

# Adaptive Sampling of Oceanographic Processes with Autonomous Underwater Vehicles

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## ABSTRACT

During the last decade, Autonomous Underwater Vehicles (AUVs) left the academic environment and started to be used as real tools for ocean sampling. Although their utilization is still quite limited as far as real world applications are concerned, some very interesting results have emerged from their use in challenging environments, such as under Arctic ice-sheets, in deep water and in other extreme environments. However, almost all current applications performed by AUVs concern the direct replacement of traditional techniques. Although this can yield significant advantages, the full capabilities of AUVs are yet to be explored, by devising new approaches for a more efficient utilization of this new tool.

One of such approaches is to replace the standard predefined AUV "mission" by an adaptive sampling mission, for which a set of rules are given, but where there is no a priori knowledge of the trajectories that will be followed by the vehicle. Such an approach exploits the on-board computational power to make assumptions about the oceanographic environment and to react to this environment by making decisions about the best sampling strategy to use.

By continuously interpreting collected data, this decision can be made in real time so that the vehicle can use all the available resources (mainly power) in sampling the ocean in regions of interest.

Our paradigm is based on the assumption that there are ocean processes that can be represented by simple models with time varying parameters. These models can be seen as temporal evolution of spatially distributed features. In this paper, we will restrict our study to processes that can be described under this assumption and we will present the corresponding strategies to identify their characteristics by adaptively changing the sampling pattern of a single AUV. For these processes, we will present some examples of real data taken in the field and we will show the results of the simulation of the operation of the AUV in such scenarios.