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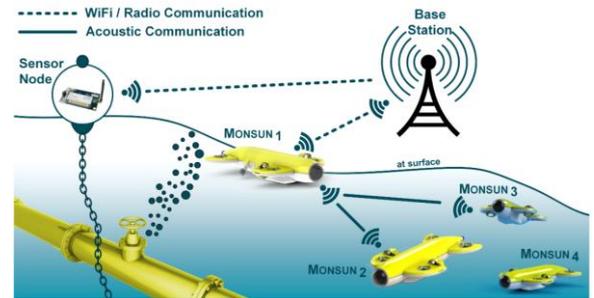
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## Master's Thesis together with TUHH

### FPGA based Signal-Processing for Acoustic Underwater Communication

#### Motivation:

Low-power, underwater communication is a mandatory prerequisite for swarms of micro AUVs (autonomous underwater vehicles). The latter have recently drawn considerable research attention, as they can be used in scenarios stretching from dam inspections over localization of pollution sources to scientific experiments. Unfortunately, the acoustic underwater channel is extremely severe; two major sources of interference being reflections from the water surface and thermoclines. They suppress certain signal portions, so that narrowband modulation is strongly impacted. In previous studies at TUHH a lightweight and cost-efficient acoustic modem was developed to enable underwater communication, e.g. based on chirp signals. However, the current digital signal processing is performed on low power MCUs which limits the evaluation, analysis and filtering. Therefore an FPGA based signal processing is intended to overcome this limitation.



#### Work description:

You will start with a research study to get some knowledge about the current state of the art and existing implementations. Furthermore, you should discuss the scope of your thesis regarding relevant related work. For the practical part the integration of the analog front end (picture on the left) into a SoC (FPGA + processing unit) should be done by utilizing the existing DAC/ADC interfaces (via SPI). The signal processor itself should provide several information about the spectrum, e.g. performing a hardware-accelerated FFT directly. Moreover, basic filtering should be part of the FPGA implementation. The existing software components should be ported to the SoC to enable compatibility with the system architecture. Finally, your system should be able to be used for extensive evaluations in real world environments. The recording and direct extraction of features can help to gather more knowledge on channel characteristics and thus further improve the underwater communication.



#### Prerequisites:

For successful thesis completion, you should fulfill the following requirements:

- Background in signal processing and digital communication
- Knowledge of FPGA firmware implementation and programming experiences in C
- The willingness for hands-on implementation as well as theoretical considerations and analyzes

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