & assembly in remote, challenging environments
Proposal Title: Hierarchically Structured Dry Adhesive Materials to Enable Dexterous Robotic Grasping

Small Business Concern

Firm: Nanoscale Labs
Address: 1006 BRENTWOOD ST, AUSTIN, Texas - 78757

Summary Details

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

Grasping uncooperative objects in space remains a critical challenge for NASA's robotic systems. Traditional gripping technologies vacuum grippers, sticky attachments, and mechanical grippers are incompatible with space environments due to vacuum conditions and the unique geometries of space debris and satellites. In this project Nanoscale Labs will develop a novel low-cost gecko-inspired dry adhesive material (GDAMs) with hierarchical nano- and microscale surface structures enabling reliable, passive gripping for space robotics. Our innovation directly addresses NASA SBIR IGNITE Subtopic I04.01's need for low-cost, modular, scalable robotic subcomponents by delivering a fundamentally new end-effector technology. The proposed GDAM features three breakthroughs: (1) ultra-low-cost manufacturing via proprietary spray-based self-assembly, reducing costs by 10x-100x versus current lithography and molding methods, (2) 3x-10x increased adhesion strength per unit area compared to commercial offerings, enabling smaller, lighter grippers, and (3) hierarchical nano- and microscale structures providing superhydrophobic self-cleaning properties critical for space dust resistance. Phase I will deliver a prototype hierarchical GDAM to demonstrate technical feasibility of our scalable colloidal lithography approach. Our team combines Dr. Gabriel Cossio's expertise in nanopatterning and the patent-pending Aerosol Assisted Self-Assembly (AASA) platform with Dr. Mitch

Pryor's Nuclear & Applied Robotics Group for comprehensive team across material science and applied robotics system development. Phase II will advance GDAM adhesion strength via novel geometry and deliver a prototype grasping robot with autonomous grasping enabled via computer vision volumetric grasping network algorithm.

Duration: 6