ID37 FURTHER TELEOPERATED EXPERIMENTS WITH AN UNDERWATER MOBILE MANIPULATOR VIA ACOUSTIC MODEM: MODEM CHARACTERIZATION

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ABSTRACT

In this study, we conducted preliminary experiments to characterize an acoustic sonar [1][2] for underwater communication. We carried on image transmission experiments and attempted to reduce reflections using insulating cork. Moving the buoy along the surface revealed the central area of the tank to have the best communication with Girona. We plan to conduct further experiments with the acoustic modem in a realistic environment. In addition, we are also testing Visible Light Communication (VLC) [3] optical modems, which yielded better results than the acoustic modem. We aim to develop a multimodal system for improved communication under different environmental conditions.

Keywords - Underwater Communications, Robot Networks, Simulation, Remote Control, Hardware In the Loop, Optical Modem

SUMMARY OF EXPERIMENTS

We are following up with the acoustic sonar characterization experiments at CIRTESU. Firstly, we repeated the image transmission experiments previously conducted and explained in the Oceans article.

Nevertheless, due to problems with reflections caused by the tank walls, we attempted to reduce the reflections by using insulating cork. However, this did not improve communication. We also performed various tests by moving the buoy along the surface to identify areas with better communication with Girona, and the best results were obtained in the central area of the tank, as we can see in figure 1.

Our next test with the acoustic modem will be carried out at the Port of Castellón, as we believe it to be a more realistic environment.

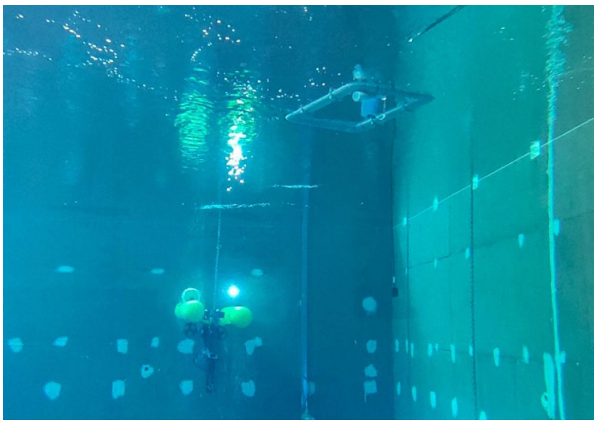

Fig 1. Cirtesu stage with the buoy located in the middle of the tank

Meanwhile, we are conducting experiments at CIRTESU using Visible Light Communication (VLC) optical modems (reference) to improve communication and develop a multimodal system with two communication modes to obtain the best communication conditions regardless of the environment. We can see in figure 2 a scheme of the scenario.

Preliminary tests with the optical modem yielded much better results than those conducted with the acoustic modem. However, the major disadvantage of the optical modem compared to the acoustic modem is the range, which is limited in theory to 50 meters. Therefore, we aim to develop a multimodal system that will allow us to communicate using the optical modem and switch to the acoustic modem in case of loss of communication. Although the acoustic modem has a lower bandwidth, it has a much greater range. Moreover, we can use both modems simultaneously, allowing us to take advantage of the acoustic modem to obtain location information, operation and supervision commands. Furthermore, with the optical modem, we can obtain images in real time and there is even the possibility of connecting several robots to each other to carry out cooperative tasks.

With the acoustic modem, we can also calculate the distance between the buoy and Girona, which will help us determine when to switch between communication modes. Furthermore, by knowing the depth of Girona and its relative distance to the buoy, we can orient the optical modem using a servo motor.

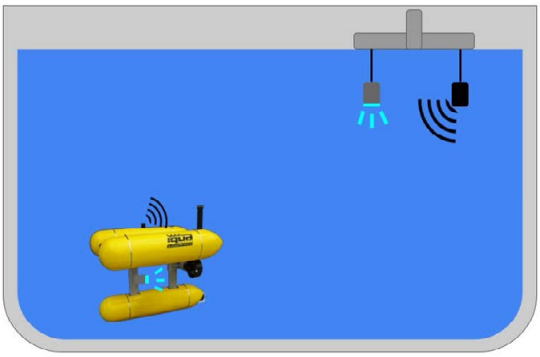

Fig 2. Diagram of the tank with the two modems

CONCLUSIONS

In conclusion, our preliminary experiments with both acoustic and optical modems have shown promising results for underwater communication. While the acoustic modem has a greater range, the optical modem has higher bandwidth and performs better in terms of communication quality. Developing a multimodal communication system that incorporates both modems could provide the best of both worlds, allowing for improved communication under various environmental conditions. Future studies will focus on refining the multimodal system and conducting more experiments in realistic underwater environments.

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