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KEYWORDS: Helmet; Head Protection; Suspension System; Retention System; Blunt Impact; Ballistic Energy Dissipation

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N142-086 TITLE: Ad-Hoc Ground Based Counter-Fire System

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PM Armor and Fire Support Systems, Ground Counter Fire System Program

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OBJECTIVE: Develop improved, advanced-processing algorithms, to be utilized in the Command Post, of the Ground Counter Fire Sensor (GCFS) system to enable the gathering and processing of sensor data from either static or dynamically placed listening posts. Proposed systems shall utilize all available information from multiple vehicle sensor platforms to locate and identify indirect fire platforms.

DESCRIPTION: The mission of the GCFS system is to provide the Point of Origin (POO), Point of Impact (POI) of rockets, artillery, mortars, and IED’s, as well as identify the type of firing platform. The current GCFS system utilizes multiple remote Listening Posts (LP) that include an acoustic array placed on the ground, metrology sensors to measure the environmental conditions at the listening posts, and a radio to communicate information between the listening posts and the Command Post (CP). These remote listening posts must be emplaced, maintained, and repositioned by a team of Marines. This is costly in terms of manpower, maintenance, and training. The current GCFS system requires a team of 10 Marines and one High Mobility Multipurpose Wheeled Vehicle (HMMWV) to operate and maintain the system. This new approach would reduce the number of Marines to 3 and eliminate the need for a HMMWV.

The USMC is interested in augmenting or replacing the existing GCFS with a more flexible system that permits the attachment of acoustic sensors directly onto maneuver platforms. This will reduce the number of Marines required to support the system and free-up Marine teams from having to set up listening posts (microphone arrays with a weather station and comms) in hostile areas. The GCFS Program Management Office (PMO) is interested in exploring the development of improved, advanced-processing algorithms for use at a CP in anticipation of the dynamic placement of microphone arrays on vehicles. These microphone arrays would ‘tag along’ with the Marines that use the vehicles during normal military operations and would have varying configurations and would be easily relocated as required by the user. The intent is to replace the current listening posts with a Relocatable Listening Posts (RLP). For the purpose

of this topic, RLP's will consist of a microphone array attached to a vehicle, a weather station to determine local atmospheric conditions, a self-location device, a microphone orientation device (determines True North to orient the microphone array), and a communications device. Additionally, the CP will have access to terrain data that describes the area that the GCFS covers.

The GCFS Program is interested in innovative approaches in the development of advanced-processing algorithms to be utilized in the CP, able to gather and process data from either static LPs such as those GCFS currently utilize, but also utilize RLP's of varying configurations. Proposed concepts would also permit asynchronous reporting as each RLP and LP could report an event at different times because of latency due to the speed of sound. Furthermore, proposed concepts should address the challenge of RLPs dropping off or being added to the network as Marines using the vehicles maneuver them on the battlefield. Performers will be responsible for determining the data required from each LP and RLP for their proposed concept in order to meet GCFS performance requirements. Examples of this information could include, but is not limited to, LP/RLP location, configuration, orientation, event report time, event bearing, uncertainty surrounding event bearing, local weather conditions, and possibly others that the performer determines. Proposers should employ open architecture design concepts as practicable when proposing concepts for consideration.

The following is a set of tasks that proposed algorithm concepts will be expected to accomplish:
• Utilize data from up to 12 total listening posts, composed of a mix of RLP's or static LP's.
• Determine the POO/POI and time associated with all events covered by the GCFS mission. Deconflicting multiple reported bearing angles from multiple Listening Posts and determining accurate POO/POI is viewed as a key technical challenge for this effort. Since acoustic sensor arrays can locate a sound event in bearing only and not the source location, correlation and deconfliction of many intersecting bearing angles to the correct point of origin is very challenging. This is compounded by asynchronous reporting of acoustic events (due to speed of sound) and effects of weather and terrain.
    o Determine the POO (POO with 90% probability, of any indirect firing platform that could potentially fire upon a listening post. Put another way, if a firing platform could potentially fire upon and hit a listening post, the GCFS system must be able to locate that firing platform.)
    o Determine the POO and POI location to an accuracy of 2% of range between the closest listening post.
• Display the information on an overlay map for utilization by an operator.
• Store the POO/POI information.

The Phase I effort will not require access to classified information. If need be, data of the same level of complexity as secured data will be provided to support Phase I work. The Phase II effort will likely require secure access, and the contractor will need to be prepared for personnel and facility certification for secure access.

PHASE I: Develop concepts for improved, advanced-processing algorithms for use in the GCFS system that meets the requirements as highlighted in the description. The company will demonstrate the feasibility of the concepts in meeting Marine Corps needs and will establish that the concepts can be developed into a useful product for the Marine Corps. Feasibility will be established by material testing and analytical modeling, as appropriate. The small business will provide a Phase II development plan with performance goals and key technical milestones and that will address technical risk reduction.

PHASE II: Based on the results of Phase I and the Phase II development plan, develop prototype processing algorithms within a software environment that permits evaluation of the algorithms. These algorithms will be evaluated to determine its capability in meeting the performance goals defined in the Phase II development plan and the Marine Corps requirements as outlined in this document.

PHASE III: If Phase II is successful, the small business will provide support in transitioning the technology for Marine Corps use. The small business will develop a plan to determine the effectiveness of the developed algorithms for use at a CP for the GCFS system in an operationally relevant environment. The small business will support the Marine Corps with certifying and qualifying the system for Marine Corps use.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology is applicable to monitoring areas of potential civil unrest, including the locating of IED events, shots fired, and discriminating between non-threat background events (such as vehicle backfires) from actual threat events. The ability to have on-

board sensors that are able to network together as part of a greater system could be used by police departments to determine the location of shots fired.

REFERENCES:
1. Ground Counter Fire Sensor System (GCFS) Digital Communications Capability, Solicitation Number: M6785411I6014. This link has a description of the required capabilities of the current GCFS system: https://www.fbo.gov/index?s=opportunity&mode=form&id=b2136191b88ba5380cd2a4768921d4df&tab=core&_cview=0

2. Ground Counter Fire System, Naval Surface Warfare Center Dahlgren, http://www.navsea.navy.mil/nswc/dahlgren/Warfighter/GCFS/default.aspx.

KEYWORDS: GCFS; Ground Counter Fire Sensor; maneuverable assets; point of origin; point of impact; processing algorithms

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N142-087 TITLE: Expeditionary Portable Oxygen Generation System

TECHNOLOGY AREAS: Biomedical

ACQUISITION PROGRAM: PM Combat Support Systems (CSS), PdM Combat Support Equipment (CSE)

OBJECTIVE: The objective is to develop a portable oxygen generation system that consumes less electrical power, and has a compact cube/size and reduced weight. This objective is in support of the expeditionary medicine requirements of the Marine Corps.

DESCRIPTION: The Forward Resuscitative Surgical System (FRSS) provides an expeditionary surgical capability for the surgical stabilization of injured warfighters. Portable Oxygen Generation (POG) is a core technology for Marine Corps medical operations. For expeditionary medical applications, POG systems are used to produce medical-grade oxygen from air. The oxygen is used for patient ventilation, anesthesia, refilling oxygen bottles, etc. (Ref. 1). Presently, the FRSS uses two On Site POGS (Ref. 2). The current power demand of these POGS can exceed 1800 W, often creating a power overload of the FRSS electrical generators. Additionally, the current technology's space and weight are 34.35 cu ft. and 644 lbs. This footprint creates an increased burden on the logistics chain. While the currently used On Site POGS do produce oxygen at the concentration levels desired, they are considered too heavy, bulky and/or are not robust enough in design to properly facilitate the mission of the FRSS. Oxygen bottles are used in limited circumstances; however, due to their finite storage capacity they too create a logistics burden that is not sustainable as a primary solution for the provision of oxygen. Commercially available systems, such as the Oxygen Generating Systems International's OG and OGS series or the PCI DOCS series, do not produce the required output, or are too heavy or big, not man-portable, and are not intended to operate in harsh environments. Improvements may be realized with the application of some advance technology concepts such as, but not limited to, new compressor technologies (reduced power consumption, size), alternative/lighter material systems, or running on alternative power sources such as batteries (Ref 3, 4).

The Marine Corps seeks innovative approaches in the development of a smaller, lighter, man-portable (2-4 personnel), and more energy efficient (requiring reduced electrical and mechanical power to operate) oxygen generation system capable of producing medical-grade oxygen for patient administration and oxygen bottle refilling. Proposed concepts should have a total weight that does not exceed 350 lbs., and a volume that does not exceed 20 cubic ft. The maximum operational power should not exceed 1200 Watts with a start-up surge power that does not exceed 1250 Watts. Proposed concept should be able to produce United States Pharmacopeia (USP) 93% oxygen, at flow rates of