Research on Depth Control of Underwater Platform Based on Buoyancy Adjustment

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ABSTRACT

By controlling the ballast water to adjust the buoyancy of the platform to achieve automatic float. Designing a fuzzy PID controller for the characteristics of strong nonlinearity, time-varying and susceptibility to the process of blowing off ballast water. In order to simplify the calculation of the characteristics of the high pressure blowing system, making assumptions that the gas and water have water-liquid interface, and the change of gas parameters within the unit time step is considered as a static process. According to the law of fluid flow, the displacement of the ballast tank is calculated by volumetric method and Bernoulli formula, and the platform model is established by using Archimedes' law and Newton's second law. Secondly, in view of the maturity and extensive use of PID control, this paper designs a fuzzy PID control to reduce the influence of the control object model and the uncertainty of gas flow state. Finally, the depth requirement of the floating process of the platform is verified by Matlab simulation.

KEY WORDS: Underwater Platform; depth motion control; ballast tank; fuzzy PID; Matlab simulation control technique

INTRODUCTION

Nowadays, the ocean has become a platform for modern military powers to display their high-tech equipment and show off technology. The focus of attention at home and abroad has focused on the development of high-tech in the ocean (Blidberg, 1991). Underwater lifting platform is widely used in marine resources exploration, marine and underwater environment test. The control system of the underwater lifting platform is mainly composed of three parts: the sensor system, the integrated control system and the actuator. This paper focuses on the establishment of the platform model and the design of the control system in the integrated control system. In the aspect of underwater lifting platform construction in China, most of the operating conditions have been basically realized automatic control. However, because the research of aerodynamic control is in the initial stage, most of the current underwater lifting platform operation drills rely on manual operation (Sun, 2001). Because only relying on human judgment and accuracy can not complete the analysis under complex conditions in a limited time. It is also difficult to carry out the specified program consistently and ensure the accuracy of the system control like the automatic control system, so there is a big potential safety hazard in the control, and the timeliness and accuracy of the platform lifting operation are not satisfactory.

To sum up, the development of an efficient and reliable underwater platform control system has great theoretical significance and application value to the development of China's underwater platform deep submergence technology (Pan, 2006, Richard, 1981). However, the adjustment of ballast water based on buoyancy adjustment mentioned in this paper is more practical.

WORKING MODE IN SUBMARINE FLOATING PLATFORM

In order to realize the underwater motion characteristics of an equipment, it is necessary to design a platform that can carry the equipment, so that the equipment can reach the specified depth of water, and carry out experiments. First of all, the shell of the platform has positive buoyancy and a symmetrical ballast tank is designed in the shell. By changing the water volume of the ballast tank in the platform, the platform can float up and dive down. The change of water volume in the ballast tank can reduce the water injection volume of the platform by blowing off the ballast water in the tank with high-pressure air, and increase the water injection volume of the platform by its own gravity, so as to realize the floating / diving conditions of the platform, as shown in Figure 1. The connection and working principle of platform ballast tank are shown in Figure 2. To facilitate analysis and understanding, each small ballast tank in the platform is combined into a large tank. In this paper, the motion of the platform in the pool is studied, and the limited guide rail is installed on the pool wall and the roller is installed on the four corners of the platform. It is assumed that the working conditions of the ballast tank in the platform are completely consistent, and the moment of transverse and longitudinal force is small, that is to say, the effect of transverse and longitudinal inclination of the platform is ignored.

![Figure 1 Schematic diagram of platform movement](image-url)