

**WHO**

**SYSCOM:** NAVAIR

**Sponsoring Program:**

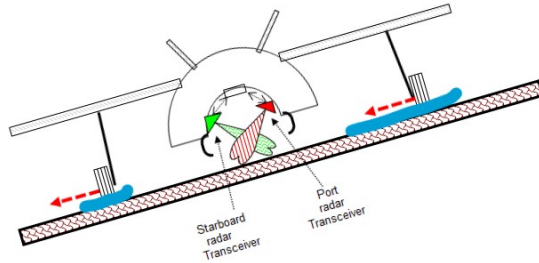
**Transition Target:**

**TPOC:**

301-342-5480

**Other transition opportunities:** o - DARPA's Robotic Autonomy in Complex Environments with Resiliency (RACER) program - high speed unmanned ground vehicles (UGV)

- o - Crane Aerospace is a MQ-25 subcontractor for braking control.
- o - Air transport operations on icy or rain-slicked taxiways for detecting sliding off taxiways.
- o - Military and civilian operation of tracked vehicles on rough/snow-covered terrain to detect sliding danger.
- o - Precision odometer for land vehicles operating GPS-denied on sand, ice, snow, and other surfaces.
- o - Military and civilian aircraft anti-skid systems to provide speed and direction of motion on taxiways when wheels are sliding laterally and little information is provided by wheel rotation counters.
- o - Military and civilian automotive anti-lock braking (ABS) and traction control systems to provide vehicle speed and direction independently of wheel rotation sensors and with no road contact.



Courtesy BCO Incorporated

**WHAT**

**Operational Need and Improvement:** Unmanned aerial vehicles(UAVs), taxiing under their own power, on the flight deck of a ship, may not move in the commanded direction. Deck surface conditions and motion of the ship could cause the aircraft to slide or skid. Knowing that the aircraft is sliding to the side can be vital to recovering from an emergency. BCO's Low Speed Sensor (LSS) enhances the ability of remotely located flight controllers to take action to counter skids/lateral sliding by making non-contact measurements of both velocity and heading in the presence of sliding/skidding from open wheel wells.

**Specifications Required:** A radar sensor suite based on COTS mass-produced automotive radar chips is needed which will measure both longitudinal and lateral movement referenced to a ship deck or to an asphalt runway, for speeds of 0.4 mph (7 in./sec) to 6 mph. The sensors must scan from open wheel wells. The sensors must carry out velocity measurements with moving personnel and moving equipment nearby. Microwave power levels must be safe for personnel working under the aircraft. The sensor must operate on surfaces with a wide range of radar reflectivity including: worn non-skid surfaces and fresh and salt water on the deck.

**Technology Developed:** BCO's Low Speed Sensor (LSS) product will utilize pairs of one axis sensors to fulfill the need for longitudinal and lateral velocity measurements. The LSS sensors use extremely economical mass produced COTS radar-system-on-a-chip technology operating in the 60-GHz unlicensed band. They operate in a swept frequency mode emitting a safe 20 mw of peak power. Breadboard one-axis sensors have been successfully tested on a moving cart on the 1/3 carrier deck at Lakehurst Naval Air Station as well as on asphalt surfaces. The radar chips house all microwave circuitry including an electronically scanned antenna array. This results in simple mass production of the sensors which are self testing. The LSS runs under BCO developed radar software.

**Warfighter Value:** Pilots onboard a manned aircraft maneuvering on a ship's flight deck, have visual, audible, and tactile information that is unavailable to a unmanned vehicle's remotely located flight controller. Providing vehicle velocity and heading to the remote flight controller can enable them to take timely action to counter dangerous skidding and lateral sliding.

**WHEN**

**Contract Number:** N68335-19-C-0139 **Ending on:** February 28, 2022

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Measured velocity from hand pushed carts on asphalt with COTS automotive radar chips.	N/A	Measured 0.12 mph which is well below the Navy's 0.4 mph operational range.	TRL 4	August 2017
Successful test of motorized-cart-mounted COTS chip radar at Lakehurst Naval Air Station.	N/A	Accurate measurements made of velocities over the 0.4 to 6 mph range on a carrier deck.	TRL 5	July 2021
Test of networked multiple axis sensing prototype at Lakehurst Naval Air Station	Low	Accurate measurements of velocity and heading during realistic maneuvering.	TRL 6	TBD

**HOW**

**Projected Business Model:** BCO plans to bring to market a Commercial Off the Shelf (COTS) line of standard radar sensor products. These products will be manufactured in BCO's existing low volume manufacturing facility in Billerica MA. When volume increases, BCO will turn to a network of companies offering manufacturing services, that it has dealt with over the decades. The product hardware will consist of modules based on COTS: radar and micro computer modules. The radar system will operate under proprietary radar signal analysis software developed by BCO's software group. The software (and the proprietary technology) will be licensed to the customer. Initially sales will be executive selling to potential volume customer which will integrate the sensors into their products. There are on the order of 100 firms that the executive sales team can readily identify and approach.

**Company Objectives:** BCO Incorporated has delivered custom-designed shipboard equipment to the Fleet for 27 years. It has built custom fielded systems for other DOD entities. It has developed radar technology capability via participation in SBIR funded radar projects for the: Navy (helicopters), Air Force (helicopters), DOT (rail vehicles), and the current UAV project for NAVAIR. BCO plans to build on its custom systems business by offering commercial-off-the-shelf (COTS) radar-sensor products. The COTS product line will be suitable for DOD programs as well as wider Government and commercial markets.

- Potential Commercial Applications:**
- o-Military and civilian air transport operations on icy or rain-slicked taxiways for detecting sliding off of taxiways.
  - o-Military and civilian operation of tracked vehicles on rough or snow-covered terrain to detect lateral sliding danger.
  - o-Military and civilian aircraft anti-skid systems to provide speed and direction of motion independent of the wheel sensors and without runway contact.
  - o-Military and civilian automotive anti-lock braking and traction control systems to provide vehicle speed and direction of motion independently of wheel sensors.

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