



# SBIR



## Small Business Innovation Research Program

### ABSTRACTS OF PHASE II AWARDS FOR FISCAL YEAR 2014

**U.S. DEPARTMENT OF COMMERCE**  
National Oceanic and Atmospheric Administration

## **INTRODUCTION**

The Department of Commerce (DOC), National Oceanic and Atmospheric Administration (NOAA), through the Small Business Innovation Research (SBIR) program, awarded 11 Phase I contracts for FY 2014. These awards are up to \$95,000 each, and totaling approximately \$1,045,000. The awards are for a six-month effort to demonstrate the feasibility of innovative approaches to the research topics identified in the “DOC/NOAA SBIR Program Solicitation for FY 2014 (NOAA 2014-1).” Abstracts of the successful Phase I proposals submitted under this solicitation, and brief comments on their anticipated results are provided in this publication.

The SBIR program is highly competitive. A total of 76 proposals were received by DOC/NOAA in response to its FY 2014 solicitation. Internal and external scientists and/or engineers independently reviewed the proposals. With the funds available, only 11 were selected for an award. Final selection was based upon the results of the reviews, relative importance to DOC/NOAA needs, relationship to on-going research, and potential for commercialization.

In Phase II, funding is provided for projects that are most promising after Phase I is completed. These awards can be for up to \$400,000 each and for two years. The DOC/NOAA awarded a total of 9 Phase II contracts in FY 2014 for a total of approximately \$3.6 million. Abstracts of successful Phase II proposals and comments on their anticipated results are also provided in this publication.

## FY 2014 PHASE II AWARD WINNER

FIRM: Areté Associates  
1550 Crystal Drive  
Suite 703  
Arlington, VA 22201

AWARD: \$

PHONE: 703-413-0260  
E-MAIL: contracts2@arete.com

PRINCIPAL INVESTIGATOR: Steven P. Anderson

TITLE OF PROJECT: An Advanced Algorithm for Radar Derived Bathymetry

SUBTOPIC NUMBER: 9.1.3N Bathymetric Radar

### TECHNICAL ABSTRACT:

NOAA can reduce costs and improve efficiency by remotely monitoring harbors, nавигations channels and coastlines for bathymetric changes. This will aid NOAA and its mission to maintain waterways and assure maritime safety. This remote sensing can be accomplished by implementing a new radar derived bathymetry capability.

Areté Associated proposes to implement an advanced algorithm to derive bathymetry from times-series wave imagery obtained from shore based navigation radars. NOAA will benefit directly from our experience developing and transitioning other remote bathymetry solutions.

Our approach includes the following benefits:

- A low risk approach that exploits linear wave dispersion and Fourier analysis
- High spatial resolutions and accuracy retrievals using new variational assimilation approach.
- Algorithm testing and implementation to prototype operational software executable with documentation delivered to NOAA.
- A flexible and adaptive solution that can be used with NOAA's existing radar systems and extended to other platforms.

The success of Phase II will produce prototype software for a real-time, shore based radar bathymetry capability. This demonstration software is the next step towards NOAA long term goal of an operational remote bathymetric measurement system suitable for both land and ship based radar systems.

### SUMMARY OF ANTICIPATED RESULTS:

The anticipated results include the collection of one-month of radar, development of prototype operational software, and implementation of both a Fourier Analysis approach and a variational assimilation approach. We expect the variational assimilation methodology will provide higher spatial resolution and accuracy bathymetry than has previously been possible.

## FY 2014 PHASE II AWARD WINNER

FIRM: Intelligent Automation, Inc.  
15400 Calhoun Drive  
Suite 400  
Rockville, MD 20855

AWARD: \$400,000

PHONE: 301-294-4253  
E-MAIL: jhenriksson@i-a-i.com

PRINCIPAL INVESTIGATOR: Jakob Henriksson

TITLE OF PROJECT: Climate Impact Visualization Tools using 3D City for Community based Planning and Outreach

SUBTOPIC NUMBER: 9.3.1R,C

### TECHNICAL ABSTRACT:

To build a climate-smart and resilient nation, we need to foster a climate-literate public that understands its vulnerabilities to a changing climate and makes informed decisions. A core component of this challenge is to develop simple, intuitive and high-impact visualizations of climate data-data that is and will be made available through the President's Climate Data Initiative-for education and outreach activities. Intelligent Automation Inc., together with Center for GIS (Towson University), is developing the Virtual 3D City Communication and Outreach Management System (COMS) Web Portal. The Web portal will be home to education and outreach products created from visualizing existing storm surge and coastal inundation datasets from climate models (e.g. SLOSH, ADCIRC) in the popular Unity game engine. We are developing a flexible Unity SDK plugin that can create virtual 3D city models for any coastal town from USGS elevation data, point cloud LiDAR data and crowd-sourced OpenStreetMap data. Using our COMS portal, local planners and communities can visualize scientifically computed water levels in Unity to understand the effect of the storm surges and inundation. The visualizations can be recorded and distributed through social media to communicate and educate communities and policy makers about coastal area vulnerabilities and climate-preparedness.

### SUMMARY OF ANTICIPATED RESULTS:

We anticipate several results from our Phase II effort. The three main results correspond to the three core components of our approach: 1) We will have a Unity SDK plugin that can be used to generate virtual 3D city models for potentially any coastal area of the US (and beyond the US given appropriate input data); 2) We will be able to visualize existing NOAA climate datasets in 3D environments and capture the visualizations as videos and pictures for distribution as education and outreach media artifacts; 3) We will have a Communication and Outreach Management System (COMS) Web portal that will host education and outreach products related to climate data.

The creation of virtual 3D city models has many applications beyond climate data is critical for other agencies such as the DHS and the DOJ. The ability to visualize NOAA climate datasets in

3D environments and capture these intuitive visualizations for distribution has many applications. For example, this can be used to educate the public about the risks of storm surges and climate change (e.g. sea level rise). This can be done at the local level with community members, or in museums as educational displays, or via news outlets (e.g. TV news channels). Furthermore, planners and emergency personnel can use the captured education and outreach media artifacts to communicate with, and educate, policy makers at various levels of governance. Finally, another important anticipated result is the use of our 3D visualizations of NOAA climate data as a demonstrator for the President's Climate Data Initiative.

## FY 2014 PHASE II AWARD WINNER

FIRM: McQ Inc.  
1551 Forbes Street  
Fredericksburg, VA 22405

AWARD: \$399,999.94

PHONE: 540-373-2374  
E-MAIL: karmstrong@mcqinc.com

PRINCIPAL INVESTIGATOR: Mark Winston, Senior Engineer

TITLE OF PROJECT: Buoy Guard System

SUBTOPIC NUMBER: 9.3.2W

### TECHNICAL ABSTRACT:

Buoy vandalism occurs all over the world for many different reasons, and costs NOAA and other buoy operators an estimated \$1 million annually to replace and repair them. To deter vandals and report any vandal attempts to NOAA, McQ has developed the Buoy Guard System (BGS). BGS is a small, extremely low power sensor system that will detect the presence of intruders first approaching and then boarding the buoy. The primary intruder detection mode will be acoustic augmented by accelerometer. Once detected, the system will automatically capture images of the intruders and send them back via satellite communications (satcom) to buoy operators for action. Image processing will determine the optimal images to send back over satcom and optical character recognition (OCR) processing will send back the text read from the stern or sides of the intruding vessel. The detections and imagery will also be stored securely in BGS on the buoy for later retrieval. Additionally the system will have non-lethal deterrents (specifically strobe lights, an audio alarm, supplemented with sonic nausea) to ward off both ill-intentioned as well as curious intruders. The system is completely self-contained and can easily be installed on a wide variety of buoy designs.

### SUMMARY OF ANTICIPATED RESULTS:

The design that we are proposing the BGS can be readily adapted to a wide variety of buoys. The problem that BGS is designed to solve is common to all high value buoys. The scope of the problem is well documented as described in the first section of this proposal. The benefits of a BGS (reduction in loss of service, reduction in repair and replacement costs, improved weather predictions, improved safety) will make a compelling argument for sales-the cost/benefit should be viewed very favorably by buoy operators. We believe that the BGS system can also be extended to other maritime applications as well. Examples of these might be remote maritime structures such as historic lighthouses, oil rigs, research stations or other isolated structures. They could benefit from a BGS where other more traditional burglar alarm systems would not be viable for a variety of reasons. There are numerous other types of buoys such as navigation buoys and research buoys that could contribute substantially to the market for BGS.

## FY 2014 PHASE II AWARD WINNER

FIRM: NorthWest Research Associates, Inc.  
4118 148<sup>th</sup> Ave NE  
Redmond, WA 98052

AWARD: \$399,995

PHONE: 425-556-9055  
E-MAIL: leka@nwra.com

PRINCIPAL INVESTIGATOR: KD Leka, Senior Research Scientist

TITLE OF PROJECT: Delivering a Solar Flare Forecast Model that Improves Flare Forecast (Timing and Magnitude) Accuracy by 25%

SUBTOPIC NUMBER: 9.4.3W

### TECHNICAL ABSTRACT:

NorthWest Research Associates proposes to develop a prototype system to forecast solar flares for NOAA/Space Weather Prediction Center. Many activities and technological systems prevalent in today's society—air traffic control and air travel, the power grids, communications, deep-water drilling operations, human spaceflight—are vulnerable to the effects of flares from our Sun, which can suddenly produce orders-of-magnitude increases in gamma-and X-rays and high-energy particles. Resilience on satellite-based high-precision positioning is particularly vulnerable. The Discriminant Analysis Flare Forecasting System (DAFFS) characterizes the magnetic field of the solar photosphere and corona, its recent evolution, and prior flaring history. DAFFS then delivers a categorical or probabilistic forecast for future flaring above a given size and over a specified time-frame. DAFFS out-performs the present NOAA/SWPC forecasts for most categories, in particular for extended forecasts of large events. The Phase I feasibility study demonstrated its appropriateness for extension into a real-time operational tool. The objectives of this Phase II are to (1) develop and demonstrate an operational prototype and (2) incorporate the many degrees of customization that we envision are of interest for commercial customers and other government agencies.

### SUMMARY OF ANTICIPATED RESULTS:

We expect the prototype DAFFS to be automated, computationally inexpensive, and to improve upon the accuracy of the present solar flare forecast model used by NOAA/SWPC. DAFFS can be customized with respect to lead-time, forecast windows, targets, and with respect to the relative cost of false alarms and misses. Potential markets include protecting on-orbit and high-altitude humans and hardware, and for alerts as to upcoming possible HF communication outages and disruptions of high-precision satellite-based timing and location signals.

## FY 2014 PHASE II AWARD WINNER

FIRM: Phase Sensitive Innovations  
51 East Main Street  
Suite 201  
Newark, DE 19711

AWARD: \$399,979.35

PHONE: 302-456-9003  
E-MAIL: dillon@phasesensitiveinc.com

PRINCIPAL INVESTIGATOR: Thomas Dillon, Senior Research Engineer

TITLE OF PROJECT: Dynamic Frequency Passive Millimeter-wave Radiometer  
Based on Optical Up-conversion

SUBTOPIC NUMBER: 9.4.1D

### TECHNICAL ABSTRACT:

Passive microwave sensors aboard satellites provide valuable information regarding weather conditions by measuring atmospheric attenuation over a broad range of frequencies from 0-200 GHz. Additional ground-based sensors are desirable to provide complementary upward looking measurements that can be used to refine existing attenuation models. Operating over such a large bandwidth, however, places significant demands on the receiver architecture; a common approach to this challenge involves channelizing the receiver for each frequency band of interest. Unfortunately, this limits the flexibility of the system and finding components that can operate at these higher frequencies is challenging. The approach is taken by Phase Sensitive Innovations involves conversion of the collected radio frequency signals to optical frequencies, where these signals are relatively narrowband and can be processed using conventional photonic components. Optical up-conversion is accomplished using our own high speed (up to 300 GHz) lithium niobate phase modulators acting as broadband mixers. Subsequently an optical heterodyne mixer is used to tune the receiver and bring the desired frequency signals to baseband for detection. Such an approach offers significant advantages in terms of overall simplicity of the receiver design and the ability to operate efficiently at high frequencies up to and exceeding 200 GHz.

### SUMMARY OF ANTICIPATED RESULTS:

A passive microwave sensor operating at frequencies from 0-200 GHz will be developed. Both horizontal and vertical polarizations will be detected. Furthermore the sensor will be gimbal mounted to provide the scanning ability.

## FY 2014 PHASE II AWARD WINNER

FIRM: Aurora Flight Sciences Corporation  
4 Cambridge Center, Floor 11  
Cambridge, MA 02142

AWARD: \$399,903.92

PHONE: 617-500-3978  
E-MAIL: jwissler@aurora.aero

PRINCIPAL INVESTIGATOR: John Wissler, Director, Systems Engineering

TITLE OF PROJECT: Surveying Earth's Gravity with Unmanned Aerial Vehicles

SUBTOPIC NUMBER: 9.1.2R,N

### TECHNICAL ABSTRACT:

During the Phase I program, Aurora conducted a comprehensive survey of potential platforms that included government owned and furnished UAVs and manned aircraft as well as Aurora's Centaur Optionally Piloted Aircraft (OPA). The survey concluded, in part, that UAVs offer a significant improvement in data collection capability when compared to manned aircraft that are currently fielded by NOAA. The Centaur OPA has the potential to serve as a scientific research platform that enables significant mission flexibility to the end user by allowing for both unmanned flight over littorals and spare regions and manned flight over populated or high traffic areas. Further, the survey concluded that the Centaur OPA offers significant cost savings compared to UAVs currently fielded by government agencies. During the Phase II program, Aurora will integrate a Micro-g Lacoste TAGS-6 gravity meter in the Centaur OPA and demonstrate the Centaur/TAGS-6 platforms' ability to autonomously gather gravity data. The Centaur OPA will fly gravity survey missions that are representative of the gravimeter flight campaigns currently underway by the GRAV-D program. Aurora intends to demonstrate the capabilities of the Centaur/TAGS-6 platform and its suitability for the GRAV-D program and commercial gravity data gathering applications.

### SUMMARY OF ANTICIPATED RESULTS:

At the conclusion of the Phase II effort, Aurora anticipates having successfully demonstrated the utility of Centaur for performing a variety of scientific missions. Aurora anticipates that successful flight demonstration will show that the Centaur/TAGS-6 platform is a cost effective research platform capable of gathering usable gravity data.

## FY 2014 PHASE II AWARD WINNER

FIRM: Bell Aquaculture  
9885 Indiana 67  
Redkey, IN 47373

AWARD: \$400,000

PHONE: 765-369-2718  
E-MAIL: steve.craig@bellaquaculture.com

PRINCIPAL INVESTIGATOR: Steven Craig, PhD Senior Research Scientist

TITLE OF PROJECT: Improving Commercial Fish Meal Free Aquaculture Diets

SUBTOPIC NUMBER: 9.2.2F

### TECHNICAL ABSTRACT:

Domestic US aquaculture is moving toward fishmeal replacement in aquafeeds with a variety of alternative protein sources including plant-based, terrestrial and marine proteins. In our Phase I work we showed the feasibility of modifying the protein quality of several alternate protein sources, specifically animal byproduct meals, and its potential significant impacts on marine fish production. The next step in our Phase II is to continue this work focused upon fishmeal-free aquafeeds using specifically rendered and formulated ingredients made as complete diets in our new feedmill for feed testing and commercial production. Furthermore our work suggests that processing of specific feed ingredients destroys or modifies essential micronutrients resulting in poorer performances under commercial aquaculture conditions and we will work with modifications of these ingredient exposed to modified processes to formulate and manufacture fish meal free production diets and conducting extensive feeding trials with representative marine, brackish and freshwater aquaculture species, thereby correlating the presence of absence of these nutrients back to production performance. These feeds will be tested and sold to U.S. aquaculture producers targeting feed development toward marine and freshwater species for expected international and domestic adoption based on analysis of the economic variables and marketing of the final aquafeeds.

### SUMMARY OF ANTICIPATED RESULTS:

- Performance of modified fishmeal free aquafeeds using new feedmill and processing methods.
- Development of species and production specific aquafeeds for domestic aquaculture markets.
- Optimization of micronutrient composition of feeds for Recirculating Aquaculture Systems.
- Data required for economic analysis and marketing in U.S. and abroad.

## FY 2014 PHASE II AWARD WINNER

FIRM: Toyon Research Corporation  
6800 Cortona Drive  
Goleta, CA 931117

AWARD: \$400,000  
PHONE: 805-968-6787  
E-MAIL: kezal@toyon.com

PRINCIPAL INVESTIGATOR: Kenan O. Ezal, Senior Scientist

TITLE OF PROJECT: Mobile VHF Lightning Mapping System

SUBTOPIC NUMBER: 9.4.2R,D,W

### TECHNICAL ABSTRACT:

A preliminary design of a mobile receiver system for intra-cloud lightning detection, mapping, and tracking was completed and analyzed during the Phase I program. The direction-finding (DF) receiver design is small enough for use on small UAVs and utilizes the full VHF spectrum. The lightning Mapping Unmanned Sensor (LITMUS) design will be finalized, fabricated, assembled, and demonstrated during the Phase II effort. The LITMUS system comprises (a) multiple remote nodes, each equipped with the VHF receiver and communication hardware, and (b) a centralized control station hosting a graphical user interface called the Emitter Localization and Mission Planning Tool, or Empath, communication hardware, and a waveform correlation engine. Although the LITMUS system will be backward compatible with the low-bandwidth legacy lightning mapping arrays currently in existence, it will also include high-bandwidth waveform data that will achieve higher signal-to-noise-power ratios and will enable the detection and tracking of lightning flashes from much larger standoff distances and with better resolution. By the completion of the Phase II effort, a deliverable prototype LITMUS system will have been demonstrated in real-time and under realistic conditions and will be capable of mapping the entire flash sequence of intra-cloud lightning from beginning to end.

### SUMMARY OF ANTICIPATED RESULTS:

Under appropriate deployment geometries the lightning localization accuracy of the LITMUS system is expected to be better than the 10-m spherical error probable (SEP). The system has two independent runnable channels that will enable direction-finding (DF) and the ability to “bridge” between two existing lightning mapping arrays (LMA) operating at two different frequencies. The system can be used to detect other emitters within the operational band of the system and the Empath user interface can be used for any military or civilian emitter localization and tracking application. Furthermore, a UAV-based LITMUS system has the potential to save a significant number of lives because it will have much better visibility into approaching storm systems and will be able to provide earlier warnings of severe weather, thereby giving residents and utility companies more time to prepare for the storm. The electronics developed for this program can also be used for sferics-aided navigation when GPS is denied, and is relevant to the mission of virtually all NOAA organizations.

## FY 2014 PHASE II AWARD WINNER

FIRM: Toyon Research Corporation  
6800 Cortona Drive  
Goleta, CA 931117

AWARD: \$400,000

PHONE: 805-968-6787

E-MAIL: ksullivan@toyon.com

PRINCIPAL INVESTIGATOR: Kevin Sullivan

TITLE OF PROJECT: Automated Detection, Tracking Measurement, and Classification of Fish Observed by Underwater Cameras

SUBTOPIC NUMBER: 9.2.1F

### TECHNICAL ABSTRACT:

We propose to develop a system that can automatically detect, track, measure, and classify fish seen in video collected by stationary underwater cameras. Our approach makes use of a novel method for detecting motion that can mitigate false alarms due to swaying underwater vegetation. We propose a novel technique for tracking the fish in three spatial dimensions allowing for improved knowledge of the potential target dynamics, occlusion by other fish and submerged objects, and length measurements. Our system will be capable of working with two or more cameras. Our classification module will work with multiple segmented images of fish. Classification decisions will be made using as few as one frame of data, but most decisions will be based on multiple looks at each fish, taking advantage of the fact that most video cameras collect many images per second. We will create a software tool that allows an operator to view video with overlays indicating fish in track along with their estimated length and classification.

### SUMMARY OF ANTICIPATED RESULTS

The successful completion of this research will result in a system that helps NOAA biologists to more effectively conduct fish surveys. The technology also has the potential to protect fishing industries such as the commercial salmon industry by supporting tasks such as the counting of fish that travel through fish ladders. The technology could also have applications in fishing regulation enforcement where fish types and lengths are automatically identified using handheld camera. Additionally, the technology could be used by recreational fishermen to ensure that they do not violate fishing regulations by identifying their catch prior to possible release.