National Institute of Standards and
Technology
Department of Commerce

SBIR

SMALL BUSINESS INNOVATION

RESEARCH PROGRAM

PHASE I and PHASE II

AWARDS FOR FISCAL YEAR 2019

INTRODUCTION

Abstracts of Awards for Fiscal Year 2019 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 2019 List of Awardees

Award Number	Company Name	Phase
70NANB19H044	AirFlow Sciences Corp.	Phase I
70NANB19H046	Fullmoon Sensors, Inc.	Phase I
70NANB19H039	Graphene Waves, LLC	Phase I
70NANB19H043	Intact Solutions, Inc.	Phase I
70NANB19H082	nVariate, Inc.	Phase I
70NANB19H040	OmniVis LLC	Phase I
70NANB19H048	Parman Tech, LLC	Phase I
70NANB19H042	QATCH Technologies, LLC	Phase I
70NANB19H041	Robotic Materials Inc.	Phase I
70NANB19H047	Sandbox Semiconductor Inc.	Phase I
70NANB19H049	Tourney Consulting Group, LLC	Phase I
70NANB19H045	XALLENT, LLC	Phase I
70NANB19H075	Advanced Silicon Group	Phase II
70NANB19H079	AlphaCore, Inc.	Phase II
70NANB19H077	Applied NanoFlourescence, LLC	Phase II
70NANB19H080	Cyberpoint International	Phase II
70NANB19H078	H3D, Inc.	Phase II
70NANB19H081	InfoBeyond Technology LLC	Phase II
70NANB19H076	Nikira Labs, Inc.	Phase II

FY 2019 PHASE I AWARD

Title: Advanced Instrumentation for Non-Nulling Stack Velocity Testing

Firm: Airflow Sciences Corp.
12190 Hubbard St.
Livonia, MI 48150-1737

Principal Investigator: Matthew Gentry

Phone: 734-525-0300

Email: mgentry@airflowsciences.com

Award Amount: $100,000

Abstract: Industrial facilities, manufacturing plants, and electric power plants that burn fossil fuels exhaust the combustion products to atmosphere through their smokestacks. Stack pollutant emissions are quantified using manual testing methods developed in the 1960s, which are prone to error if non-axial flow exists in a stack.

Recently, NIST has been working on an improved technique of performing 3D flow testing for smokestacks which will greatly reduce the complexity, duration, and potential for human-error. Advanced data acquisition systems and software are required to accommodate the NIST test methodology. These systems must be highly accurate but also able to operate in potentially harsh environmental conditions since the testing is conducted year round on outdoor platforms of smokestacks.

This project will develop an advanced data acquisition system suitable for the NIST “non-nulling” test technique. The system requires highly accurate pressure sensors, working collectively to acquire data from multiple velocity probes. In addition, the system must have capability to purge the probe pressure lines of any debris or condensation that would degrade accuracy, operate in harsh weather, and provide a straightforward interface to an operator. The system will thus involve both advanced instrumentation along with custom software to follow the NIST “non-nulling” protocol.

Commercial Applications: The instrumentation developed during this research will be applicable to smokestacks at large industrial facilities, allowing them to more accurately quantify and minimize their pollution emissions. The system will be accurate but easy to use, allowing stack testing personnel (from the plant site or from third-party stack testing companies) to obtain high-quality data with less effort
than current methods. In addition, the instrumentation will be applicable to other industrial personnel that use EPA Method 2F test procedures. This encompasses activities such as large horsepower fan performance testing, combustion optimization of boilers, and HVAC equipment testing at nuclear power plants.

Title: Continuous Monitoring of Natural Gas Infrastructure for Increased Community Resilience using Voltammetric Sensors

Firm: Fullmoon Sensors, Inc.
68 Olmsted Rd.
Stanford, CA 94305

Principal Investigator: Ehsan Sadeghipour

Phone: 412-251-3390

Email: ehsan@fullmoonsensors.com

Award Amount: $99,980

Abstract: Fullmoon Sensors has the first chip-level sensors capable of identifying and quantifying molecules in the air. At the core of the technology are printed voltammetric sensors, which are operated using cyclic voltammetry, an electrochemical technique that probes for the redox potential, a unique signature of molecules. This sensing principle for the detection of carbon monoxide and methane has been demonstrated in two journal papers and Fullmoon Sensors has two patents on this technology. In Phase I, a signal analysis algorithm for edge computing will be built. The development of this algorithm is a critical piece of the sensing solution being developed. Performing signal analysis at the edge rather than in the cloud will allow for the generation of highly valuable data with minimum power usage. This is important for building sensing nodes that would stay in the field several years with minimum maintenance, and communicate data even after catastrophic events. To gather this data, our test setup to test our sensors for the detection of ethane and natural gas will be upgraded. The goal of this two phases SBIR project is to be ready to field test our sensing technology with our partners PG&E and SoCalGas.

Commercial Applications: Fullmoon Sensors has received non-dilutive funding from California natural gas utilities, PG&E and SoCalGas, which plans to deploy voltammetric sensing nodes as part of a chemical sensing network to continuously monitor their gas emissions and comply with state regulations. The business model will be to sell sensing nodes directly to operators, and they will own them. The data output of the sensors is very rich, which means analytics can be subsequently sold to customers. Addressing the problem of natural gas leaks will increase the resilience of communities by making the distribution of this resource safer.

Title: Developing Commercial Quantum Resistance Standard Based on Epitaxial Graphene

Firm: Graphene Waves, LLC
9711 Washingtonian Blvd., Ste 550
Gaithersburg, MD 20878

Principal Investigator: Yanfei Yang

Phone: 301 520-6065

Email: yanfei.yang@graphenewaves.com

Award Amount: $100,000

Abstract: Graphene Waves will develop a quantum Hall resistance (QHR) standard based on graphene that can be deployed for general electrical calibration in industries. Current QHR standard is based on GaAs/AlGaAs heterostructure and requires expensive liquid helium to operate. The continuous increase in price and unstable supply chain of liquid helium limit the QHR standard to be only affordable by the top National Metrology Institutes. With the advanced technology for graphene and the liquid-helium-free cryocooler, a QHR standard based on graphene will be available for on-site electrical calibration in industries worldwide. Further research is needed to reduce the production cost of graphene, enhance the stability of graphene in working environment, and simplify the calibration process for QHR standards. Graphene Waves will develop a method for large-scale production of epitaxial graphene, a technique to tune and stabilize the carrier density in graphene, as well as to design the prototype of graphene Hall bar arrays. The results will pave the way for the development of a cryogen-free QHR calibration system in the future phase. Their research on graphene will not only impact calibration and metrology industries, but also shed the light on novel electronics and photonics.

Commercial Applications: The ultimate outcome of this project is a portable, cost-effective QHR calibration system that is accessible on-site and year-round by the calibration and metrology industry. It has a significant impact on the accurate measurement to ensure the quality and consistency of products and services for aerospace, pharmaceutical and other industries. The main result from Phase I research is an affordable, robust QHR standard based on graphene that can be operated without liquid helium. Also, the low-cost, ultra-high-quality graphene to be developed in Phase I has great potential in novel electronics and photonics for quantum computing and 5G networks.

Title: Direct Performance Evaluation of Additive Manufacturing Process Plans

Firm: Intact Solutions, Inc.
211 South Paterson St.
Madison, WI 53703

Principal Investigator: Goldy Kumar

Phone: 608-334-9646

Email: gkumar@intact-solutions.com

Award Amount: $100,000

Abstract: Additive manufacturing is steadily advancing towards fulfilling its promise of customized and on-demand production of functional parts. However, performance of as-manufactured parts can differ significantly from the as-designed parts because the as-manufactured geometry differs from the as-designed geometry and the as manufactured material properties are not known. Attempts to predict performance of as-manufactured parts are hampered by the complexity of the as-planned geometry and the unknown as-manufactured material properties. Intact Solutions will demonstrate the feasibility of performing accurate structural simulation directly from additive manufacturing plans. This will be achieved by extending Intact Solutions' moment-based interoperable simulation technology to incorporate material properties through a combination of analytical, experimental, and data-driven methods. The approach will be driven by manufacturing plans and available material information from NIST's AMMD. A significant component of the proposed research is to utilize and improve the data from the AMMD in the next generation simulation technology that will support validation, planning, and optimization for additive manufacturing processes.

Commercial Applications: The ability to computationally assess performance of as-manufactured components directly from process plans can lead to dramatic savings in time and material costs in additive manufacturing throughout US industry. If successful, the developed simulation technology will serve three major customers: (1) manufacturing service industry that depends on rapid generation and evaluation of process plans, (2) aerospace, defense, and medical industry where performance of mission-critical printed components is determined by the process plan and its parameters; and (3) small businesses and maker communities that increasingly rely on additive manufacturing but are unable to predict whether 3D printed components will be functional.

Title: Gap-Free Model-Based Engineering for Manufacturing and Analysis: Digital Thread without Translation

Firm: nVariate, Inc.
1101 W. 34th St.
Austin, TX 78705

Principal Investigator: Benjamin Urick

Phone: 512-934-4765

Email: benurick@nvariate.com

Award Amount: $99,993

Abstract: Modern Model-Based Enterprise / Engineering (MBE) systems rely on freeform surfaces built as complex combinations of geometric primitives to define engineered objects. Unfortunately, the intersection of freeform surfaces in MBE applications results in highly approximated solutions, degrading models that cost billions annually by US industry to fix. Current technology limits the abilities of users in the digital thread who inherit these gap-ridden models: additive manufacturing/3D printing, computer-aided manufacturing (CAM), etc. Entire branches of industry have been set up to deal with the expensive problem of repairing, translating, and meshing models. Commonly referred to as “the trim problem”, it is considered to be the core issue hindering MBE progress. nVariate has developed technology that solves this problem, making the MBE model gap-free. The methodology uses a three-stage process to provide a well-defined mathematical mapping between conventional trimmed and gap-free models. The procedure can be integrated into existing MBE frameworks utilizing existing data structures throughout the digital thread. nVariate’s approach solves the problem natively, discretely, and seeks to make it available in native MBE software as a plug-in.

Commercial Applications: It is the goal of nVariate to provide a transition of their innovation from academic research to a private commercial software product. nVariate sees the algorithm's ability to fix geometric models as an easily integrable software plugin for existing MBE platforms, a conventionally accepted means in industry of commercially integrating with current users. This product will accept native application information and internally produce a model in the same format without gaps or openings at the surface intersections.

Title: A Portable Vibrio cholerae Concentrator for Sensitive Pathogen Detection in Water

Firm: OmniVis LLC
320 North St.
West Lafayette, IN 47906

Principal Investigator: Katherine N. Clayton

Phone: 415-309-9524

Email: kclayton@omnivistech.com

Award Amount: $97,087

Abstract: This SBIR Phase I project will develop an easy to use, inexpensive, and portable bacterial concentrator to enable more sensitive cholera pathogen (Vibrio cholerae) detection. Cholera affects communities across 41 countries, including Mozambique in 2019 after Cyclone Idai and Yemen in 2017. Current methods used to detect the cholera pathogen in water involves a 3 to 5-day procedure due to the low concentrations of the bacterium found in the water. The proposed device intakes 1L of water from an environmental water source and concentrates the solution down to 1mL, enriching the
bacteria contained within the sample. Therefore, the enriched sample can be used in conjunction with our handheld Vibrio cholerae detection device to identify low, but dangerous, bacterial levels. This project will first develop an easy-to-use portable water detection device. The concentrator's usability after construction will be evaluated. Secondly, the capture and concentration efficiency of the device will be tested by filtering and measuring varying concentrations of polystyrene fluorescent particles that pass through the filter. Lastly, the capture efficiency of Vibrio cholerae spiked environmental water samples will be determined. The final step will provide critical knowledge toward both the ability to enrich for Vibrio cholerae and the degree of which fouling of the filter will take place.

Commercial Applications: The commercial potential of this SBIR project is an inexpensive and easy to use portable device that concentrates the cholera pathogen in environmental water sources. Contaminated water sources place populations at risk for contracting cholera. When contracting cholera, patients exhibit symptoms of severe diarrhea, vomiting, and dehydration. When the patient is left untreated, cholera can ultimately lead to death. This project proposes a portable bacterial concentrator to enrich for Vibrio cholerae. Bacterial enrichment can enable humanitarian aid organizations to detect low, but dangerous, levels of Vibrio cholerae. Downstream, this technology will save the time and costs currently associated with cholera outbreaks through early detection and can be expanded to other infectious diseases.

Title: Laser Particle Separation

Firm: Parman Tech, LLC
9231 Shafers Mill Dr.
Frederick, MD 21704

Principal Investigator: John Curry

Phone: 240-405-9670

Email: jjcurry@parmantech.com

Award Amount: $100,000

Abstract: Parman Tech is dedicated to commercializing a NIST technology for sorting nano-particles. This technology uses the force of light to gently guide particles along different paths depending on the size of makeup of each particle.

Commercial Applications: Separation of nano-particles by size is essential to new therapeutics in the pharmaceutical industry including biologics, gene therapy, and nano-medicine.

Title: Microcapillary Quartz Sensors for Screening Injectability of High Concentration Protein Formulations

Firm: QATCH Technologies, LLC
551 Dairy Glen Rd.
Chapel Hill, NC 27516

Principal Investigator: Zehra Parlak

Phone: 678-908-3112

Email: Zehra.parlak@qatchtech.com

Award Amount: $99,983

Abstract: The objective of this SBIR Phase I project is to determine the feasibility of viscosity characterization of high concentration protein formulations (HCF) by QATCH's microcapillary quartz technology. HCFs are non-Newtonian fluids with shear-thinning behavior and they are administered to patients by subcutaneous or muscular injections. The injectability of HCFs depends on the viscosity at high-shear-rates (usually over 100,000 1/s). QATCH's proposed technology implements a microfluidic capillary viscometer on a quartz resonator. This unique combination can interrogate low shear-rate regimes while also measuring the thickness-shear mode resonances of the quartz resonator, which observe viscosity values over 1,000,000 1/s. As a result, the viscosity of HCFs can be characterized over a wide range of shear-rates with very small fluid volumes. In preliminary studies, QATCH had demonstrated that microfluidic quartz can measure viscosity at high-shear-rates experimentally and had modeled the response of the microfluidic quartz resonators to capillary filling of shear-thinning fluids. To accomplish the objective of this SBIR proposal, QATCH will test the low and high-shear rate measurement capability of the system and then calculate the required injection forces for well-studied formulations.

Commercial Applications: Biopharmaceutical therapeutics have a global market size over $200B and there will be over 8,000 products in the pipeline by 2020. These therapeutics are mostly high concentration protein formulations (HCF) which have to be administered by injections, but may encounter injectability problems. By developing a technology that uses a very small sample volume and yet delivers a broader viscosity

behavior range, QATCH addresses the unmet need of early-stage injectability testing. Due to QATCH's extremely small volume requirements and disposable sensor units, biopharmaceutical companies will 1)make decisions on preclinical scale-up after confirming injectability, 2)save protein costs, and 3)save personnel time.

Title: Easy-to-use, Autonomous Bin-picking and Assembly Operations for the Manufacturing Industry

Firm: Robotic Materials Inc.
1860 38th St.
Boulder, CO 80309

Principal Investigator: Nicolaus Correll

Phone: 303-717-1436

Email: nikolaus@roboticmaterials.com

Award Amount: $100,000

Abstract: Robotic Materials will develop a series of object manipulation primitives to pick up and assemble standard mechanical parts such as screws, gears and pulleys that can be configured without any programming skills. Building up on a smart robotic gripper, 3D perception and machine learning algorithms, they will design a graphical user interface for the Universal Robot E-Series that allows a user to label arbitrary 3D objects, identify assembly points, and issue pick-up and assembly commands, which are modeled by standard industrial assembly tasks that have been identified by NIST's manufacturing group. Specifically, Robotics Materials will provide routines for peg-in-hole and hole-on-peg assemblies that are defined by circular or rectangular holes or extrusions, as well as pick-up routines for arbitrary objects from clutter or in bins. The underlying algorithms have already been validated, making the focus of this project to develop interfaces that make their configuration as simple as possible, only requiring an user to present an individual object, labeling it, and selecting a desired action. With the focus of this Phase I project on demonstrating the viability of this approach and trading ease-of-use with functionality, a Phase II will extend this approach to a larger class of objects and tasks.

Commercial Applications: Making operations such as bin picking and assembly available to non-programmers at a fraction of the cost of existing systems will dramatically broaden the possible applications for collaborative robots and enable use cases that were previously too expensive or too difficult to automate. Combining 3D perception and computation inside the gripper also enables automation in spaces where space constraints prevented the use of external camera systems. Not requiring any

additional infrastructure also enables quickly adapting a robot for different applications, even at the same day.

Title: Advanced Manufacturing and Material Measurements Software Tool Weave ™ for the Acceleration and Automation of SEM image analysis in the Semiconductor Industry

Firm: Sandbox Semiconductor Inc.
54 Rainey St.
Austin, TX 78701

Principal Investigator: Meghali Chopra

Phone: 214-288-7926

Email: Meghali.Chopra@sandboxsemiconductor.com

Award Amount: $99,975

Abstract: In this Phase I SBIR project, SandBox Semiconductor™ will develop an Advanced Manufacturing and Material Measurements software tool called Weave ™ for accelerating and automating SEM image analysis for the semiconductor industry. During the development of a new manufacturing process line for a semiconductor device, tens of thousands of scanning electron microscopy (SEM) images are taken and measured as feedback to test and optimize the hundreds of processes required to fabricate a given device design. Measurements of critical dimensions (“CDs”) are extracted from these images, for example the top and bottom widths and depths of trenches. Weave ™ will automate the extraction of the CDs from a single or stitched image. This automation will improve accuracy and reduce measurement variability by avoiding human bias, improving data standardization for SEM processing, and accelerating and reducing the cost of process development. The proposed work will leverage innovations in image processing from NIST’s Image Analytics Program as well as SandBox Semiconductor’s process modeling and prediction suite, SandBox Studio™.

Commercial Applications: Measurement and analysis of SEM images in the semiconductor industry is a time-consuming and expensive process that inherently produces imperfect, user-biased results. An automated metrology tool like Weave ™ will reduce costs, help to standardize SEM process data, accelerate semiconductor process development, and remove user-bias. Currently, analysis of metrology typically comprises 8% of the total cost of a wafer. Weave ™ will reduce metrology analysis time four-fold. This reduction will dramatically reduce metrology costs for semiconductor chip and equipment manufacturers and shorten their process learning cycles.

Title: Development of a Neutron-based Nondestructive Test Method for Concrete Petrography and Chemical Analysis

Firm: Tourney Consulting Group, LLC
3401 Midlink Dr.
Kalamazoo, MI 49048

Principal Investigator: Neal S. Berke

Phone: 269-384-9980

Email: nberke@tourneyconsulting.com

Award Amount: $99,345

Abstract: To evaluate the technical feasibility of prompt gamma neutron activation (PGAA) as an alternative to a set of standard destructive tests of concrete petrography including aggregate type, water/cement ratio, aggregate/binder ratio, density, chloride content and chloride bulk diffusion constant; and to determine the specifications for the design of a dedicated commercial laboratory-based PGAA facility for the petrography of concrete.

Commercial Applications: Time and costs to determine chloride content in concrete as well as the water-to-binder ratio and binder to concrete ratio will be reduced using a nondestructive method. As only one specimen is required for several simultaneous analyses, sampling will be reduced which is of particular benefit in reducing downtime at field locations. Analysis of other chemicals in cement components and concrete will provide additional revenue sources. This will decrease response time, increase throughput, and improve profitability.

Title: Nanomachine Device for Semiconductor Process Control Monitoring

Firm: XALLENT, LLC
95 Brown Rd. Suite 271
Ithaca, NY 14850

Principal Investigator: Kwame Amponsah

Phone: 607-262-0515

Email: kwame.amponsah@xallent.com

Award Amount: $100,000

Abstract: Conventional characterization and test methods are increasingly ineffective when applied to structures less than 100 nanometers, causing challenges across R&D, process control and failure analysis. An increasing number of subtle defects become prominent drivers of failure as device size and operating margins decrease, e.g., processing anomalies in thin gate oxides, substrate problems related to doping, line width variations. Thus, there is urgent demand for tools and techniques to non-destructively characterize semiconductor devices and thin film materials. Xallent will develop a radio frequency nanomachine device to utilize for defect identification, measurement of thin film material thickness, permittivity and conductivity.

Commercial Applications: This SBIR Phase I project will focus on the development of a radio frequency nanomachine diagnostic device to utilize for early detection of defects during semiconductor integrated circuit manufacturing. The underlying motivating factor stems from a lack of non-destructive testing solutions with high resolution, accuracy and sensitivity necessary for identifying defects at the nanoscale. In addition, the nanomachine device could be used to measure the thickness of thin film materials, conductivity and permittivity. A successful outcome of this project will allow for yield improvement, reduction of chip waste, and faster introduction of electronic products to market.

FY 2019 PHASE II AWARD

Title: Developing Silicon Nanowire Sensors to Measuring Host-Cell Proteins at a Biomanufacturing Line

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

Principal Investigator: Marcie Black

Phone: 954-471-1357

Email: marcie@advancedsilicongroup.com

Award Amount: $400,000

Abstract: Advanced Silicon Group's biosensor is made of silicon nanowire arrays functionalized with antibodies to measure the concentration of specific proteins. They will take a sensor that has been demonstrated for use in measuring a set of generic host cell proteins and will apply the sensor to measure a set of proteins for a specific cell line. In doing so, they will demonstrate the utility of the sensor to be used as a cell line-specific platform for biomanufacturers who require custom sensors to measure host cell proteins for their specific cell lines. They will then make a portable system, including

both the hardware and software, and bring it to a biomanufacturer's line to do measurements side by side with ELISA tests. Lastly, they will teach their staff to run measurements using the sensors and system and use their feedback to write a manual for use.

Commercial Applications: Advanced Silicon Group's sensors have the potential to make drugs safer for patients by providing biomanufacturers a rapid quantifiable measurement of host cell proteins. The test requires minimal hands-on time, is low-cost, and simple to use. The sensors will be able to detect a wide range of protein concentrations, monitor multiple proteins simultaneously, and measure proteins at low concentrations even when submerged in a high concentration of another protein. This will allow manufacturers to test at multiple points in their manufacturing process and to focus on reducing harmful HCPs by modifying the manufacturing process or improving the purification process.

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

Firm: AlphaCore, Inc.
398 S. Mill Ave.
Tempe, AZ 85281

Principal Investigator: Lloyd Linder

Phone: 480-494-5618

Email: engineering@alphacoreinc.com

Award Amount: $400,000

Abstract: Alphacore will develop an Intermediate Frequency (IF) Conversion System for High-Bandwidth Multiplexed Sensors Arrays. The team has already successfully developed and evaluated a prototype board in Phase I. The goal in Phase II to achieve three primary objectives:

1. Optimize the design and performance of an integrated single-board Intermediate Frequency Conversion System.
2. Develop software to allow for flexible and simple user interfaces for control of amplification and attenuation settings and IQ calibration.
3. Demonstrate end to end performance of the system as part of a cryogenic detector readout.

Commercial Applications: Readout systems for MKID arrays developed by NIST for homeland security, medical imaging, radio telecopy, nuclear non-proliferation detection systems. Other applications include readout systems for superconductor-based quantum computing and general laboratory RF diagnostics.

Title: Multimode Chiroptical Spectrometer for Nanoparticle Characterization

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

Principal Investigator: Tonya Cherukuri

Phone: 713-521-1450

Email: tkc@appliednano.com

Award Amount: $399,976

Abstract: Applied NanoFluorescence, LLC (ANF) 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 the leading current example of such nanomaterials. ANF proposes a novel multi-mode chiroptical spectrometer that can distinguish left and right enantiomers through their different interactions with circularly polarized light. The instrument will offer four complementary measurement modes: (1) fluorescence-detected circular dichroism (FDCD) spectra with tunable 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 operate under integrated computer control. The combined results will offer powerful analyses of complex nanoparticle samples and their coatings, guiding research, product development, quality control, and commercial applications.

Commercial Applications: Emerging bio-applications of nanomaterials will require enantiomeric control to ensure medical efficacy and safety. However, there are currently inadequate analytical tools for distinguishing nanoparticle handedness. The project will develop a novel instrument to address this need. It will perform fast, sensitive, quantitative analysis of complex nanoparticle samples, including handedness. Phase I research has enabled ANF to offer a new excitation-scanning spectrofluorometer, for which a customer order has already been received. In Phase II ANF will develop a fully refined commercial instrument with four spectral modes and unique capabilities to support advanced nanoparticle separation and quality control in manufacturing.

Title: TheSieve

Firm: Cyberpoint International
621 E. Pratt Street
Baltimore, MD 21202

Principal Investigator: Mark McLarnon

Phone: 410-779-6700

Email: mmclarnon@cyberpointllc.com

Award Amount: $368,135

Abstract: CyberPoint International will design a cross platform product for the autonomous execution of live forensic investigations of personal computers, laptops and servers leveraging the NIST NSRL corpus and a combination of at least 3 forms of machine learning/artificial intelligent algorithms for the processing of preliminary digital evidence titled TheSieve. They will build upon work from their Phase I research effort to develop the suspicion score for a file based on an ensemble learning approach for features including entropy, location, size and file type. TheSieve will be a multi-tier product for conducting a live investigation requiring zero installation on target systems. TheSieve possesses the ability to automatically execute evidence collection and analysis techniques using a deterministic rule engine which fires during each step of analysis of a single host. Leveraging probability-based decision tree modeling, TheSieve will automatically offer suggestions on a target system under investigation at the end of collection and analysis. At the conclusion of this research effort, TheSieve will be a functional minimally viable product for conducting a live investigation of malicious code events or system misuse for Mac OS X and Linux endpoints and re-train data models based expert user feedback.

Commercial Applications: Consultation with industry experts shows a lack of availability of investigation software for OS X and Linux. In addition, Cyberpoint International is unable to identify a commercial product which offers autonomous operation or is driven by machine learning for classification. Given sufficient interest, they can restructure TheSieve to offer third-party products the ability to interface with TheSieve intelligent models for classification and analysis.

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

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

Principal Investigator: Hao Yang

Phone: 734-661-6416

Email: hao@h3dgamma.com

Award Amount: $400,000

Abstract: In Phase I, H3D proved that the current setup achieves better than 8mm spatial resolution for 2.2MeV prompt gammas. However, 1mm spatial resolution presents a significant challenge for the current setup due in part to limited timing resolution and count rate. A new analog ASIC will be developed to replace the current analog ASIC that will have better timing resolution and deliver higher count rates. In addition, the dynamic range of the new analog ASIC will increase to 9MeV to measure prompt gammas from elements other than hydrogen. In parallel to the analog ASIC development, a dual plane hybrid Compton camera will be built with our existing digital ASIC. This ASIC has similar timing resolution and dynamic range to the new analog ASIC but operates at lower count rates. It will serve as a testbed for high-energy gamma imaging studies during Phase II. The goal of these studies is to identify and approach the limits of spatial resolution for our dual plane imager by optimizing both the imager design and source-detector configuration. The final goal is to achieve 1 mm spatial resolution at 2.2MeV with 1% H concentration in 3 dimensions.

Commercial Applications: This technology has wide commercial applications including fieldable active interrogation for in situ inspection of mechanical structures to identify faults, such as degradation in bridges, nuclear facilities, and other critical structures of great interest. In addition, the newly developed high-resolution imaging capability is a good solution for in-vivo beam range verification for proton therapy.

Title: CSAT: A User-friendly Efficient NIST-spec Information System Development Guideline Tool

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: $399,998

Abstract: NIST developed risk management framework and guidelines that assist agencies to implement integrated, organization-wide programs to manage information security risk, and further developed Cloud Security Architecture Tool (CSAT) to facilitate in this matter. However, NIST's CSAT needs further improvement and implementation of new functions such that it can be commercialized as an Enterprise-grade product. In this project, InfoBeyond will develop of a user-friendly, efficient, reliable, and generic CSAT. Their CSAT will be delivered: (i) an Enterprise CSAT standalone version, and (ii) a CSAT Cloud version. Specifically, their CSAT is built over a Java Spring and Angular Web –based architecture to support state-of-the-art operational flexibility through user-friendly GUI. It overcomes the NIST's CSAT limitations such as an outdated Windows-based software architecture. In such an architecture. InfoBeyond's CSAT efforts are two-fold: (i) Enhancement of the existing NIST's CSAT functions, (ii) Implementation of new functions. More specifically, their CSAT enhances the NIST's CSAT functions, such as report composition and generation, heatmap, and user interfaces. Meanwhile, InfoBeyond's CSAT implements new features, e.g., collaborative user mode for generating the guideline report. All these improvements and the new features facilitate government agencies' adoption of secure cloud solution effectively.

Commercial Applications: CSAT can be widely used as a Risk Management Framework (RMF) tool for guiding the selection of NIST-grade privacy and security controls before implementation. It helps Federal governments or contractors to reduce development cost, time, and manpower by using our tools to quickly define their cloud information system requirements in NIST SP guidelines. Further, CSAT can be a RMF tool used for financial and stock companies, enterprises, hospitals, insurances, and many other business domains. CSAT helps them to optimize information system architecture in a lowest cost, while increasing the security robustness by systemically providing NIST guideline and risk management.

Title: Compact Raman Fiber Optic Probe with Inline Spectral Filtering

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: $299,162

Abstract: 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 in vivo and other difficult to access areas. It will complement existing Raman spectroscopy efforts that are ongoing at NIST including tissue studies and broadband coherent anti-stokes Raman scattering measurements. In Phase I, Nikira Labs demonstrated technical feasibility by deploying semi-soft materials on single-mode fiber, multi-mode fibers, and fiber optic bundles. In Phase II, Nikira Labs will improve the coating process and fabricate higher quality, hard oxide dielectric films. These coatings will be deposited on a Raman fiber probe to generate a compact Raman fiber optic probe with inline spectral filtering.

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.