Abstracts of Awards for Fiscal Year 2012 SBIR Program

Phase I and Phase II

FY2012 Phase I Awardee

**Topic:** [Manufacturing](#book9_02)

**Subtopic:** Low-cost Stabilized Diode Lasers for Displacement Measurements

**Title:** Low Cost Stabilized Laser Diode System

**OU:** Engineering Laboratory

**Firm:** Ceebco, LLC
1721 Sterling Rd
Charlotte, NC 28209

**Principal Investigator:** Mahsa Farsad **Phone:** 704-352-1086 **Email:** mahsa@ceebco.com

**Award Amount:** $89,985.00

**Abstract:** This Phase 1 SBIR project aims to develop a frequency stabilized laser diode system suitable for application in optical metrology and in displacement measurement. The compact design of the semiconductor laser lends itself to many applications where a coherent light source is required, but space is at a premium. Some fields, such as precision optical metrology require a coherent light source whose frequency is stable to one part per million. The frequency of the laser diode is not inherently stable. A laser diode system which combines its compact size with a frequency stabilized output is a desirable product. We propose a feasibility study to investigate the use of two interferometers with different path imbalances to stabilize the output frequency of a laser diode to within one part per million By simultaneous use of two interferometers it is also possible to ensure that the frequency to which the laser is stabilized is unique, thus guaranteeing repeatability if the system is switched off and back on again.

**Commercial Applications:** It is evident from the number of companies actively present in the He-Ne laser market the size of this market is very large, although it is a fragmented market. A key argument in support of the frequency stabilized laser diode is economic; financial budget, optical power budget, weight budget, etc. It could be argued that a laser system that could satisfy the frequency stability requirements with added advantages of low cost, high power, small size and multiple outputs has the potential to have significant market penetration. Furthermore, the existing frequency stabilized laser seeks adaptation of the user to its constraints (weight, dimension, low power and price). Therefore, there is a hidden cost associated with a system adopting to these constraints and incorporate current laser systems. Ceebco’s laser systems could be made of modular components such that the final products could be designed per customer needs. This is very important when working with OEM and in a fragmented market. Ceebco’s stabilization technique could be applied to all laser diodes so the frequency of the laser could be chose by the customer.

FY2012 Phase I Awardee

**Topic:** [Information Technology and Cybersecurity](#book9_01)

**Subtopic:** WS-BiometricDevices (WS-BD) Conformant Handheld Fingerprint Sensor

**Title:** Fulcrum Biometrics' Plan for Research and Development of WS-BD Conformant Handheld Fingerprint Sensor

**OU:** Information Technology Laboratory

**Firm**: Fulcrum Biometrics, LLC
1862 W Bitters Rd #100
San Antonio, TX 78248

**Principal Investigator:** Kenneth Nosker
**Phone:** 210-348-3687 **Email:** ken@fulcrumbiometrics.com

**Award Amount:** $90,000.00

**Abstract:** Trusted biometric validation of individual identities has never been more important. Several contributing factors are the increase in global terrorism, identity theft and the increase in legislation which are driving the accelerated adoption of biometric technology. Unfortunately, the biometrics industry has not actively responded to the changing market conditions being driven by the explosion in mobile computing. These new mobile devices are rapidly replacing traditional desktop and laptops in both commercial and public sector organizations. This project seeks to explore the development of new wireless biometric sensors that deliver biometric data over secure web services. We propose to implement a fully functional wireless biometric fingerprint sensor by starting with an existing microcomputer platform. Although our end goal will be the development of a fully operational prototype device, we primarily aim to understand technical challenges and limitations of implementing the complex embedded web service specified by NIST while also exploring new state of the art secure System on Chips (SoC’s) for future commercial development efforts.

**Commercial Applications:** The mobile computing revolution and the nearly complete lack of biometric sensor technology that can be used or accessed by such devices today has created an opportunity to develop a totally new breed of portable, wireless secure biometric sensors. The commercial potential for this research is very large and it is immediately viable. The opportunity cuts across both private and public sectors with both sectors clearly experiencing rapidly growing demand. Examples of vertical markets (domestic and international) that can immediately take advantage of this technology if developed are: Law Enforcement, Military, eGovernment, Workforce Management, Mobile Banking/Micro Finance, and Mobile Health. As the trend towards adoption of totally mobile, always connected computing devices continues, nearly all of the biometric sensor devices that have been deployed to date will face obsolescence. A new breed of secure wireless biometric sensor device free from the traditional headaches associated with software drivers and complicated installation/configuration will further accelerate the inevitable demise of the old USB tethered sensor paradigm.

FY2012 Phase I Awardee

**Topic:** [Manufacturing](#book9_02)

**Subtopic:** Query-based Geometric Interoperability for Advanced Manufacturing

**Title:** Query- Based Interoperability and CAD/CAE Integration in Assemblies

**OU:** Engineering Laboratory

**Firm:** Intact Solutions, LLC
3734 Grandier Road
Sun Prairie, WI 53590

**Principal Investigator:** Dr. Michael K. Freytag **Phone:** 614-499-0120 **Email:** freytag@intact-solutions.com

**Award Amount:** $90,000.00

**Abstract:** We propose to design and implement a set of CAD queries by which to achieve model interchangeability in assemblies, model interoperability, and model integration for CAD/CAE. A model scenario will be used to illustrate how this can be accomplished. In Phase 1, we will establish the feasibility of the approach, develop high level algorithms and conduct software experiments to verify their efficiency and scalability. Specific manufacturing use cases and delivery via Service Oriented Architecture (SOA) will be designed with a view towards a Phase 2 of the project.

The proposed query-based approach to support interoperability for advanced manufacturing is expected to side-step many of the intrinsic problems of data-centric approach that has been promoted by standards bodies over many years. Owing to the flexibility of queries, moreover, the work proposed here is expected to be adopted by vendors and clients alike.

**Commercial Applications:** The proposed approach differs fundamentally from the current, data-centric approach; it aims to dramatically broaden accessibility to and scope of advanced manufacturing, by providing fully interoperable software solutions. Specific commercial applications fully automated and integrated engineering analysis, cloud-hosted analysis services, and other web- and cloud-based manufacturing applications delivered via SOA.

The approach opens the arena for small, innovative companies offering new technology that can be integrated into the advanced manufacturing process chain, and lowers the barrier to their entry into the market place.

FY2012 Phase I Awardee

**Topic:** [Information Technology and Cybersecurity](#book9_01)

**Subtopic:** Microfabricated High-Frequency Connectors for Millimeter-Wave Technology

**Title:** Microfabricated Broadband Connectors for Frequencies Above 100 GHz

**OU:** Physical Measurement Laboratory

**Firm:** Nuvotronics, LLC
7586 Old Peppers Ferry Loop
Radford, VA 24141

**Principal Investigator:** Ken Vanhille **Phone:** 800-341-2333 **Email:** kvanhille@nuvotronics.com

**Award Amount:** $89,995.63

**Abstract:** The region of the electromagnetic spectrum from 100 GHz to 400 GHz is currently underutilized but an area of exciting promise. Although atmospheric attenuation is higher in this region, the high frequency enables higher bandwidth operation. Transmit and receive components are also small resulting in the potential for lightweight miniature systems. Sub-millimeter waves also have the unique ability to “see through” materials that are opaque at other wavelengths, allowing imaging through dust, walls, and clothing. There is currently a lack of connectors and adapters that operate at these frequencies which hinder effective test and measurement, slowing development and increasing system development costs. Nuvotronics will develop a new class of connectors and adapters for operation at these high frequencies based on our extensive background in microfabrication of devices at millimeter wave frequencies.

**Commercial Applications:** Connectors and adapters developed in this work will find applications in test and measurement and in system designs for security, radar, satellite/terrestrial communications, space exploration, and earth science instruments.

FY2012 Phase I Awardee

**Topic:** [Manufacturing](#book9_02)

**Subtopic:** Non-contact Microwave Measurement of Electrical Properties of Nanofiber Materials

**Title:** Non-contact Inline Material Sensor for Measurement of Electrical Properties of Nanofiber Films

**OU:** Material Measurement Laboratory

**Firm**: PaneraTech, Inc.
2295 Village Crossing Rd, Ste 302
Falls Church, VA 22043

**Principal Investigator:** Yakup Bayram **Phone:** 614-429-1208 **Email:** yakup.bayram@paneratech.com

**Award Amount:** $89,916.00

**Abstract:** PaneraTech is proposing a non-contact dual sensor for broadband and real-time characterization of thin nanofiber films during the manufacturing. Our solution offers several unique aspects that are ideal for this application. For instance, it uses a dual CPW sensor for low frequencies and free space transmission system for higher frequency band. Our proposed sensor system is also equipped with highly accurate distance sensors to determine the thickness and distance of the sensor from the film as it will vary within the manufacturing environment. Our proposed sensor also employs sensor fusion to improve extracted electrical parameters of the manufacturing environment. Our proposed sensor also employs sensor fusion to improve extracted electrical parameters of the nanofiber films. Our system is also low-cost as it’s primarily based on low-cost probes and commercially available distance sensors. It also shares the same hardware between the two probes, thus offering very low-cost yet highly accurate measurement system.

**Commercial Applications:** This technology has significant applications in characterization of nanofiber film materials. It provides quick and real-time measurement methodology to assess quality of thin films and monitor their manufacturing process. Thin and light-weight EMI shields find their applications for a wide range of applications from aerospace to medical devices, telecommunication devices, navigational devices, scanner and data acquisition devices etc. Our proposed technology provides a powerful tool for manufacturers for quick and accurate assessment of their prototype thin film materials to have real-time quality monitoring of fabrication process of thin films.

FY2012 Phase I Awardee

**Topic:** [Information Technology and Cybersecurity](#book9_01)

**Subtopic:** WS-BiometricDevices (WS-BD) Conformant Handheld Fingerprint Sensor

**Title:** A Compact, Tamper-Resistant, Portable Fingerprint Scanner

**OU:** Information Technology Laboratory

**Firm:** SBG Labs
1288 Hammerwood Ave.
Sunnyvale, CA 94089

**Principal Investigator:** Jonathan Waldern **Phone:** 650-793-2695 **Email:** jonathanw@sbglabs.com

**Award Amount:** $89,918.00

**Abstract:** With the growing demand for more efficient fingerprinting techniques, live scans are rapidly displacing traditional ink-based methods. Despite improvements in detector and processing technology for capturing and digitizing fingerprints, current equipment falls well short of NIST’s goal of a small, tamper-resistant, battery-powered, handheld scanner. Incumbent equipment suppliers have little commercial incentive to lead the introduction of low-cost portable devices that can be widely deployed. In response to this need, SBG Labs is pleased to announce an innovative portable scanner based on proprietary holographic technology. Our solution features a compact, high-resolution scanner integrated with a smart, hardware data encrypted, GPS enabled tablet. It can rapidly capture multi-fingerprint images which are fully compliant with FBI standards. In Phase 1, we propose to implement a NIST-compliant protocol for wirelessly communicating with and controlling the operation of our biometric device. This work will leverage several parallel, separately –funded technology development efforts.

**Commercial Applications:** Fingerprints are by far the most widely used computerized solution for biometric authentication, owing to their ease of acquisition, established use, and user acceptance. Portability is becoming increasingly important, especially for state and local governments, air travel authorities, and other security-conscious organizations where immediate identity and background checks on an individual are highly desirable, if not crucial. Besides identification, fingerprint recognition can also be used for authentication. Thus, in the longer term, commercial demand for applications like access control, facility security, and time and attendance management will outstrip demand from government agencies, driving down cost and spurring further technical development.

FY2012 Phase I Awardee

**Topic**: [Manufacturing](#book9_02)

**Subtopic:** X-ray Chemical Shift Mapping for Industrial Materials Analysis

**Title:** Improved Microcalorimeter Detectors for X-Ray Chemical Shift Mapping

**OU:** Physical Measurement Laboratory

**Firm:** STAR Cryoelectronics
25 Bisbee Ct, Suite A
Santa Fe, NM 87508

**Principal Investigator:** Robin Cantor **Phone:** 505-424-6454 **Email:** rcantor@starcryo.com

**Award Amount:** $89,970.00

**Abstract:** X-ray fluorescence spectroscopy is a widely used and extremely sensitive analytical technique for qualitative as well as quantitative chemical analysis. Superconducting Transition Edge Sensor (TES) microcalorimeter detectors have now been developed that achieve an energy resolution of 2 eV (full width at half maximum) for 1.5 keV X-rays, which is sufficient to enable the measurement of the small shift of the X-ray line position and line shape that occurs depending on the chemical bonding state of the fluoresced atoms. STAR Cryoelectronics proposes to develop the necessary processes to fabricate improved TES detectors that match this performance and integrate these detectors into the company’s energy dispersive microcalorimeter X-ray spectrometer for chemical shift mapping. This will significantly enhance the power of X-ray fluorescence spectroscopy as an analytical tool for a broad range of applications.

**Commercial Applications:** The primary commercial application for the proposed spectrometer with improved transition edge sensor (TES) microcalorimeter detectors is high resolution X-ray microanalysis for qualitative and quantitative chemical compositional analysis and chemical shift mapping. These analytical capabilities are extremely important for high technology industrial applications such as for semiconductor manufacturing as well as materials research.

FY2012 Phase I Awardee

**Topic:** [Manufacturing](#book9_02)

**Subtopic:** High-Precision, Random Profile Roughness Specimens

**Title:** An Automated Lapping Apparatus and Process for High- Process for High-Precision Random Profile Roughness Specimen Fabrication

**OU:** Physical Measurement Laboratory

**Firm:** X-wave Innovations, Inc.
407 Upshire Circle
Gaithersburg, MD 20878

**Principal Investigator:** Dan Xiang **Phone:** 301-948-8351 **Email:** dxiang@x-waveinnovations.com

**Award Amount**: $89,994.00

**Abstract:** The measurement and quality control for smooth engineering surfaces are becoming more and more important in modern science and technology due to their important engineering functions and high production costs. NIST has frequently received requests for U.S. industry to provide Standard Reference Material (SRM) high-precision, random profile roughness specimens to support smooth surface measurements. However, the fabrication process develop by a NIST researcher was complicated, which hinders the availability of the SRM specimens. In this proposal, X-wave Innovations, Inc. (XII) proposes an automated lapping apparatus and process, which is based on the idea and claims outlined in NIST’s expired patent, for fabricating the high-precision, random profile roughness specimens. The proposed apparatus and process possess advantages such a high manufacturing throughput, high reproducibility, and low operation cost. The success of this SBIR effort will result in an automated apparatus for manufacturing SRM high-precision, random profile roughness specimens for NIST to support U.S. manufacturing industry.

**Commercial Applications:** The quality control for smooth engineering surfaces becomes increasingly important, not only because of their important engineering functions, but also the high production costs. The market for the SRM High-Precision, Random Profile Roughness Specimens has been existing for a long time. This market potential will increase in the future along with the advance of the high-precision engineering and manufacturing, which is fueled by the increasing demands for high performance mechanical systems such as the propulsion systems for aerospace vehicles, medical devices, and nano-technologies. Not only do the high-precision random profile roughness specimens have huge market opportunities, but also the developed automated lapping apparatus itself. This is because the developed lapping apparatus can be easily converted to a generic surface material characterization instrument, such as a wear tester or surface material analyzer. This could open up other market opportunities for the developed apparatus and associated process.

**Phase II Awards**

FY2012 Phase II Awardee

**Topic:** Information Technology

**Subtopic:** Development of a SCAP Content Creation Tool

**Title:** SCAP Content Editor

**OU:** Information Technology Laboratory

**Firm:** G2 Inc.
302 Sentinel Dr., Suite 300
Annapolis Junction, MD 20701

**Principal Investigator:** Matthew Kerr **Phone:** 301-575-5137 **Email:** matt.kerr@g2-inc.com

**Award Amount:** $299,066.16

**Abstract:** NIST and G2 have been on the forefront of security automation with the development of the Security Content Automation Protocol (SCAP). However, the barrier to entry for SCAP content creation is the requirement to have in depth knowledge of the underlying specifications. This project aims to allow security experts to create SCAP content without the need to be an expert in the specification. By leveraging the experience of our SCAP team, G2 will build on the concepts and lessons learned from our Phase 1 work to provide such a content creation tool.

**Commercial applications:** This research will result in the commercial creation of a comprehensive and intuitive content editor to create, change and manage information security automation instructions. Based upon G2’s expertise in similar research and engineering, our understanding of the community through collaboration with NIST leadership, and market observations, we have identified a unique need for such a product.

Since 2005, the security automation community has developed numerous languages to enable interoperability among security products, but there is an inherent complexity to achieve the software assurance and governance goals envisioned. The SCAP Editor product will enable lower the barrier to entry for users to harness the capability of security automation technology.

FY2012 Phase II Awardee

**Topic:** Materials Science

**Subtopic:** Environmental Chambers for an Integrating Sphere-based Weathering Device

**Title:** Irradiated Environmental Chambers

**OU:** Engineering Laboratory

**Firm:** Measurement Analysis Corp.
23850 Madison St.
Torrance, CA 90505

**Principal Investigator:** John Sparks **Phone:** 310-378-5261 **Email:** jsparks@macorp

**Award Amount:** $300,000.00

**Abstract:** Using a novel concept for humidity control, based on a proprietary saturated air source, MAC will construct and evaluate a prototype of an environmental chamber for use with NIST’s SPHERE UV source, in weathering or other UV degradation studies. The chamber will interface to the exit ports of the SPHERE, maintaining the material coupons, mounted in a standardized sample holder, at a programmed temperature and relative humidity, within specified tolerances, for the duration of testing. The prototype will be evaluated for temperature and humidity control performance over a range of conditions, to include variations in ambient temperature and barometric pressure typical to a laboratory environment, and simulated altitude up to 2000 meters. The prototype will be installed on the NIST SPHERE for a period of testing to evaluate performance in the SPHERE environment.

**Commercial Applications:** Primarily intended to support the eventual installed base of SPHERE sources, over a range of IR to UV, the chamber design will also be adaptable, where practical, to other sources, such as commercially available Solar Simulators, and other controlled environment application with very small air volumes. The underlying technology can be adapted to temperature and humidity chambers where the thermal and/or humidity loading is relatively small, such as material studies, precision manufacturing applications, microbiological studies. The technology is not applicable where large humidity control inputs are required, such as greenhouse environments.

FY2012 Phase II Awardee

**Topic:** Materials Science

**Subtopic:** Development of Anion Exchange Resins for Chirality-Based Separation of Single Walled Carbon Nanotubes

**Title:** Anion Exchange Resin for Chirality-based Separation of Single-wall Carbon Nanotubes

**OU:** Material Measurement Laboratory

**Firm:** Sepax Technologies, Inc.
5 Innovation Way, Suite 101
Newark, DE 19711

**Principal Investigator:** Ke Yang **Phone:** 302-366-1101 **Email:** Kyang@sepax-tech.com

**Award Amount:** $300,000.00

**Abstract:** Sepax Technologies, Inc. has identified a new type of anoin-exchange resin which separates single-wall carbon nanotubes (SWCNTs) with >80% recovery yield and resolves in a single pass the chiral tubes of (6,5) well from commercial SWCNT starting materials by Chromatography. Improvement and scale up of the targeted resin production will facilitate the separation of chiral nanotubes for the academic research and industrial application.

**Commercial Applications:** SWCNT separation is an enabling step for many potential applications and fundamental studies that require defined nanotube structures and properties. Nanotubes with different chiralities could be used in semiconductor industry and material industry. Pharmaceutical industry can apply nanotube technologies to develop nanomedicine, drug delivery and medical imaging.

FY2012 Phase II Awardee

**Topic:** Manufacturing

**Subtopic:** Production of ISMRM/NIST MRI Calibration Phantoms

**Title:** Production Methods and Software for NIST Calibration Phantoms

**OU:** Physical Measurement Laboratory

**Firm:** Sigma-K Corp.
511 Clayton Rd.
Durham, NC 27703

**Principal Investigator:** Douglas Kirven **Phone:** 919-971-4287 **Email:** dkirven@sigma-k.com

**Award Amount**: $300,000.00

**Abstract:** Magnetic Resonance Imaging data needs to be calibrated using a universal standard. NIST and the ISMRM SQRM committee have developed the NIST/NIST MR phantom. The group had two phantoms manufactured to their specifications and these phantoms have been imaged at numerous imaging facilities. Sigma-K now proposes to develop a complete manufacturing method that will produce 50 MRI phantoms. These phantoms will be sent to numerous imaging facilities for research and testing. The phantom design proposed by Sigma-K will ensure measurement traceability of all of parameters in the phantom. These include 100 contrast and fiducial spheres, resolution inset(s), and slice profile wedges. The work performed by Sigma-K during the Phase 2 Work Plan, will allow Sigma-K to immediately begin a production process that will allow this phantom to be purchased for less than $2500.

**Commercial Applications:** The work performed during the Phase 2 Work Plan will have allowed Sigma-K to develop a complete manufacturing process as well as a quality control system for the ISMRM/NIST phantom. At the commencement of the Phase 2 efforts, Sigma-K will go directly into full scale production of this phantom. The results of the Phase 2 efforts will be the development of a proprietary manufacturing process for this phantom. This fully automated assembly system will be a subset of the complete assembly method that will ensure measurement traceability throughout the five year life of the phantom.