A Low-cost Vision System for Underwater Vehicle, SNUUV-II

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ABSTRACT

A vision system has been developed in order to support the autonomous operation. The operation includes marine life monitoring, pipeline inspection and vehicle docking. A vision system is installed for an underwater vehicle named by SNUUV-II (Seoul national university underwater vehicle II). The vision system consists of a low-cost image grabber with DirectShow library and a small waterproof camera. A simple image processing algorithm is examined and shows the performance of the vision system. The low-cost vision system is expected to be a substitution in the area of underwater vision research.

KEY WORDS: AUV, docking system, vision system, low-cost image grabber

INTRODUCTION

In recent years, unmanned vehicles such as FireScout(vertical takeoff unmanned aerial vehicle), REMUS(unmanned underwater vehicle), Gladiator(unmanned ground vehicle) have been developed for scientific and industrial applications as well as for military purpose. Computer vision is used for various applications and becomes an important part of the autonomous vehicles. However, the application of vision system for AUVs has been limited due to its poor visibility in the ocean environment. The sensors used on AUVs have been sonar, inertial, pressure and underwater telemetry. High autonomous operation can not be performed using those sensors.

The rapid evolution of optical technologies such as high sensitivity cameras and vision recovering algorithm enables wide applications which can not be performed using traditional sensors. With the help of these vision systems, it is possible for underwater vehicles to perform various works such as marine life monitoring, pipeline inspection and see floor mapping. It is particularly the case for docking system, which enables underwater communication and also elongates the operation time of vehicles. As a result, underwater vision becomes of the most popular research themes in the area of AUVs.

In spite of the importance of the underwater vision, high cost of the traditional image grabber limits its the applicability. In this paper, we developed a low-cost vision system installed for a small sized economic vehicle, SNUUV-II. The low-cost vision system can be used for underwater vehicles to implement the image processing algorithm.

SNUUV-II

The main purpose of SNUUV-II is to develop control algorithms assisted by vision system. Due to lots of disturbances which can distort the image, an image processing algorithm needs a lot of experiments and corrections for developing the effective method. For experimental convenience, the AUV can be monitored by a remote desktop through wireless modem as shown in Fig. 1. As a result, the performance of the image processing algorithm and the control algorithm can be examined and tuned easily.

Fig.2 shows the main body and Table 1 gives the specification of SNUUV-II. The configuration of the vehicle is basically a long cylinder of 0.2m diameter and 1.5m long. The main body of the AUV is made of stainless steel to prevent corrosion. As shown in Fig.3, two pairs of control fins with NACA0012 cross section are used for controlling the motion. Servo motors can change the direction of control fins. On the end of the body, a main propeller which is driven by 80W brushless DC (BLDC) motor is mounted. In front of the body, a waterproof