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Novel Approaches to Geophysical Navigation of Autonomous Underwater Vehicles

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Abstract. This paper introduces a method for the navigation of autonomous underwater vehicles (AUVs) and tracking of submersible targets that relies on analytic inversion of magnetic field anomalies. The magnetic sensor arrangement proposed configures a gradiometer array whose nodes may correspond to a set of collaborative AUVs deployed in a formation of adaptable geometry. The solution presented envisions applications to scientific, industrial, and military activities.

1 Introduction

Despite the remarkable advances achieved in the field of marine robotics in the last decades, true autonomous navigation of underwater robotic vehicles is still a challenging problem. Efficient and affordable navigation methods are still required to enable underwater robotic vehicles with the capacity of executing long-range and long-term missions without human intervention. Among the methods proposed to complement the conventional techniques of navigation whose limitations are well-known, the terrain aided navigation (TAN) approach has already demonstrated great potential for the development of a new generation of reliable and affordable navigation systems. The by now conventional TAN approach, often designated as bathymetric TAN, consists essentially in matching a set of range measurements acquired with sonar sensors installed in the vehicle with a previously acquired map of the terrain to estimate its position. Simultaneous localization and mapping (SLAM) is an alternative approach which does not require a previous map of the environment for navigation. The method consists in sequentially building a map of the features observed in the environment while concurrently using this map for navigation.

In this paper we describe a localization method which exploits local geomagnetic information that can be integrated with TAN and SLAM to improve the navigation capabilities of the next generation of autonomous underwater vehicles (AUVs).

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