ID36 - REP18 ATLANTIC – A LARGE SCALE EXERCISE USING UNMANNED SYSTEMS

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Abstract

We present the REP18 exercise in which were operated heterogeneous unmanned underwater and aerial vehicles. This large scale exercise organized together with the PO Navy and with the participation of key players in the area, served to test the large scale use of unmanned vehicles in real-world operations both in defence and scientific areas. This work showcases how the LSTS Toolchain for Autonomous Systems enables all this.

Keywords – Autonomous Vehicles, Remote Sensing.

I. INTRODUCTION

REP18 Atlantic is a naval exercise with a share organization of LSTS (Underwater Systems and Technology Laboratory) from University of Porto – Faculty of Engineering, and Portuguese Navy. This yearly event focus on the use of autonomous systems to aid the execution of real-world operational needs in the areas of defence and science. For this purpose LSTS and PO Navy bring together world-class players to challenge and see in action both commercial and research products for unmanned systems. NATO CMRE from La Spezia, Italy, has been a long time participant in the exercise bringing their expertise on acoustics and also its research vessel. Additionally this year we operated with the Polish Navy, NUWC from the USA, and also the University of Hawaii.

We operated autonomous vehicles in the following scenarios:

· Acoustic communications for a manned submarine in a distress situation,

· Sidescan sonar and magnetometer in mine warfare surveys, and

· Scientific data collection for the study of a river estuary and the detection of nonlinear internal solitary waves.

Digital Acoustic Communications in Manned Submarine Distress was done jointly with NATO CMRE. We had a scenario where a manned submarine was in distress and underwater. We conducted the operation in two stages. First by using acoustic digital communication based on JANUS[1] protocol that allowed the communication of relevant distress information from on-board the submarine as text messages (done by the CMRE). In the second stage we processed those distress messages to trigger search and map behaviours on a AUV equipped with acoustic modem and sidescan sonar.

For the Mine Warfare scenario, we needed to survey several areas where mines and mine-like objects were disperse. The sensors used for these surveys were sidescan and magnetometer.

For the scientific data collection we had two exercises: SaVel – Sado Estuary Study, and SnOW – Study of Nonlinear Internal Solitary Waves. These operations have similar characteristics. Both were executed by launching several AUVs for periods that encompassed 13 to 30 hours in continuous operation. The areas where we operated are with heavy maritime traffic and with lengths of 2.5km (1.3 nautical miles), which makes Wi-Fi operations difficult. For this reason satellite communications was used. Also UAVs where deployed from ships in order to survey from the air with FLIR and visible light cameras in order to complement the data collected underwater. This UAV data served also to correlate the satellite data from the survey periods.

These scenarios contain several challenges due to their characteristics. Operating autonomous underwater vehicles (AUV) and unmanned aerial vehicles (UAV) have some differences in terms of operator awareness, data availability, and reaction to vehicle abnormal operation. Autonomous underwater vehicles stay longer periods of time disconnected from the operator due to the difficulty of underwater communications that are lower rate and unreliable. On the other hand, unmanned aerial vehicles keep, for the most time, connection with the operator. Another characteristic of UAVs is that they operate on much higher speeds than the AUVs and so the reaction to abnormal events needs to be quicker.

To operate on these challenge environments we use the LSTS Toolchain for Autonomous Systems [2]. It allows seamless operation of heterogeneous autonomous vehicles and contains tools to plan, simulate, execute and monitor, as well as review and analyse the collected data. We will show how the use of the LSTS toolchain helped to resolve the challenges posed by this rich operational environment with heterogeneous vehicles.

II. CONCLUSIONS

LSTS has been used to successfully operate with heterogeneous autonomous vehicles in the most diverse of operational challenge environments. It supports single vehicle operation, but also scales for multiple heterogeneous vehicle operations, either with or without coordination. The example is the REP18 naval exercise where multiple vehicles were operated from simple surveys to environmental triggered behaviours.

REFERENCES

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Fig 1. AUV vehicles, UAV vehicles, and REP18 group photo