ID6- DESIGN OBSTACLE DETECTION SYSTEM FOR AUV GUANAY II

C. Galarza[152], I. Masmitja[154], J. González[159], J.Prat, S. Gomariz[162],Joaquín del Río[156]

Abstract: - The autonomous underwater vehicles (AUV) carry out inspection missions and intervention on known and unknown environments, where it is important to ensure their safety. The ability for obstacle detection and their avoidance during navigation is a requirement for safety. In this article is presented an obstacle detection system for the experimental vehicle Guanay II using mechanical scanning sonar, the Tritech Micron MK. Given that the Guanay II operates autonomously, a new software has been designed that allows adjustment, control, acquisition and processing of the sonar signals. Experimental tests done at sea have allowed us to verify the correct operation of the designed software, and to determine the optimal values of the fundamental parameters of sonar.

Keywords: AUV Guanay II, sonar MK3, obstacle detection, acquisition and signal processing, automatic operation.

I. INTRODUCTION

The Guanay II [1] is an AUV developed by SARTI group from Universitat Politècnica de Catalunya, with the aim of providing a platform for measuring diverse oceanographic variables such as temperature and salinity of the water column, with high spatial and temporal resolution. This vehicle navigates on the sea surface to predetermined points, where it stops and makes vertical immersions to obtain a profile of a water column. To ensure the safety of the vehicle, it is desired to develop a system for obstacle detecting and avoidances [2] [3] [4] [5]. In this paper, an obstacle detection system is proposed based on the mechanical scan sonar Tritech Micron MK3 [6]. For this, a new algorithm has been developed in LabVIEW programming environment from National Instruments, which is compatible with the vehicle control unit software and performs the adjustment, control, acquisition and processing of sonar signals.

Moreover, the paper presents all the experimental tests performed at sea, where the feasibility of this equipment for this application is verified. The tests have been carried out with different obstacles such as boats and walls. Finally, the results of the experimental tests are shown, and the obtained optimal values are given for the operating parameters of sonar, acquired based on theoretical results and the tests performed.

II. OBSTACLE DETECTION SYSTEM

The obstacle detection system is based on a MK3 sound. The sonar configuration parameters are: mechanical operating range, turning mechanical resolution, number of points measured per beam, maximum operating distance of the sonar, input gain.

Given that the Guanay II operates autonomously, a new software has been designed for configuration, control, acquisition and processing of sonar signals. The algorithm designed is divided into four functional blocks: Block 1. Communication and Configuration of the Sonar, Block 2 - Acquisition and Data Visualization, Block 3- Automatic Detection of Obstacles Process, Block 4-Positioning based on GPS.

The field tests have been conducted in the port of Vilanova i la Geltrú, with the main objective to assess and characterize the operation of sonar in order to discriminate the walls of the piers and to distinguish the static boats of different sizes. In Figure 1, are illustrated the results obtained by applying the automatic processing block for detecting obstacles.

With this algorithm, the AUV can locate each of the elements present in the tests area and calculate its surface. These tests have also allowed us to determining the runtime the software, which sits between 23 and 96 seconds, depending on the configuration of the operating parameters.

III. DETERMINATION OF THE OPTIMAL VALUES OF THE PARAMETERS OF OBSTACLE DETECTION SYSTEM.

The optimal configuration of the operating parameters of the sonar it is crucial in order to have a correct performance of obstacle detection system that is developed for the vehicle Guanay II. The values for these parameters are established by correlating theoretical specifications of the sonar (beamwidth and operating range of each of the configurable parameters), the sonar results of the

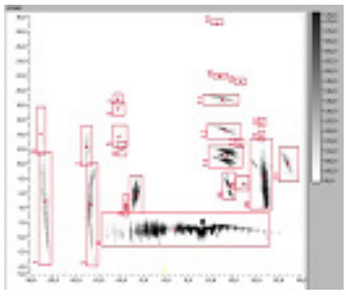

Figura 1. Image corresponding to results obtained by performing automatic processing for detecting obstacles

field tests(runtime of the algorithm) and operating specifications of the vehicle (maximum speed 1m / s braking distance 5 m). The analysis of the correlations between the different specifications cited above, has allowed us to obtain the optimal operating parameters for the sonar as shown in Table I.

Table I. Optimal configuration parameters the sonar, with respect to vehicle operating conditions.

Parameters	***Value***
mechanical operating range	90º
mechanical resolution	0.9º
number of points measured	400
maximum operating distance of the sound	70
input gain	40dB

IV. CONCLUSION

The studies carried out as well as the results obtained in this work have allowed us to validate the software designed by means of which it is achieved the adjustment, control, acquisition and processing of signals from the sonar.

The results are highly satisfactory, giving to the Guanay II AUV the ability to detect and discriminate objects and structures in the vehicle's path. It has been determined the optimum configuration for the sonar operating parameters based on the sonar theoretical specifications, vehicle operating specifications and practical results obtained in the field tests.

ACKNOWLEDGMENT

This work has been funded by the Spanish Ministry of Education and Science, projects nº CGL2013-42557-R

REFERENCES

[1] Gomariz S, Masmitjà I, González J, Masmitjà G, Prat J. "GUANAY II: an autonomous vehicle for vertical/horizontal sampling" Journal of marine science and technology, 2014.

[2] George C. Karras, Charalampos P. Bechlioulis, Hashim Kemal Abdella, Tom Larkworthy, Kostas Kyriako poulos and David Lane. A Robust Sonar Servo Control Scheme for Wall-Following using an Autonomous Underwater Vehicle, 2013 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), November 3-7, Tokyo, Japan, 2013.

[3] Ghatak A, D.K. Pratihar, C.S. Kumar. Online Measurement of Obstacles' Distances Using Forward Looking Sonar Sensor Mounted on an Experimental AUV, IEEE,2006.

[4] Ribas D, N. Palomeras, P. Ridao, M. Carreras and E. Hernandez. ICTINEU AUV Wins the First SAUC-E Competition, IEEE International Conference on Robotics and Automation Roma, Italy, 10-14 April, 2007.

[5] Philipp Woock, Christian Frey, Deep-Sea AUV Navigation Using Side-scan Sonar Images and SLAM, 978-1-4244-5222-4/10/IEEE, 2010.

[6] Tritech, Micron Sonar, Document, Product Manual, Document, software notes for controlling and operating RS 232 Sonar: 0650-SOM-00003, 0650-SOM-00004, Issue: 02.2013.