National Institute of Standards and
Technology
Department of Commerce

SBIR

SMALL BUSINESS INNOVATION

RESEARCH PROGRAM

PHASE I and PHASE II

AWARDS FOR FISCAL YEAR 2018

INTRODUCTION

Abstracts of Awards for Fiscal Year 2018 SBIR Program

Note: Certain non-ASCII characters may not be represented accurately in this document. In cases where there may be doubt, please direct your questions to sbir@nist.gov.

Fiscal Year 2018 List of Awardees

Award Number	Company Name	Open Topics/Topic Areas	Phase
70NANB18H190	Advanced Silicon Group	Advanced Manufacturing and Materials Measurements	Phase I
70NANB18H185	Alphacore, Inc.	Exploratory Measurement Science	Phase I
70NANB18H187	Applied NanoFluorescence, LLC	Advanced Manufacturing and Materials Measurements	Phase I
70NANB18H184	CyberPoint International, LLC	Cybersecurity and Privacy	Phase I
70NANB18H189	H3D, Inc.	Advanced Manufacturing and Materials Measurements	Phase I
70NANB18H173	InfoBeyond Technology, LLC	Cybersecurity and Privacy	Phase I
70NANB18H172	Nikira Labs, Inc.	Exploratory Measurement Science	Phase I
70NANB18H183	OG Technologies	Advanced Manufacturing and Materials Measurements	Phase I
70NANB18H186	Pollere, Inc.	Advanced Communications, Network, and Scientific Data Systems	Phase I
70NANB18H188	Senvol, LLC	Advanced Manufacturing and Materials Measurements	Phase I
70NANB18H178	Steve Winter Associates, Inc.	Physical Infrastructure and Resilience	Phase I
70NANB18H176	Cadre Research Labs, LLC	Systems	Phase II
70NANB18H179	ColdQuanta, Inc.	Precision Measurements	Phase II
70NANB18H182	En'Urga, Inc.	Collaboration and Partnership	Phase II
70NANB18H175	Low Thermal Electronics, Inc.	Precision Measurements	Phase II
70NANB18H181	MBSE Tools, Inc.	Data and Modeling	Phase II
70NANB18H171	MetroSage, LLC	Data and Modeling	Phase II
70NANB18H170	Nikira Labs, Inc.	Systems	Phase II
70NANB18H169	Smart Information Flow Technologies (SIFT), LLC	Systems	Phase II
70NANB18H174	Tetramer Technologies, LLC	Precision Measurements	Phase II
70NANB18H180	XpressRules, LLC	Systems	Phase II

FY 2018 PHASE I AWARD

Topic: Advanced Manufacturing and Material Measurements

Subtopic: Biomanufacturing

Title: Measuring the Concentration of Host-cell Proteins in Biomanufacturing Using Silicon Nanowire Array Sensors

OU: Material Measurement Laboratory

Firm: Advanced Silicon Group
173 Bedford Rd.
Lincoln, MA 01773

Principal Investigator: Marcie Black
Phone: (954) 471-1357
Email: marcie@advancedsilicongroup.com

Award Amount: $100,000

Abstract: Advanced Silicon Group's innovation is a low cost, sensitive, quantitative biosensor that can detect many biomarkers on the same chip. The sensor consists of vertically aligned silicon nanowires. The silicon nanowires' high surface area to volume ratio makes them sensitive to the environment around them and can thus lead to high sensitivity detection. Each of the nanowires can be functionalized to be sensitive to either specific DNA or proteins. For Phase 1 of this SBIR, Advanced Silicon Group will apply their already demonstrated biosensor to monitoring HCPs in biomanufacturing. In particular, they will functionalize their silicon nanowires to be sensitive to Escherichia coli (E. coli) HCPs. As a first step they will measure a conglomerate of HCPs that are present in potential product, but eventually will separate the antibodies and measure each protein in a separate sub-sensor.

Commercial Applications: The sensor will measure the concentration of host cell proteins rapidly and with minimal hands-on time and do so at a low cost. The sensor will allow manufacturers to test at multiple points in their manufacturing process (inline utility) and to focus on reducing harmful HCPs by modifying the manufacturing process or improving the purification process. The improved manufacturing of biopharmaceuticals as a result of a rapid quantifiable measurement of HCPs in the manufacturing process will result in safer therapies for patients.

Topic: Exploratory Measurement Science

Subtopic: Intermediate Frequency Conversion System for High-Bandwidth Multiplexed Sensors Arrays

Title: IF Conversion System for High-Bandwidth Multiplexed Sensors Arrays

OU: Physical Measurement Laboratory

Firm: Alphacore, Inc.
398 South Mill Ave.
Tempe, AZ 85281

Principal Investigator: Esko Mikkola
Phone: (520) 647-4445
Email: esko.mikkola@alphacoreinc.com

Award Amount: $99,942

Abstract: Alphacore will develop an Intermediate Frequency (IF) Conversion System for High-Bandwidth Multiplexed Sensors Arrays. Alphcore has already successfully developed and evaluated a similar printed-circuit board (PCB)-based system for NIST (ROACH2 BLAST-TNG, refer section 1.2). The goal in Phase I is therefore to achieve two primary main objectives: 1) Optimize a system architecture for a single-board Intermediate Frequency Conversion System 2) Design, fabricate and test the individual components that comprise the Intermediate Frequency Conversion System. The final single-board design will be evaluated and optimized in the Phase II program.

Commercial Applications: Readout systems for MKID arrays developed by NIST for homeland security, medical imaging, radio telescopy, nuclear non-proliferation detection systems.

Topic: Advanced Manufacturing and Material Measurements

Subtopic: Measuring Handedness by Fluorescence

Title: Multimode Chiroptical Spectrometer for Nanoparticle Characterization

OU: Material Measurement Laboratory

Firm: Applied NanoFluorescence, LLC
3701 Kirby Drive
Houston, TX 77098

Principal Investigator: Tonya Cherukuri
Phone: (713) 521-1450
Email: kc@appliednano.com

Award Amount: $99,970

Abstract: This project will develop a new scientific instrument optimized for the advanced characterization of near-infrared fluorescent nanoparticles that can exist as left- or right-handed structures (enantiomers). Single-walled carbon nanotubes (SWCNTs) are currently the leading example of such nanomaterials. Applied NanoFluorescence, LLC (ANF) proposes a novel multi-mode chiroptical spectrometer that can distinguish left and right enantiomers through their differing interactions with circularly polarized light. The instrument will offer four complementary measurement modes. These modes are (1) fluorescence-detected circular dichroism (FDCD) spectra with visible excitation (400-700 nm) and near-infrared emission (900-1600 nm); (2) rapid excitation-emission fluorimetry covering the same visible excitation and near-infrared emission ranges; (3) direct near infrared circular dichroism absorption spectra; and (4) normal near-infrared absorption spectra. Unlike existing FDCD instruments, mode (1) will offer spectral selection of the emission wavelength, thus allowing structure specific measurements of CD spectra in unsorted SWCNT samples. Mode (2) will measure full excitation-emission maps with peak signal-to-noise ratios above 100 in less than 2 minutes. All four measurement modes will be performed under computer control. The combined results will offer powerful analyses of complex nanoparticle samples and their coatings, guiding production, processing, and application development.

Commercial Applications: Nanomaterials have substantial potential for electronic and biomedical applications. Controlling enantiomeric content of these nanomaterials may be critical in pharmaceutical applications, where molecular handedness is known to have dramatic biological effects. However, there are currently inadequate analytical tools for distinguishing handedness of nanoparticles. The project will develop a novel instrument to address this unmet need. It will enable fast, sensitive, and quantitative analysis of complex nanoparticle samples, including their handedness. The outcome of this project (following Phase II) will be a new type of commercial instrument to support nanoparticle separation and quality control in manufacturing.

Topic: Cybersecurity and Privacy

Subtopic: Digital Forensics

Title: TheSieve

OU: Information Technology Laboratory

Firm: CyberPoint International, LLC
621 E. Pratt St.
Baltimore, MD 21202

Principal Investigator: Mark McLarnon
Phone: (410) 779-6700
Email: mmclarnon@cyberpointllc.com

Award Amount: $81740.49

Abstract: CyberPoint will create an advanced forensic analysis tool called TheSieve. This tool will use machine learning techniques that can classify files as malicious or benign as well as suggesting files for closer inspection. Built upon custom enhancements to the National Software Reference Library (NSRL), TheSieve will allow forensic investigators to spend their valuable time examining the most significant files. An important application of data repositories, like those in the NSRL, is a system that associates NSRL hash values with additional information derived through static and dynamic analysis. Phase I will yield a prototype web service and application delivered with integrations into at least one forensic analysis software package. TheSieve will be used in a controlled case study to determine if searching and provided suggestions can reduce the amount of time spent identifying files. Time permitting, the prototype will improve file suggestions using machine learning. TheSieve will not replace endpoint detection and response products (EDR), instead it will augment them by applying Big Data analysis techniques. Finally, CyberPoint will develop a process by which TheSieve database can be improved with an analyst feedback loop to enhance previously seen queries.

Commercial Applications: TheSieve has commercial benefit for forensic analysts as a web service or REST API that can be queried through an integration script or tool. CyberPoint envisions a freemium model where users can perform a set number of basic queries and subscribers can use an access token or key to perform more advanced analysis queries. This website will be designed to function offline for parties where analysis is performed on air-gapped networks. TheSieve will provide client API examples for scripting languages (e.g. Python) for simplicity.

Topic: Advanced Manufacturing and Material Measurements

Subtopic: Compton Scattering Tomography System with Sub-keV Energy Resolution for Gamma Ray Energy at 1-10 MeV Range

Title: Dual Plane 3D Compton Scattering Imager with Pixelated CZT Detectors for 1-10MeV Gamma Ray

OU: Material Measurement Laboratory

Firm: H3D, Inc.
812 Avis Dr.
Ann Arbor, MI 48108

Principal Investigator: Hao Yang
Phone: (734) 661-6416
Email: hao@h3dgamma.com

Award Amount: $100,000

Abstract: A dual plane Compton imager prototype system with large volume pixelated CZT detectors will be built for spectrally resolved MeV gamma ray tomographic applications. These two planes will be operated at independent clocks and they will be synchronized via a common periodical pulse. The common periodical pulse is self-generated so it does not rely on external pulse generator. Each detector will be coupled with an application specific integrated circuit (ASIC). The ASIC will convert the gamma ray energy detected by the CZT detectors to a voltage signal. An in-house developed readout and processing electronics will translate the voltage signal to corresponding location and energy deposition information of each gamma ray interaction. This information will be used by 3D Compton imaging reconstruction algorithm to create a 3D map of the material of interest inside the under-test object. In order to achieve the best imaging performance for this application, various detector position configurations and reconstruction algorithms will be evaluated. The final prototype system with optimal reconstruction algorithm will be tested by resolving phantoms with different hydrogen mass concentration.

Commercial Applications: Prompt gamma activation analysis has been used both in industrial application and medical applications. H3D's CZT detector technology inherently provides better energy resolution so the material analysis industries and non-destructive testing industries may use H3D'S technology to enhance their capability of resolving gamma ray emissions from various elements. Prompt gamma activation analysis has also been adopted in the medical application, such as the proton beam range verification in proton therapy. The CZT detector technology will provide high resolution energy and position information of the MeV gamma rays to calculate the proton beam range in-vivo.

Topic: Cybersecurity and Privacy

Subtopic: Leveraging Cyber Security Framework to Identify the SP 800 53 Security and Privacy Controls for Cloud-based Information Systems

Title: Leveraging Cyber Security Framework to Identify the SP 800 53 Security and Privacy Controls for Cloud-based Information Systems

OU: Information Technology Laboratory

Firm: InfoBeyond Technology, LLC
320 Whittington Pkwy.
Louisville, KY 40222

Principal Investigator: Bin Xie
Phone: (502) 371-0907
Email: Bin.Xie@InfoBeyondtech.com

Award Amount: $99,999.65

Abstract: NIST developed information system risk management and guidelines that assist agencies in implementing integrated, organization-wide programs to manage information security risk. However, further improvement and implementation of new functions are needed such that it can be commercialized as an enterprise tool. In this project, InfoBeyond advocates the development of a user-friendly, efficient, reliable, and generic tool. InfoBeyond Technology's tool: (i) an Enterprise CSAT standalone version (Phase I), and (ii) a cloud version (Phase II). Specifically, the tool overcomes the NIST's tool limitations such as failing FIPS policy due to outdated MS internal configuration, insecure software architecture, requiring MS Excel for report generation and database repopulation, and running single operating platform. Further, the tool implements new features, such as additional SP 800 series data for risk management, technical user credential management service, and built-in database editor. All these improvements or new features facilitate government agencies' adoption of secure cloud solution effectively through friendly GUI. For efficiency, the tool is implemented in an MVC software framework to achieve enterprise-level runtime performance with scalability for many users.

Commercial Applications: InfoBeyond's tool falls in the cloud security market which has grown by more than 19.29% yearly. The tool offers the value propositions to enhance and facilitate Federal and local government agencies' adoption of secure cloud solution in order to meet the FISMA requirements. This protects the information in the clouds or information systems to ensure that these systems operate securely and reliably. In addition to the market of the government agencies, the tool can be used for enterprises to achieve NIST-graded privacy and security protection in their information systems, e.g., Banking, Financial Services and Insurance (BFSI), Healthcare, Pharmaceutical, and Chemical, etc.

Topic: Exploratory Measurement Science

Subtopic: In-line Spectral Filtering for Integrated Raman Fiber Optic Probes

Title: Compact Raman Fiber Optic Probe with Inline Spectral Filtering

OU: Material Measurement Laboratory

Firm: Nikira Labs, Inc.
1931 Old Middlefield Way
Mountain View, CA 94043

Principal Investigator: Manish Gupta
Phone: (650) 906-0274
Email: manish.gupta@nikiralabs.com

Award Amount: $99,962

Abstract: In this SBIR effort, Nikira Labs Inc. will develop a compact Raman fiber optic probe with inline spectral filtering that improves fiber-coupled Raman measurements by filtering out Raman scattering from the excitation fiber and elastically scattered laser light from the collection fibers. The technology will enable compact fiber probes for Raman studies and complement existing NIST Raman spectroscopy efforts including tissue studies and broadband coherent anti-stokes Raman scattering. In Phase I, Nikira Labs will demonstrate technical feasibility by fabricating a set of Raman probes that include a central excitation fiber surrounded by collection fibers. A custom, dielectric coating will be deposited on the face of the excitation fiber to serve as a bandpass filter and remove wavelengths generated by inelastic Raman scattering within the fiber. Likewise, dielectric coatings will be deposited on the collection fiber faces to reject elastically scattered laser light and only pass Raman signal. The fibers will be integrated into a probe assembly and extensively tested on Raman standards, highly scattering compounds, and a phantom tissue sample. Finally, the Phase I results will be used to design a Phase II system.

Commercial Applications: In Phase III, Nikira Labs Inc. will commercialize the Raman fiber optic probes for numerous markets including research and development laboratories, in vivo medical procedures, and non-invasive blood glucose monitoring. A preliminary market estimate suggests 5-year global revenues of $2.2 – $7.7M and $8M for the former two market segments alone. Moreover, these attractive markets are expected to continue to grow, with the in vivo market having a predicted compound annual growth rate (CAGR) of 5.3 % through 2022. Contingent upon the SBIR funding, Nikira Labs Inc. is poised to take advantage of this growth.

Topic: Advanced Manufacturing and Material Measurements

Subtopic: Smart Visualization for Smart Manufacturing

Title: Manufacturing Data Compiler for Visualization Based on Engineering-Driven Machine Learning

OU: Engineering Laboratory

Firm: OG Technologies
4480 Varsity Dr.
Ann Arbor, MI 48108

Principal Investigator: Tzyy-Shuh Chang
Phone: (734) 973-7500
Email: chang@ogtechnologies.com

Award Amount: $100,000

Abstract: There has been substantial development in data analytics. However, the complex mathematical formulation of “big data analytics” is difficult to populate in general manufacturing plants. There is a need for an SPC-like tool to enable the acceptance of the advanced data analytics and its visualization. The MD Compiler, a tool to bridge the gap between data available and the information demanded by the users, is proposed. It will employ a hierarchical approach along with machine learning to complement the knowledge of the process so that the manufacturing data streams generate the informative process indexes that can be formulated quickly and presented to the operators for the illustration of the intended process attribute(s) and/or causal relations. The innovation of this SBIR project consists of the integration of the industrial process/product states into the data pipeline and applying unsupervised machine learning to automate the “mapping” processes in the analytics along with the concept of process snapshots. The MD Compiler, once developed, is expected to be a software package with functional modules that can take in the source data and automatically compile the data into informative process indexes for presentation with computing and data acquisition hardware support.

Commercial Applications: The intended SBIR product is targeting those users with complex enough manufacturing processes but lack of resources to employ a team of data experts. There is still a substantial room to improve in process efficiency, from a garage-sized shop making diamond pad conditioners for CMP to as large as a steel mill. The advancement of data analytics and visualization could make a major contribution as there is still a huge room to Theoretical Optimal Practices for the manufacturers. The potential customer base for the MDC product is in the order of tens of thousands of plants.

Topic: Advanced Communications, Networks, and Scientific Data Systems

Subtopic: Secure and Distributed Network Measurement

Title: Secure Role-Based System for Distributed Network Measurement

OU: Information Technology Laboratory

Firm: Pollere, Inc.
1213 Alamo St.
Montara, CA 94037

Principal Investigator: Kathleen Nichols
Phone: (650) 529-0231
Email: nichols@pollere.net

Award Amount: $99,697

Abstract: Network measurement is a critical element in networks but it has largely been an afterthought and inadequately secured. With the emergence of Information-Centric Networking technologies, specifically the popular open source Named-Data Networking (NDN), there is the early stage opportunity to create a useful and flexible network measurement system that can accommodate a range of network probes. This project's objective is development of a prototype distributed Network Measurement System (NMS) that leverages the NDN architecture to ensure privacy of data and role-based authorization of entities in the NMS. The NMS can be deployed in devices with an NDN Forwarding Daemon (NFD) within an all-NDN network or as an overlay measurement system in an IP network. NDN-specific performance probes will be developed.

Commercial Applications: Whether the future of the Internet is Information-Centric Networking or not, ICN is already making an impact in specialized areas, particularly Internet of Things, which is projected by Forbes to grow to $8.9T in 2020, and in government networking where it is at the heart of new DARPA program. Network measurement has proven to be critical in networking as a way to prevent and quickly recover from costly downtime. Development of a flexible network measurement system for ICN can be used by companies deploying ICN and is expected to bring consulting revenue to Pollere in its application and development of new probes.

Topic: Advanced Manufacturing and Material Measurements

Subtopic: Continuous Learning for Additive Manufacturing Processes Through Advanced Data Analytics

Title: Continuous Learning for Additive Manufacturing Processes Through Advanced Data Analytics

OU: Engineering Laboratory

Firm: Senvol, LLC
335 Madison Ave.
New York, NY 10017

Principal Investigator: Annie Wang
Phone: (267) 241-1119
Email: annie.wang@senvol.com

Award Amount: $99,946

Abstract: Additive manufacturing (AM) is a promising manufacturing technique for end-use parts that can solve challenges for American manufacturers in many industries, e.g. aerospace, defense, automotive, energy, and healthcare. However, despite the potential that AM offers, the rate of AM adoption in industry is very slow. This is because AM suffers from low repeatability and quality consistency issues, which lead to high cost and time requirements in AM qualification. Conventional manufacturing is mature enough such that there are commercially available engineering software and data analytics tools (e.g. injection molding simulation, casting simulation, finite element analysis) that elucidate Parameter-Structure-Property (PSP) relationships. Unfortunately, in the AM industry, these engineering software tools are barely nascent and not fully validated for AM, and appropriate data analytics tools for understanding PSP relationships do not exist. Furthermore, the database schema that holds and structures the data upon which AM engineering software tools draw is not standardized for AM data. Senvol will develop a robust AM data schema that will be able to structure multiple types of AM data, including in-situ monitoring data, microstructure data and non-destructive testing (NDT) data; and to further develop a data analytics software tool that will analyze AM's PSP relationships.

Commercial Applications: Senvol's revised AM data schema and AM data analytics tools will help American manufacturers increase their rate of adoption of AM, and thus improve their global competitiveness. Manufacturers will be able to leverage the updated schema to structure their AM data, which, in turn, will make it easier for them to analyze the AM data that they have already collected. Manufacturers will be able to use Senvol's data analytics tool to quantify AM PSP relationships. Overall, the work being done in this project will help American manufacturers increase the speed of and improve the effectiveness of their AM qualification efforts.

Topic: Physical Infrastructure and Resilience

Subtopic: Self Configuring Residential Conditioned Air Zoning System for Low Energy Homes

Title: Self-Configuring Residential Conditioned Air Zoning System for Low Energy Homes

OU: Engineering Laboratory

Firm: Steve Winter Associates, Inc.
61 Washington Street
Norwalk, CT 06854

Principal Investigator: Srikanth Puttagunta
Phone: (203) 857-0200
Email: sputtagunta@swinter.com

Award Amount: $97,883

Abstract: Steven Winter Associates, Inc. (SWA) will undertake research to develop a self-configuring residential conditioned air zoning system for low load energy homes. The Phase I prototype will feature zone nodes and a master controller. The zone nodes will measure and wirelessly report environmental conditions to the central controller, and modulate a damper based on commands received from the master controller. The master controller will be capable of receiving information from the zone nodes, interpreting said information via on board logic and control loops, wirelessly issuing commands to individual zone nodes, and interfacing with an installed HVAC system. The master controller will feature a graphical user interface which will provide the user with a visual representation of zone node sensor readings. The master controller will also feature a commissioning and installation feature which will allow the installer to name zones and configure system settings per ACCA Manual J room-by-room calculations.

Commercial Applications: The need for HVAC comfort solutions is evidenced in the popularity in smart thermostats (7 million smart thermostats out of 29 million thermostats sold worldwide in 2016). Still, these don’t get to the main issue of improper air flows that is being addressed under this research effort. While SWA is not a manufacturer, they would seek partnerships with their connections in the HVAC industry. To get the desired scale for launching such a product, the best approach is to sell the product thru existing HVAC sales channels (rather than a consumer approach of online sales and DIY).

FY 2018 PHASE II AWARD

Topic: Systems

Subtopic: An Automated System for Firearm Evidence Identifications

Title: Development, Validation, and Implementation of CMC Algorithm into a Software Platform for Firearm Analysis

OU: Laboratory Programs

Firm: Cadre Research Labs, LLC
363 W Erie St.
Chicago, IL 60654

Principal Investigator: Ryan Lilien
Phone: (508) 443-1275
Email: Ryan.Lilien@CadreResearch.com

Award Amount: $299,400

Abstract: The research involves implementation of a comparison algorithm for firearm forensics. The Congruent Matching Cells (CMC) algorithm and its associated CMF, CMPS, and CMX methods have been developed by NIST yet do not appear in any commercially available software. Cadre Research Labs will implement the algorithms in the C++ programming language, will validate their performance, will develop similarity visualization modes, and will develop a statistical scoring model. Across all aims they will evaluate performance using what is to their knowledge the largest set of 3D surface topography data of firearms evidence. The result of this Phase II work will be a great enhancement of the TopMatch software which implements import, visualization, masking, database, and search functionality. Most importantly the TopMatch software is already deployed and in use at a number of crime labs. Therefore, the NIST methods would get immediate distribution. Overall, Cadre Research will advance the NIST developed CMC-Family of methods with real world testing and will incorporate these methods into TopMatch, a fully functional software application that has already been deployed to crime labs.

Commercial Applications: The research involves implementation of several comparison algorithms for firearm forensics. These methods have been developed by NIST yet they do not appear in any commercially available software. The methods facilitate forensic examination and allow connections to be made between criminal cases. Cadre Research Labs will implement and validate these methods as well as develop a statistical scoring model. They will incorporate the methods into their already commercially available software for firearm analysis. Their software implements import,

visualization, masking, database, and search functionality. Therefore, the NIST methods will join a fully functional software application and will be ready for commercialization.

Topic: Precision Measurements

Subtopic: Atomic Vapor Cell Technology for Electric-Field Metrology

Title: Compact Vapor Cell Technology for Rydberg-Atom RF Metrology

OU: Communications Technology Laboratory

Firm: ColdQuanta, Inc.
3030 Sterling Cir.
Boulder, CO 80301

Principal Investigator: Steven Hughes
Phone: (303) 440-1284
Email: steven.hughes@coldquanta.com

Award Amount: $300,000

Abstract: ColdQuanta seeks to develop compact, stemless vapor cells designed specifically for high-accuracy RF electric field (E-field) metrology with Rydberg atoms. Sensors utilizing these vapor cells can take advantage of Rydberg atoms' exceptional sensitivity to RF, microwave, and millimeter radiation between 1 and 1000 GHz. Featuring resolutions down to the uV/cm level, the accuracy of these devices will be at least ten times better than existing technologies (e.g. dipole probes). In addition, these sensors will be self-calibrating, allowing their accuracy to be attained in the field without relative standards or external calibration sources.
In Phase II, ColdQuanta will construct stemless, all-glass vapor cells that minimize perturbations in electric fields. ColdQuanta will construct the cells using contact bonding, removing the need for stems left from glass blowing. The cells are designed to be capable of electromagnetically induced transparency (EIT), and to achieve 40% absorption at room temperature. Additionally, the cells will undergo a detailed 3D simulation to determine the effect of the cell on external E-fields. ColdQuanta will also design a fiber-coupled system that incorporates the compact vapor cells.

Commercial Applications: RF electrometry with Rydberg atoms offers the potential of superior resolution, bandwidth, and accuracy to all current technologies. However, these precision measurements are often limited by the quality of the vapor cell. The unique, optically contacted vapor cells developed in this work are designed to reduce measurement uncertainties, allowing Rydberg-atom based E-field sensors to realize

their full capabilities. In this way, Rydberg-atom based E-field sensors threaten to replace antennas as the leading commercial E-field sensor technology.

Topic: Collaboration and Partnership

Subtopic: NIST Technology Transfer

Title: Optical Device for Sorting Particles by Size

OU: Innovation and Industry Services

Firm: En'Urga, Inc.
1201 Cumberland Avenue
West Lafayette, IN 47906

Principal Investigator: Yudaya Sivathanu
Phone: (765) 497-3269
Email: sivathan@enurga.com

Award Amount: $300,000

Abstract: This Phase II SBIR project will continue the development of an optical sorter that will be used to estimate drop sizes in sprays. The optical sorter will determine the size of drops in the 0.1 to 10 microns range. Drops in this size range are prevalent in the automobile industry, where the fuel injection pressures have increased tremendously over the past two decades. These newer injectors provide higher fuel efficiency and lower pollutant emissions. However, their continued development is hampered by the lack of a drop sizer to validate numerical models of the spray generation.

The feasibility of estimating drop sizes using the optical sorter was demonstrated during the Phase I project. The primary objective of the Phase II work is to develop a prototype drop sizer for the automotive industry. The four tasks that are required to achieve this objective are: 1) determine the optimal configuration for the optical sorter, 2) design and fabricate a drop sizing instrument based on the optimal configuration, 3) develop a Graphical User Interface for the prototype instrument, and 4) evaluate the prototype system under laboratory conditions. The prototype system will be provided to NIST after the validation is complete.

Commercial Applications: The primary commercial application for the drop sizer is in the quality audit of spray nozzles and fuel injectors used in automotive and aerospace applications. Conventional diffraction based drop sizers and phase Doppler anemometers cannot provide accurate drop size estimates in sprays that have very

small drops. Many of the newer fuel injectors and spray nozzles are producing very small drops since they increase the fuel mixing and efficiency of the engines. The sizer will enable injector and nozzle manufacturers to evaluate the drop size distribution in their very fine sprays ensuring rapid commercialization.

Topic: Precision Measurements

Subtopic: Precision 10 kV Programmable Voltage Source

Title: Precision 10 kV Programmable Voltage Source

OU: Physical Measurement Laboratory

Firm: Low Thermal Electronics, Inc.
PO Box 210
Itasca, TX 76055

Principal Investigator: David Fitzgerald
Phone: (254) 687-9700
Email: dave@lowthermal.com

Award Amount: $298,499

Abstract: Low Thermal Electronics, Inc. will design a stand-alone, programmable voltage source capable of supplying precision voltages in the range of zero to 1,000 volts direct current (DC), with options for scaling up to 10,000 volts, and with a total expanded uncertainty (k=2) of less than 10uV/V for the 10,000 volts version. This instrument will improve state-of-the-art measurements in high resistance, high voltage, and potentially other research and metrology applications that require precision voltages between 1,000 and 10,000 volts. It will also provide improved performance and cost savings when compared to currently available commercial multi-function calibrators in the range of zero to 1,000 volts DC.

Commercial Applications: A stand-alone, programmable 1,000 volt DC voltage source with uncertainties in the single digit ppm range is not commercially available today. A stand-alone, programmable 10,000 volt source of sufficiently low uncertainty to advance state-of-the-art measurement is also not commercially available. A cost effective, single instrument that can satisfy both of these requirements is needed to improve measurements and high voltage sourcing in the areas of precision high voltage and high resistance measurements. Low Thermal Electronics intends to manufacture a commercially available instrument in the United States that satisfies these requirements.

Topic: Data and Modeling

Subtopic: Modeling and Simulation Analysis for Manufacturing Systems

Title: Developing Model-Based Tools for the Design and Improvement of Manufacturing Systems

OU: Engineering Laboratory

Firm: MBSE Tools, Inc.
5120 Oakwood Circle
Cumming, GA 30028

Principal Investigator: George Thiers
Phone: (770) 312-7812
Email: george.thiers@modgeno.com

Award Amount: $300,000

Abstract: The vision is to create enterprise-grade software tools supporting the design and improvement of manufacturing systems, tools that can provide answers to fundamental business questions about product selection, resource planning, scheduling, and logistical control – quickly, accurately, and with adequate consideration of risk. Objectives accomplished in Phase I included adding formality and rigor to a widely-adopted manufacturing system modeling language, delineating scope and boundary limitations for language extensions, and demonstrating automated formulation of computational analysis to answer routine questions about expected cycle time, throughput, capacity, and inventory levels. Phase II objectives include maturing behavioral and control definitions in reference models, integrating SysML-language reference models with software implementations, formalizing system – analysis integration, and extending the manufacturing system modeling language to express components of resource planning and scheduling problems. At the conclusion of the work MBSE Tools will have a software tool that can demonstrate to potential customers and test within their production environments.

Commercial Applications: Potential commercial applications include solving concrete problems that arise in the design, diagnosis, and continuous improvement of manufacturing systems. In the initial target market, the problem is poor tool support for answering questions about resource usage, including sequencing order releases to the manufacturing floor, calendar-scheduling those releases, when and how to dynamically re-sequence (e.g. expedite), dynamic decisions about movement and storage, and other logistical-control questions. These types of questions cannot be quickly and accurately answered today, and consequences include a barely controlled chaos induced by order expediting, the inflexibility of long lead times, and poor on-time customer deliveries.

Topic: Data and Modeling

Subtopic: Interactive Software Tools for Processing QIF-formatted Part Models to Generate Realistic and Accurate Measurement Plans and Programs in Standard Digital Languages

Title: Interactive Software Tools for Processing QIF Formatted Part Models to Generate Realistic and Accurate Measurement Plans and Programs in Standard Digital Languages

OU: Engineering Laboratory

Firm: MetroSage, LLC
26896 Shake Ridge Road
Volcano, CA 95689

Principal Investigator: Jon Baldwin
Phone: (415) 336-2244
Email: jmbaldwin@metrosage.com

Award Amount: $300,000

Abstract: The QIF standard shows the promise of offering an environment where best-in-class metrology applications can be linked to yield solutions that are automated, optimized, adaptive, and traceable, maintaining the agility required to ensure U. S. global competitiveness. While the QIF standard has reached a substantial level of comprehensiveness and maturity, the embodiment of the standard in actual, commercial-grade software applications remains in its beginning stage because many developers of metrology applications software are waiting to see whether the QIF standard is sufficiently mature to warrant adoption. MetroSage will demonstrate QIF maturity and to facilitate future development of commercial applications of QIF by means of a three-faceted program: (1) Development and commercialization of a QIF-based software application that will enable the automated generation of optimized CMM inspection plans and programs. (2) Development and dissemination to the user and developer communities of free, open source tools for QIF instance file generation and maintenance. (3) Production of a report of recommendation of extension of the QIF Rules schema in future editions.

Commercial Applications: The project will find valuable commercial application in the manufacturing industries primarily by promoting the application of the QIF standard to provide a means for automated production of known-good, economically optimum measurement plans for CMM based measurement, thereby improving the profitability and competitive posture of U.S. manufacturing companies. Additionally, it will promote the further use and development of QIF-based software tools by providing end users

and developers with a suite of free, open source tools for creating, maintaining and validation of QIF instance files.

Topic: Systems

Subtopic: High Speed Large Field-of-View Optical Microscope

Title: Large Field of View Microscope for Rapid, High- Resolution Imaging

OU: Information Technology Laboratory

Firm: Nikira Labs, Inc.
1931 Old Middlefield Way
Mountain View, CA 94043

Principal Investigator: Manish Gupta
Phone: (650) 906-0274
Email: manish.gupta@nikiralabs.com

Award Amount: $299,424

Abstract: In this SBIR effort, Nikira Labs Inc. will develop a high-resolution (< 1.2 micron) microscope that can rapidly (< 60 seconds) image a large field of view (> 1 cm2). The instrument will provide a wide array of imaging modalities, including brightfield, darkfield, fluorescence, quantitative phase, and Rheinberg imaging. In Phase II, Nikira Labs will fabricate and test a turnkey microscope system that provides all the aforementioned imaging modalities. The system will include the hardware (microscope, incubator, motorized XY stage…), electronics (LED array, LED driver, computing…), and software (data control/acquisition/analysis/reporting and user-interface) necessary to take periodic images of live cell cultures. It will enable researchers to scan 12 well plates in under 15 minutes. Additionally, it will allow for higher power objectives to provide imaging of individual cells without being limited by the working distance of the objective.

Commercial Applications: In Phase III, Nikira Labs Inc. will commercialize the product for research institutions, educational applications, and medical diagnostics. As detailed in the Commercialization Plan, the product resulting from the SBIR is expected to yield a total 5-year revenue in excess of $9.5M for the latter two markets alone. These attractive markets are expected to continue to grow with a predicted compound annual growth rate (CAGR) of 7.5% through 2021. Contingent upon the SBIR funding, Nikira Labs Inc. is poised to take advantage of this growth. Furthermore, the work also has a very significant societal impact, by enabling the development of low-cost medical diagnostics for tuberculosis, urinalysis, and cancer detection.

Topic: Systems

Subtopic: Sources of and Triggers for Cybersecurity Failures

Title: ISABEL - Integrated Secure Automated Bug Extraction List

OU: Information Technology Laboratory

Firm: Smart Information Flow Technologies (SIFT), LLC
319 1st Ave N.
Minneapolis, MN 55401

Principal Investigator: David Musliner
Phone: (612) 325-9314
Email: musliner@sift.net

Award Amount: $299,928

Abstract: To automatically detect software bugs, understand their characteristics, and categorize them according to the evolving NIST Bugs Framework (BF), SIFT is developing ISABEL: Integrated Secure Automated Bug Extraction List. ISABEL will provide three key functions:
- Using symbolic analysis and fuzz-testing tools to find inputs that trigger vulnerabilities (bugs).
- Using fuzz-testing, delta-debugging, and other analyses to refine the triggering inputs.
- Analyzing fault information and related code to characterize the bug and output a descriptive BF report.

The Phase I research developed a proof of concept implementation, identifying and addressing several key technical risks. SIFT tested the robustness of the approach on thousands of test cases from NIST's Juliet test suite. In Phase II, SIFT will extend the approach to a broader set of bug classes and improve the bug characterization methods, leading towards a commercially viable tool for automatically understanding and characterizing software vulnerabilities. By automatically finding software flaws and characterizing them within the BF, ISABEL will help organizations improve their software quality, detecting flaws before they are deployed, and helping rapidly prioritize them for remediation.

Commercial Applications: SIFT has identified a key commercialization partner to help transition the ISABEL technology into practical applications. Their software analysis tool is widely used in critical software development. The partner has invited SIFT to help create new features for their upcoming new product that will evaluate and prioritize vulnerabilities, which is directly aligned with the ISABEL project. This will make the benefits of the ISABEL research available to a wide audience of software developers, including both professionals and students.

Topic: Precision Measurements

Subtopic: Innovative Manufacturing of Nanoscale Calibration Spheres

Title: Rational Design of sub-100 nm Polystyrene Particles with a Low Coefficient of Variation in Size

OU: Physical Measurement Laboratory

Firm: Tetramer Technologies, LLC
657 S. Mechanic St.
Pendleton, SC 29670

Principal Investigator: Michael Schreuder
Phone: (864) 646-6282
Email: Michael.schreuder@tetramertechnologies.com

Award Amount: $299,951

Abstract: During this Phase II SBIR development program, Tetramer Technologies will develop highly monodisperse 100-nm and sub-100-nm diameter nanoparticles for use as latex size standards. Highly monodisperse nanoparticle latexes are needed for improved calibration of electron microscopes, light scattering particle sizing instruments, atomic force microscopes, and particle counters/contamination monitors used in the semiconductor industry. Current commercial latex standard size distributions are too broad to provide the required resolution for the calibration of these systems. During Phase I, Tetramer synthesized highly-monodisperse 100-nm nanoparticles with less than 2 nm size variation and demonstrated the ability to tune the size below 100 nm, however, the sub-100-nm syntheses were not optimized. Building on the Phase I success, Tetramer will develop reproducible synthetic methods to produce highly-monodisperse sub-100-nm nanoparticles, study the stability of the produced latexes, and scale-up the process to commercially viable levels. Initially, Tetramer will develop a synthetic method to reproducibly deliver sub-100-nm nanoparticles with controlled sizes. Subsequently, Tetramer will investigate methods to produce narrower size distributions, analyzing the samples with both dynamic light scattering and scanning electron microscopy. Nanoparticles will be analyzed to determine their long-term stability as latex solutions. Finally, Tetramer will scale-up the synthetic and purification procedures and begin sampling materials to commercial partners.

Commercial Applications: The market potential for highly-monodisperse nanoparticle standards is modest but significant. The total market size for particle size analysis was more than $300MM in 2017. Size standards are an enabling technology for this industry; more narrow size standards will allow for improved particle analysis, and subsequently improved manufacturing in the semiconductor industry. In addition to sales to NIST, Tetramer will sell highly-monodisperse nanoparticle latex size standards

directly to instrument manufacturers, instrument users, and individual academic researchers.

Topic: Systems
Subtopic Policy Machine/Next Generation Access Control Implementation

Title: XpressRules-PM: Commercial Implementation of PM/NGAC

OU: Information Technology Laboratory

Firm: XpressRules, LLC
9515 North Wieber Dr.
Spokane, WA 99208

Principal Investigator: Ron.Turner@XpressRules.com
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Email: Ron.Turner@XpressRules.com

Award Amount: $300,000

Abstract: New Generation Access Control (NGAC)—because of its “neutrality by design”—represents the most effective and scalable approach for deploying “smart” access control and consent solutions in large dynamic scenarios. NGAC however presents with its own problems: (1) it has miniscule recognition and uptake in the workplace, (2) it is unusable by non-technical policy officers and (3) its documentation and wider “infosphere” are very early-stage. XpressRules-PM is a natural language-based NGAC toolkit for (1) equipping non-technical stakeholders—in their own words—to deploy privacy and consent policies, (2) enabling an organization to configure the product to fit their environment instantly, repeatedly and without IT assistance, (3) exposing its policy store to logic checking and analytics, and (4) applying NGAC’s Decision Algorithm to perform real-time “dispute resolution” in an IoT information blockchain. For healthcare XpressRules-PM facilitates a “longitudinal patient consent™” to accompany a longitudinal patient health record through its migration. NGAC retains the rich semantics of relationships between entities. The NGAC “family of standards” expresses this semantics abstractly with a directed acyclic graph (DAG). Therefore the most appropriate implementation of NGAC is graph-based, running on a NoSQL platform. Phase II specifies Neo4j initially, but its design will support any NoSQL database product.

Commercial Applications: XpressRules-PM’s neutrality, scalability and bandwidth enable it to support massive markets in governance, risk management and compliance (GRC), which spans every information-critical sector: banking, healthcare, pharma, telecom, insurance, law enforcement, manufacturing, government business, and

defense. And because the technology already demonstrates resolution of pervasive and persistent cybersecurity challenges, it is positioned to become a dominant enterprise solution. The market size for enterprise GRC (eGRC) is expected to grow from USD 22.14 Billion in 2017 to USD 43.87 Billion by 2022. The most efficient market penetration strategy is to embed the product as a security layer within large B2B vendor’s solutions.