# Surveying subsea cables and pipelines with sonar

This project aims at benchmarking adaptive array signal processing methods applicable to sonar data from subsea cable and pipeline surveys by simulating sonar recordings for a large number of scenarios. This would enable the selection and pre-verification of the adaptive DSP method with the highest expected performance before it would be used under field conditions.

## Background

Safe and efficient transportation of offshore energy will always require well maintained underwater infrastructure, no matter if the energy source is fossil, wind, sun or wave. Subsea cables and pipelines can be efficiently surveyed using **sonar systems** mounted on surface or underwater vehicles.

**Adaptive array signal processing** methods are increasingly used to improve image quality in specific survey scenarios. However, adaptive methods can be very sensitive to the circumstances they are used in, therefore choosing the right one from the many available candidates requires extensive testing in various scenarios, which is often not feasible out at sea.

Sonar data can be generated by **computer simulations** for a large number of scenarios with a great freedom in choosing the parameters. These virtual recordings then can be used to benchmark adaptive array signal processing methods with the additional advantage that the ground truth is known, which can be difficult to ensure under field conditions.

Realistic simulation of complex underwater scenarios using the **Field II Ultrasound Simulation Program** in combination with adaptive array signal processing of the output using the open access package **UltraSound ToolBox** (USTB) has been previously demonstrated[1].

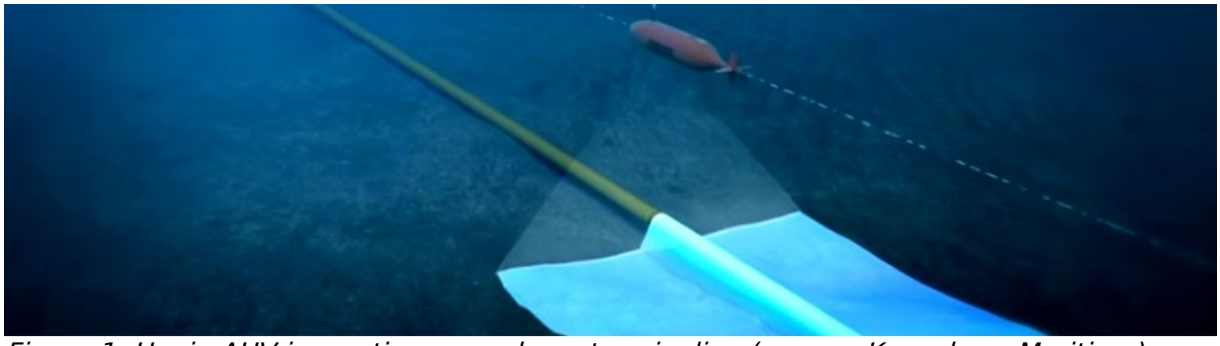

*Figure 1: Hugin AUV inspecting an underwater pipeline (source: Kongsberg Maritime)*

[1] A. Blachet, T. I. B. Lønmo, A. Austeng, F. Prieur, A. Hunter, R. E. Hansen: *Sonar data simulation with application to multi-beam echo sounders —UACE2017 - 4th Underwater Acoustics Conference and Exhibition*, https://www.uaconferences.org/docs/UACE2017_Papers/265_UACE2017.pdf

## About the DSB group

The project is hosted by the group for Digital Signal Processing and Image Analysis (DSB) at the Department of Informatics (Ifi) together with two other **relevant summer projects**, which allows participating students to exchange ideas and techniques. Furthermore, it has direct relevance to an **ongoing PhD project** at the group, which allows the student to work closely with a PhD researcher.

The DSB group is participating - together with Kongsberg Maritime (KM) and the Norwegian Defence Research Establishment (FFI) - the **Next generation echo sounder** industrial research project founded by the Research Council of Norway (RCN). The DSB activity within the project includes an ongoing PhD research (Gábor Geréb) and it builds on the results of two recently defended PhD theses from the DSB group (Tor Inge Birkenes Lønmo, Antoine Blachet).

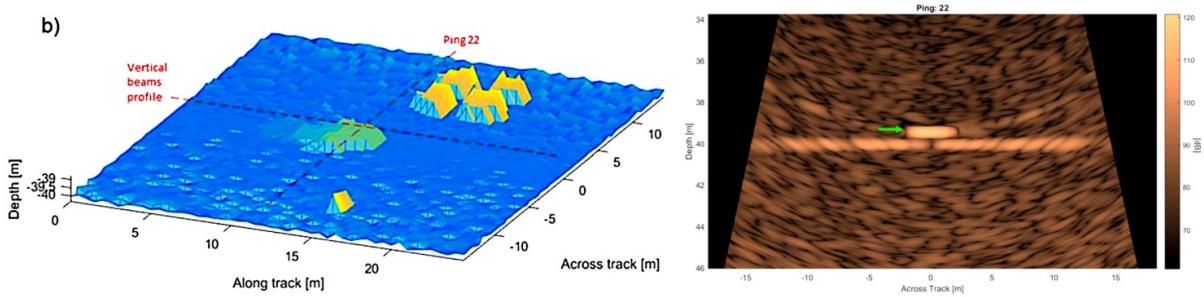


*Figure 2: Field-II input model (left) and USTB output image (right), (source: Blachet2017)*

## About the candidate

The participating student will have to **set up artificial scenarios** reflecting the real conditions of an infrastructure survey and then use the Field II Ultrasound Simulation Program to **simulate sonar data**. The student will have to **process the data** with multiple preselected adaptive array signal processing methods using the USTB Matlab package and perform **quantitative evaluation** of the results.

The task involves numerical simulation and processing sonar data using Matlab or Python. We are looking for an **enthusiastic and self-driven** candidate who has a passion for scientific computing, signal processing, and who would like to work with applications related to green energy.

You need to know how to write structured and clear code in Matlab/Python using version control systems (Git). Previous knowledge in **numerical modelling, signal processing and applied statistics** is an advantage (for instant having taken the courses IN3190/4190, IN5340, IN5450, AST5340, STK4060).

This is a single project proposed for one student. The timeframe is flexible but the project should be started before the summer vacations in July.

## Contact persons

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