Radar Detection of Marine Mammals

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LONG-TERM GOALS

The long term goal is to develop a radar solution for the detection of marine mammals using ship-borne radar and demonstrate its performance. In particular, a solution using commercial surface search radars is desired as it provides a readily accessible technique for commercial shipping concerned about ship strike of marine mammals and/or detection for compliance with operating permits.

OBJECTIVES

There are two technical objectives for this work. The first is to develop a near-real-time signal processor/radar combination that is suitable for the detection of marine mammals. The second objective is to assess the performance of such a combination in specific ocean conditions / species combinations in order to establish the utility of such a system.

APPROACH

The general approach is to iterate between experimental results and processing improvements. As such, the current work represents one cycle of development. There are three elements to the approach as follows:

The first task is to collect a data set from a fixed location. The dataset should have significant diversity in (a) look directions, (b) range from the radar and (c) sea conditions. The dataset should have sufficient animals to make a statement about both probability of detection (PD) as well as false alarm rate (FAR).

The second task is to make an assessment of the performance of the radar plus signal processing algorithm for the detection of marine mammals

The third is to convert the algorithm into a low-latency processor suitable for a ship borne application where a mitigation action may need to be undertaken in response to a detection.

The resulting processor will then be tested in a ship borne test. This will be followed by a number of iterations to improve both the timeliness of the processor as well as a reduction in the FAR.

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WORK COMPLETED

The work during this year has been focused on the first two tasks. A major experiment was conducted during January 2008 and satisfies task one and will be described below. Task two is still underway.

An Areté-owned Furuno radar was mounted on a cliffside as an element of the MAST08 experiment. This experiment was conducted in January, 2008 off of the grounds of the Diablo Canyon nuclear power plant (operated by Pacific Gas & Electric). Figure 1 shows the radar as mounted near the cliff side with the RV used for the data collection system. Figure 2 shows the same setup as seen from a nearby hill for perspective. In addition to the radar, a visual observation team from the University of Hawaii (Joe Mobley, Mark Deakos and Laurie Mazuka) provided simultaneous observation and tracking of individual animals and pods during the experiment.

Figure 1: Furuno radar mounted on a stand near the cliff at the Diablo Canyon power plant. The RV shown at left was used to house the data acquisition and analysis computers during the experiment.

Figure 2: The radar set up as seen from a nearby hill. The small feature in the upper right is known as Lion Rock.

During the experiment, over 200 pods were identified and tracked by the visual observation team with sea conditions ranging from Beaufort scale 1 to 7. For this experiment, a fully developed signal processor was not ready. However some pods were tracked in a semi-manual fashion using an offline capability. Figure 3 shows an example comparison of the visual team observations (red) versus the radar observations (green). The white box shows the location of the radar. The comparison between these is excellent. Comparisons of the recorded times that the radar detections match the visual observations confirming that the radar observations are in fact Gray whales.

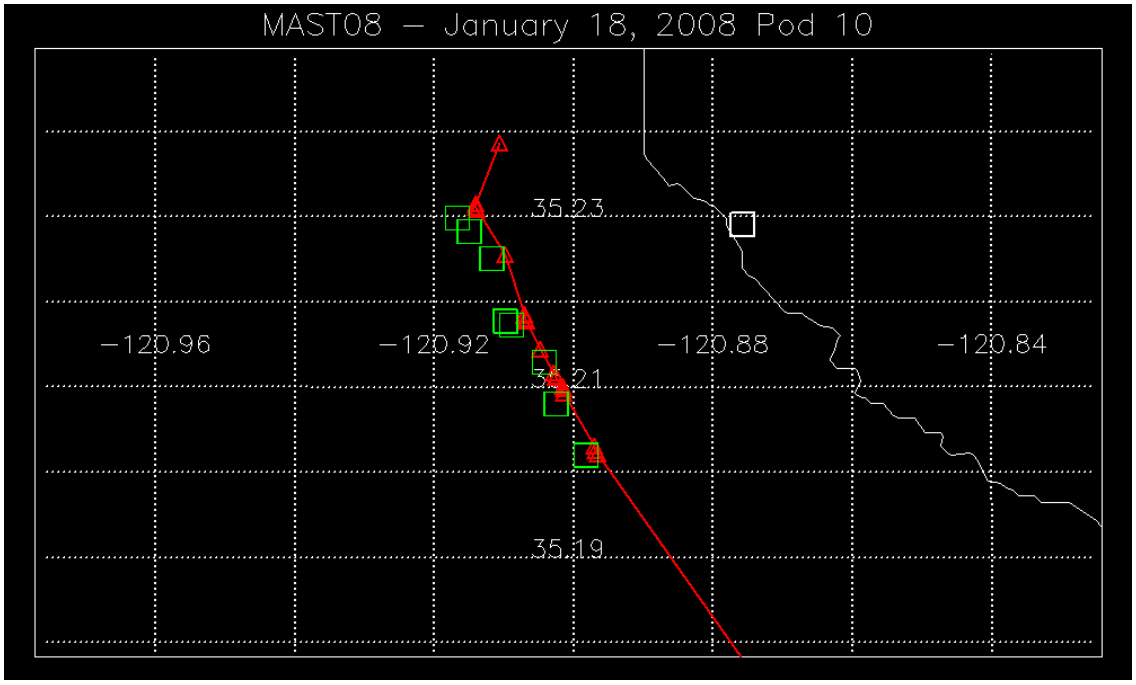

Figure 3: Shows the track of a specific pod as seen by the visual team (shown in red) and the radar operators (shown in green). The coastline is shown in white and the white box shows the location of the radar.

RESULTS

We have been able to make radar detections of Gray whales for a range of sea conditions and ranges. Figure 4 shows a scatter plot from January 18 showing radar detections with corroboprating visual team tracks. This shows detections in sea conditions from Beaufort 2 through 4 at ranges from 2 to 6 km. These detections have been manually identified using simplified radar processing as inputs.In most cases, the first radar detection of a surfacing sequence is slightly earlier than the first visual sighting. The corresponding false alarm analysis is underway but not ready for reporting.

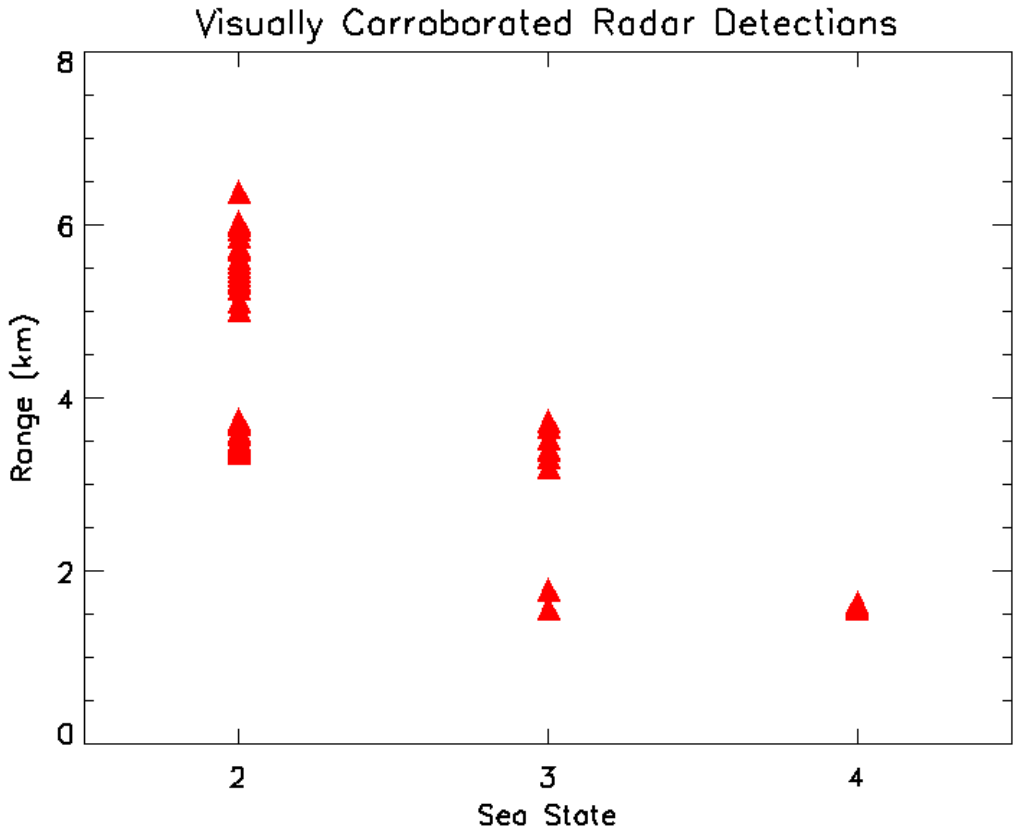

Figure 4: Visually corroborated radar detections form the MAST08 experiment. The graph shows the sea state diversity (beaufort 2 to 4) and range from the radar (2 to 6 km) for marine mammal detections as observed on January 18, 2008.

IMPACT/APPLICATIONS

The project can provide a significant new capability for operations in and around marine mammals. If the commercial radar approach is succesfull, a relatively low-cost solution will be available to detect and track marine mammals. This capability can be used to extend operations into low visibility conditions (e.g. night and fog) for both ship strike avoidance applications as well as area clearance operations around active sources. Since the capability can be configured to use existing radars, there is relatively low impact on commercial ships use of the technology. Similar approaches can be developed for military-grade radars if desried.

RELATED PROJECTS

None.