

## **Development of a Pneumatic Launcher Delivery System for the New Digital Recording Tag, DTAG3**

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### **LONG-TERM GOALS**

The goal of the project was to build a new aerial rocket tag system (ARTS) in order to accommodate the new version 3 digital recording tag (DTAGv3) that will replace the current DTAGv2. The smaller and lighter DTAGv3, which contains a bigger memory required both a new carrier and a new robot arm to be constructed.

### **OBJECTIVES**

The objective of the project was to implement a reliable attachment system to deploy the new DTAGv3 on marine mammals such that the efficiency and duration of deployments would be increased.

### **APPROACH**

During the design and engineering phase, efforts focused on: (1) reducing stress on the DTAGv3's electronics; (2) increasing the launch force of the tag; and (3) preventing tag reboundings, sliding,

and/or damage. Initial ballistic laboratory testing using a dummy whale target was first conducted at WHOI and then at FFI to investigate deployment accuracy over ranges of 5-15 m using variable pressures in the ARTS chamber (6-15 bar). A prototype DTAGv3 was constructed and used in these tests. Testing was then conducted at sea under variable wind conditions using a typical tag boat and a floating dummy whale. Final testing was conducted during the 3S project's field trials.

The proposed work consisted of building a dummy DTAGv3 to evaluate impact forces at different ranges and pressures. We also proposed to build a new carrier and robot arm to accommodate the different weight and shape of the DTAGv3. Initial tests were to be performed at Woods Hole Oceanographic Institution (WHOI) followed by equipment testing at the Forsvarets Forskningsinstitutt (FFI) research facility in Horten, Norway, and culminating in testing at sea during a 3S project research cruise.

Key individuals who worked on this project include Alessandro Bocconcelli, Daniel Bogorff, and Peter Tyack of WHOI; and Lars Kleivane and Petter Kvadsheim of FFI.

## **WORK COMPLETED**

During the testing period the same dummy whale targets were used as in the ARTS-DTAGv2 project. The final laboratory version was a hard-packed plastic structure of 50 x70 cm wrapped in a 12 mm rubber coat, with a target area of 0.35 m<sup>2</sup>. The target design provided the capability of adjusting the angle at which the tag struck the target. Extensive testing of the ARTS-carrier, including a total of 308 launching tests on a dummy whale in the test laboratory and a total of 47 tests on a dummy whale at sea, was performed. The initial tests in the laboratory were performed at a distance from the target of 10 m and used different pressure ratings for the launcher (8, 10, and 12 bar).

We began this project by testing various robot holders for the DTAGv3, and we videotaped all of the launchings both to help our analysis of the tag trajectory and to study the impact forces and attachment of suction cups to the target. At the end of the test period, all launchings were documented by using a fast-speed video camera (Photron, Fastcam, APX, RS).

During initial testing, the dummy whale was always kept wet and angled at 90° to the tagger, and we performed tests with chamber pressure on the ARTS from 6 to 10 bar. We then restricted the launching pressure to 8 bar for a 10 m and 12 m target distance. The next step was to change the angle of the target to create a more realistic scenario that was closer to a field operation. The dummy whale was angled to 60-70°, and the launching values and distance were kept at the same levels of 8 bar and 10 m. A total of 169 controlled lab launchings were performed during testing at FFI's Horten, Norway, facility.

No field testing was scheduled for this project. Despite this, several attempts were made to test the system in the field, mostly during 3S trials. Since this effort was always secondary to other trial objectives, we never had a chance to actually test the ARTS launching of DTAGv3 in the field.

## **RESULTS**

The new five-stud configuration of the ARTS-carrier combined with the new grip docking robot proved immediately to be very effective in absorbing shock and reducing sliding. The docking construction was found to be flexible and adjustable to fit the body of the DTAGv3. The new sight

system resulted in significantly improved accuracy of the system during lab testing, with close to a 100% hit rate. Testing with chamber pressure on the ARTS from 6 to 10 bar gave us a variable curved trajectory, but with practice we obtained successful hits within this pressure range. The lighter DTAGv3 has a less curved trajectory than the DTAGv2; and we discovered that for target distances up to 12 m, a chamber pressure of 10 bar is too high and causes a higher risk of the tag rebounding on the target. We determined that a launching pressure of 8 bar was adequate for 10 m and 12 m target distances. With the whale angled to 60-70°, the launch pressure held to 8 bar, and the distance kept at 10 m., the ARTS-carrier system holding the DTAGv3 still deployed the tag on the target. Although we experienced some rebounds, more often than not the DTAGv3 merely slid a little on the dummy whale and stuck. During the testing at FFI's Horten, Norway, facility, we registered no damage to the DTAGv3 dummy tag or to the new ARTS-carrier.

## **IMPACT/APPLICATIONS**

During the 3S-2012 trial, the hit/miss ratio using the ARTS-carrier and DTAGv2 was 50/50. Comparing this to almost 100% hits during lab testing using the new ARTS-carrier and DTAGv3 indicates that the ARTS-DTAG system still needs improvement to increase resiliency. We think the main problem when working at sea with moving targets is the shooter's ability to make quick decisions about range to target and thereby choose the appropriate launching pressure and aimpoint. Further steps need to be taken to improve the launcher's pressure control. However, with a lighter setup using the new ARTS-carrier with DTAGv3, we believe that the system will be more accurate with a less curved trajectory from launcher to target, thus making the overall system more reliable.

## **RELATED PROJECTS**

None