Precise characterization of acoustic backscatter levels to improve complex seabed identification

Advisors: B. Zerr (ENSTA Bretagne, France), Ph. Blondel (University of Bath, UK)

G. Le Chenadec (ENSTA Bretagne), J. Marchal (Sorbonne Université), M. Legris (ENSTA Bretagne)

1. Objective

The main objective of this PhD work is to improve seabed characterization with bathymetric echosounders by improving the extraction of information in the acoustic backscatter signal, in particular for complex seabeds and environments (e.g. marine vegetation). This enhancement comes from a better theoretical and experimental understanding of the parameters that influence the final backscatter level. This will be done by using specific and relevant statistical tools compared to the state of the art and by studying the performances of different acquisition systems.

2. Description

This PhD inscribes itself within the general topic of seabed characterisation by bathymetric echosounders, for which there is an abundant body of work and literature. Time signals recorded by these systems are composed of information linked to: (1) the characteristics of the medium in which the signal propagate; (2) the echosounder parameters; (3) the acquisition parameters and (4) the nature of the seabed and any objects or materials affecting it (e.g. marine vegetation, other deposits). In order to isolate the actual seabed signal, and therefore to get rid of the three others components, theoretical and experimental studies lead to the definition and estimation of the acoustic reflectivity index (backscatter strength: *BS*) of the seabed, derived from the sonar equation.

A comprehensive body of studies have been published over the last decades about *BS* inversion to determine the seafloor nature, nevertheless the results are most often limited (models based on simple and homogeneous seabeds). The GEOHAB international working group concludes on the necessity to multiply the theoretical and experimental studies on the *BS* index by adopting a combined approach. Studies proposed in this PhD will try to answer the two following questions: (1) what kind of information could be extracted from backscattered signals from echosounders? (2) What accuracy is needed to precisely characterize the seafloor? Answers will allow, specifically, to manage comparative analyses between data from a same system but at different imes (repeat surveys, structure monitoring, sedimentary movement patterns, coastal erosion, habitat monitoring) and also between data from different echosounders (merging cartographic surveys and enabling comparison of “like for like” processed measurements).