Robust radio link solution for a semi-autonomous underwater vehicle

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Keywords: *semi-autonomous underwater vehicle—intelligent buoy—sonar—Keutschacher See*

CHNT Reference: Bommhardt-Richter, Michael; Bochmann, Hilmar, and Block-Berlitz, Marco. 2021. Robust radio link solution for a semi-autonomous underwater vehicle. Börner, Wolfgang; Kral-Börner, Christina, and Rohland, Hendrik (eds.), Monumental Computations: Digital Archaeology of Large Urban and Underground Infrastructures. Proceedings of the 24th International Conference on Cultural Heritage and New Technologies, held in Vienna, Austria, November 2019. Heidelberg: Propylaeum.
doi: 10.11588/propylaeum.747.

Motivation and Introduction

Since GPS is not easily received in water, localisation in the sub-documentation still poses a major challenge (Baletti, 2015). Furthermore, the working time of a research diver is limited and requires special safety precautions (Papadimitriou et. al., 2015).

The use of low-cost mini submarines is a candidate to meet both challenges. On the one hand, no decompression breaks are required and on the other hand, available systems can penetrate to a diving depth of 100 meters and deeper. In combination with self-localization algorithms, which enable live 3D reconstruction and are used in autonomous robotics, orientation and localization tasks can also be solved with a good view of the subsurface. Since the transmission of signals under water is not possible, all currently available mini-submarine systems transmit the control and video signals via cable. This cable can have a length of several hundred meters. For practical documentation work, e. g. in shallow water areas, special cable management solutions are required (Block et. al., 2018).

Fig. 1. The diving robot “Manio” documents semi-autonomously a pile dwelling settlement. Since the system has not yet reached market maturity, it is supported by a snorkeler who can intervene if necessary.

This poster presents a robust wireless solution that can reliably transmit both control and video signals. A radio buoy was developed for the BlueROV 2, which has already been used successfully in various documentation campaigns. The buoy was extended by a sonar and will serve as a further sensor for localization in the future. At Lake Keutschacher See in Austria, the system was successfully used with a radio range of up to 500 metres (see Fig. 1).

Construction and realisation of the radio link

There is a base station on the shore. Here the control and video signals are controlled and monitored. A directional antenna from NanoBeam with 5 GHz at the base station is used to realize the radio link to the buoy. Inside the buoy two omnidirectional antennas receive the radio signals. In order to enable a parallel propagation of the radio waves over the water surface, the antennas were installed orthogonal to the water surface.

The buoy can receive radio signals from any direction with the presented solution. The system enables a transmission speed of approx. 640 MBit/s and has a latency of 1.3 ms on average. Thus the signals are transmitted in real time. The documentation campaign at Lake Keutschach has shown that the system works reliably at a distance of 500 metres.

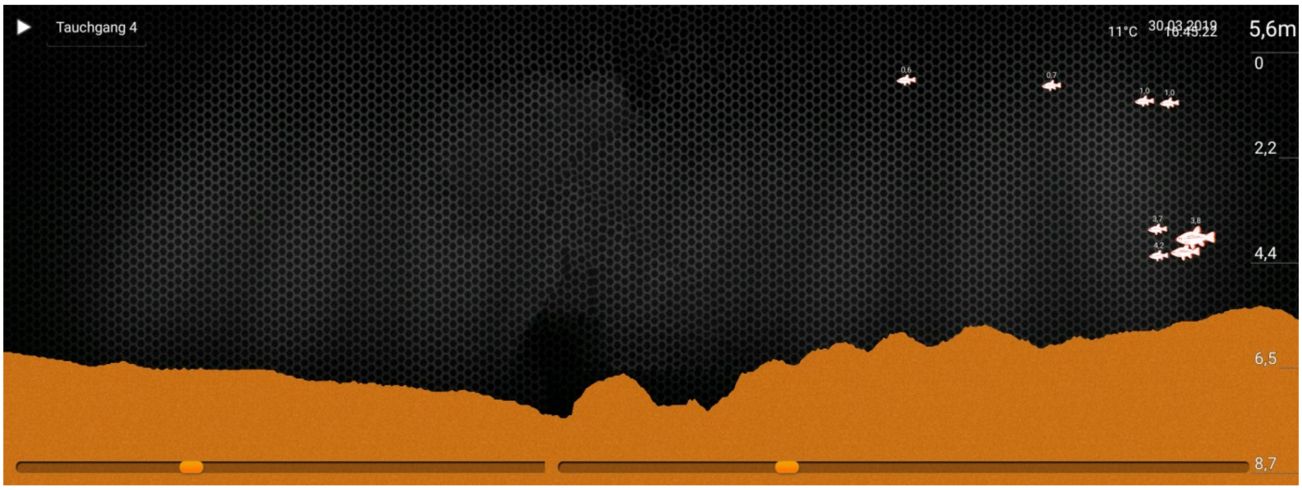

Fig. 2. The buoy pulls the sonar sensor Deeper Pro Plus about 20 cm behind it. The available data is read out live and also transmitted via the radio link. You can see a time series during one of the dives at Lake Keutschacher See.

The available bandwidth makes it possible to transmit different data in parallel. This includes sonar data (see Fig. 2), GPS positioning of the buoy and sonar, temperature data of the submarine and buoy, diving depth, speed and direction of the submarine, control signals and live video signals from various underwater cameras.

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