Department of the Navy SBIR/STTR Transition Program

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SPAWAR SR-2018-311

Topic # A06-T005

Large Aperture Micro-Electro-Mechanical Modulating Retro-Reflector Development

Boston Micromachines Corporation

WHO

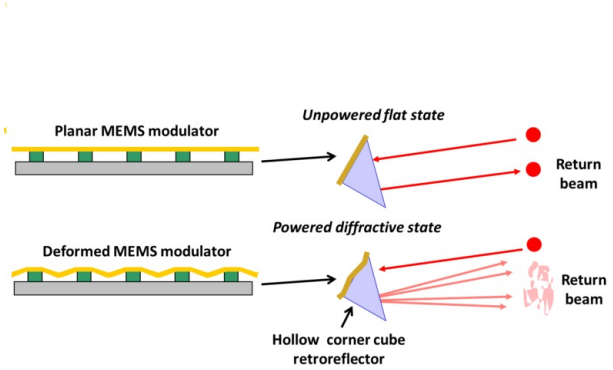
SYSCOM: SPAWAR

Sponsoring Program: PEO Space Systems

Transition Target: Space-based Laser Communication Systems

TPOC:
(619)553-1020

Other transition opportunities: Mobile User Objective System's (MUOS) Wideband Code Division Multiple Access (WCDMA), Cubesat, Nanosat, and SmallSat satellite communications: Integrated Communications Extension Capability (ICE-Cap); mobile tactical communications, commercial satellites and cellular communication



Notes: Boston Micromachines Corporation's (BCC) Modulating RetroReflector (MRR) system has been demonstrated to provide continuous asymmetric free space optical communication at up to a 200 kHz data rate.

WHAT

Operational Need and Improvement: The Navy currently operates a legacy Ultra High Frequency (UHF) SATCOM system and is in the process of replenishing and replacing the legacy UHF SATCOM constellation. The Navy in cooperating with the Army is interested in deploying mobile communication and small satellite capabilities to support tactical communications in support of three key missions:

- Air & Missile Defense
- Land Attack
- Anti-Ship Warfare

Specifications Required: The MEMS Modulating Retroreflector (MRR) is a reflective device that modulates an interrogating beam at high-speed and reflects the beam back to the beam's origin. Through the use of established communication protocols, this device is an enabling component for secure free-space laser communication links. This technology is different from existing technologies in that it enables asymmetric communication: the data-sender can operate at low size, weight and power due to the MEMS technology at the heart of the MRR. BMC's Modulating RetroReflector (MRR) system supports continuous asymmetric free space optical communication at up to a 200 kHz data rate.

Technology Developed: BMC has produced MEMS MRRs with apertures of 25.4 mm and developed systems to test modulator performance characteristics, contrast ratios and temporal response in vacuum environments. BMC is developing a new MEMS modulator fabrication approach that improves manufacturing yield. This approach employs single crystal material to replace the polycrystalline, defect-prone material used previously. BMC assembles and packages MRRs in a sealed chamber that provides critical damping, enabling it to perform in vacuum surroundings. BMC will enhance achievable contrast in MRR devices by incorporating modulators in all three facets of the MRR. This significantly increases contrast, especially at high angles of incidence, in comparison to previously single modulator devices.

Warfighter Value: Optical communication is critical for military operations in situations where conventional radio frequency (RF) channels can be disrupted or are unavailable for use. MRR technology is ideal for conventional free-space optical communication where hardware cannot be supported due to size and power consumption limitations. Weighing only 9 oz., MEMS MRRs can be positioned on soldiers or, as a smallsat payload enabling covert, secure communication.

WHEN

Contract Number: N68335-17-C-0508 **Ending on:** August 3, 2018

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Implement MEMS MRR Architecture	Low	SWaP-C	TRL-4	September 2017
Achieve Targeted Xmit/Receive Rates	Low	Achieve 200 kHz data rate	TRL-4	February 2018
Implement Batch process manufacturing	Med	Achieve economy-of-scale	TRL-6	June 2018

HOW

Projected Business Model: Founded in 1999, BMC is the leading provider of microelectromechanical systems (MEMS) - based mirror products and a designer of adaptive optics instrumentation as well as advanced retinal imaging instrumentation. BMC's modulator products offer an alternative to other intensity modulation technologies through their inherent property of being reflective, broadband and polarization insensitive. BMC's wavefront correction devices aid in the production of high-resolution images by enhancing images blurred by the earth's atmosphere as well as for imaging biological tissue and the human retina. They are widely used to drive scientific discovery in astronomy, laser beam shaping, microscopy, vision science, and support a variety of defense applications.

Company Objectives: BMC provides MEMS-based commercial adaptive optical control systems. It offers deformable mirrors (DM), such as mini-DM for laboratory-scale adaptive optics (AO) and low-order wavefront control applications; multi-DM for use in AO systems; kilo-DM; and AO kits for wavefront correction applications. BMC provides AOs, which include wavefront sensors and develops low power modulating retro-reflectors for the United States Army. BMC is seeking strategic partnership, with Department of Defense Prime satellite, unmanned aerial surveillance (UAS), communication capability providers.

Potential Commercial Applications: BMC's products are employed in astronomy, microscopy, laser control and beam shaping, medical discovery, defense, and retinal imaging applications. BMC serves manufacturers of optical imaging and communication systems, governmental agencies and contractors, and vision science research laboratories in the United States and internationally. BMC is actively pursuing partnerships with commercial communication providers that could benefit from its MEMS MRR technology.

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