A Drift Force On Submerged Body In AUV Design

Zainah Md Zain[1] and Safwan Bin Mohd Rawi
Robotics and Unmanned System (RUS) research group, Faculty of Electrical & Electronic Engineering, Universiti Malaysia Pahang (UMP) 26600 Pekan, Pahang, Malaysia.
E-mail: zainah@ump.edu.my[1]

***Abstract*--Autonomous Underwater Vehicles (AUVs) are robots able to perform tasks without human intervention (remote operators). Research and development of this class of vehicles are growing, due to the excellent characteristics of the AUVs to operate in different situations. Therefore, this study aims to analyze the drift force over different geometric configurations of an AUV hull, in order to reduce the drag force on the body. It is important to design an AUV with minimizing the drag forces acting on the hull to make AUV cruising smoothly. We also simulate the drift force for our X4-AUV ellipsoidal shape to compare the results with other hull shape.**

***Index Terms*--AUV, Drift force, Ellipsoid, Slenderness ratio.**

I. Introduction

Underwater vehicles are being used in an ever increasing number of applications ranging from scientific research to commercial and leisure activities. Most of them tend to be used for a specific application, consequently, there is a wide variety of underwater vehicles in operation. These vehicles can be categorized into several different groups according to their particular characteristics. One of these characteristics is the method of control and the groups used in this category are defined as illustrated in Fig. 1.

This work focuses on Unmanned Underwater Vehicles UUVs) and more specifically AUVs. AUVs have onboard control systems that use the information recorded by sensors to determine the demands to be sent to the vehicle actuators to complete the defined missions. The reliance on these components dictates a need for a robust design. A constraint on the use of an AUV is the limited energy supply that can be carried onboard. Most AUVs use batteries of various types to provide both propulsion and power. Therefore the total energy available is limited by the available volume (or weight) for batteries and the energy density of the chosen batteries.

These two characteristics of AUVs heavily influence the design choices during the development of an AUV. The autonomous nature of the vehicle means that key design factors include reliability, robustness and controllability. The limited energy available means that the energy cost associated with the various choices is a key factor in the design evaluation process. The combination of these factors shows that the design cycle for an AUV is highly iterative.

In contrast, ROVs are operated with a connection to a surface station, either on land or on a surface vessel. This connection is used to provide a communication link between the vehicle and a human operator, allowing human control, rapid data transfer and much larger power supply. On most ROVs the control system is dependent on partly human, partly automation; some elements of the control systems are undertaken using automatic control (for example depth control) allowing the human operator to concentrate on the intricacies of the particular task. The larger power supply allows the designer (and operator) to design the vehicle with less consideration for the energy required and this freedom also allows redundancy to be built into the design, for example in thruster configurations, which is not found on energy limited AUVs [1].

The required range of a vehicle can significantly influence the characteristics of an AUV during the design of the vehicle. For example, the design of a short range AUV requires less emphasis on propulsive efficiency in energy use. This freedom allows the short range AUV designer to include more energy consuming devices and to be optimized for the mission requirements. On the other hand, the key to successful long range AUV design is a compromise between functionality limitations and mission range requirements and hence greater emphasis on hydrodynamic efficiency. The AUVs were first built in the 1970s, put into commercial use in the 1990s, and today are mostly used for scientific, commercial, and military mapping and survey tasks [2].

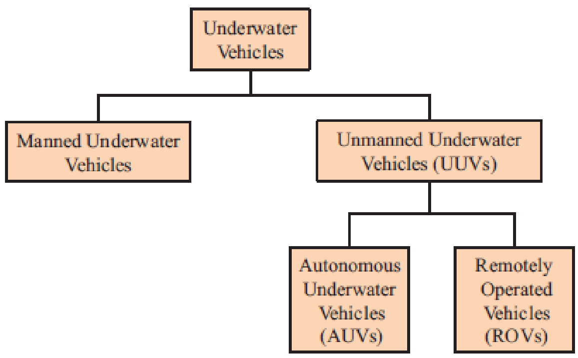

Fig. 1. Types of underwater vehicles