The Development of Advanced Passive Acoustic Monitoring Systems Using microMARS Technology

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LONG-TERM GOALS

The goal of this project is the development of an advanced yet compact and easy to use passive acoustic monitoring system that will allow localization, tracking and real-time monitoring of marine mammals from their vocalizations. While a variety of localization systems systems are currently available, few are autonomous recorder based. Advanced microMARS will provide the science community with a practical system for extended duration marine mammal localization that will be available in a number of configurations for deep and shallow water environments alike.

OBJECTIVES

The project has two main objectives:

1. Development of all the components of a compact passive acoustic monitoring system suitable both for shallow water moored configurations including solar power, limited satellite real-time reporting and GPS time synchronization, and self-synchronizing deep water configurations that do not requitre surface equipment. These components including the localization capable recorder, the surface buoy electronics and hardware, an acoustic pinger for deep-water self-synchronization and an acoustic release for data recovery.

2. Field testing and validation of the system through two test series, first targeting the GPS synchronized shallow water and then the self-synchronized deep water configurations.

The project will conclude with the availability a commercialization ready passive acoustic system suitable producing a tightly synchronized multi-channel .wav file suitable for localization of marine mammal vocalizations using standard algorithms.

APPROACH

In order to achieve these objectives within a limited time and cost framework, the project builds on existing commercial components manufactured by Desert Star Systems, implementing modifications to achieve the stated objectives.

These components include the microMARS underwater acoustic recorder, the FRF-2 surface buoy electronics, the TLP series acoustic pingers and the ARC-1 acoustic commanded release mechanism,.

Beyond minimizing development time and cost, this modular approach will allow Advanced microMARS to inherit a substantial field record in most major functionalities, thus improving initial reliability and performance over what would otherwise be possible.

The modification and enhancement of existing commercial hardware also assures that this capability will become commercially available to the wider research community, and that a moderate price point will be achieved for an advanced capability.

WORK COMPLETED

This project started towards the end of FY15. The work completed so far is the electronic schematic design for all system components. The acoustic pinger has passed schematic review and is now in printed circuit board layout. The microMARS recorder electronic schematic is in review, with some additional changes being defined due to new insights gained (see next section).

RESULTS

The advanced microMARS project is strongly related and impacted by developments of and insights gained from the early use and evaluation of the basic microMARS recorder by multiple parties. All of these projects have succeeded in acoustic data collection and validated the recorder operation but also uncovered bugs and limitations. While not part of the formal work plan, Advanced microMARS is providing an opportunity to implement responsive changes to the basic recorder system which in turn will benefit this project.

The following specific specific changes are in progress or have already been implemented:

1. The development of sloped frequency response hydrophone configurations that can simultaneously record industrial noise in excess of 200dB at low frequencies while offering high sensitivity for marine mammal monitoring at high frequencies.

2. A change in the acoustic data streaming and buffering hardware to avoid occasional millisecond duration sample losses on account of variable SD card write speed (slow writes).

3. An associated opportunity for further recorder power consumption reduction, potentially increasing high sample rate (250 kHz) continuous monitoring endurance to around 50 days (approx. 35 days now), and low-sample rate monitoring potentially up to 120 days.

4. An increase of the maximum sample rate beyond 250kHz, with a 500kHz upper target (expectation 300kHz-500kHz range). This will enable monitoring of high frequency vocalizing species such as harbor porpoises and Heavisrecorder ide's dolphins.

5. Ultra-capacitor based buffering of the primary lithium battery to extend battery endurance.

6. Changes to the recorder firmware to provide a more stable sample rate.

7. Changes to the recorder firmware to keep recording segment start times on a rigid and redicteable schedule to support automated processing.

8. Work on the microMARS Reader software to spped the SD card data recovery and .wav file generation. Currently, this data recovery and conversion speed is 12x - 18x the recording speed for 100kHz sampled files. Initial tests have shown a speed potential of up to 90x, although around 60x may be a more realistic expectation for a full-function version.

9. Changes to the recorder housing that will speed recorder turn-around at sea and improve mechanical reliability. The number of screws to be replaced to open the housing for battery and memory card echange will be reduced from 12 to three. Only one end cap will have to be removed during normal service, and a hydrophone connection cable that has reliability concerns will be replaced with a backplane connection system.

IMPACT/APPLICATIONS

Most underwater acoustic recorders on the market today are suitable for marine mammal detection and classification purposes only, but do not offer a localization capability. Advanced microMARS may make recorder array based animal localization an easily practiced and readily available capability, thereby improving studies such as the impact of man made noise sources on the behaviour of these animals.

RELATED PROJECTS

Advanced microMARS builds on and is enabled by multiple related Desert Star products and projects.

- The microMARS receorder, which was developed under the NOAA ASTWG program and provides the basis for Advanced microMARS. http://desertstar.com/product/micromars/

- The TLP series acoustic pingers, developed as part of the RangeNav underwater tracking system for the Naval Surface Warfare Center. http://desertstar.com/product/rangenav/

- The ARC-1 acoustic release, originally developed for the Pfleger Institure of Environmental Research (PIER). http://desertstar.com/product/arc-1xd/

- The FRF-2 surface buoy electronics, originally developed as part of the Southstar wireless underwater tracking system for use in Antarctica as part of a NSF project,and enhanced for underwater unexploded ordnance detection under the NOMAD project for USACE. http://desertstar.com/product/southstar/

Advanced microMARS also relates to and benefits from the work of the various microMARS users that are currently using or evaluating the recorder and providing feedback that is validating and leading to improvments of the recorder design.